

COMMONWEALTH OF MASSACHUSETTS




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**CONTRACT DOCUMENTS  
AND SPECIAL PROVISIONS**

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PROPOSAL NO.	609035-126590
P.V. =	\$14,468,000.00
PLANS	YES

FOR

**Federal Aid Project No. STP/CMQ/TAP-0033(038)X  
Rehabilitation of Boston Road**

**in the Town of**

**WESTFORD**

In accordance with the STANDARD SPECIFICATIONS  
for HIGHWAYS and BRIDGES dated 2024

This Proposal to be opened and read:

**TUESDAY, JULY 30, 2024 at 2:00 P.M.**

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DOCUMENT 00102

**NOTICE TO CONTRACTORS**

Electronic proposals for the following project will be received through the internet using Bid Express until the date and time stated below and will be posted on [www.bidx.com](http://www.bidx.com) forthwith after the bid submission deadline. No paper copies of bids will be accepted. All Bidders must have a valid vendor code issued by MassDOT in order to bid on projects. Bidders need to apply for a Digital ID at least 14 days prior to a scheduled bid opening date with Bid Express.

**TUESDAY, JULY 30, 2024 at 2:00 P.M.** \*\*

**WESTFORD**

**Federal Aid Project No. STP/CMQ/TAP-0033(038)X**

**Rehabilitation of Boston Road**

**\*\*Date Subject to Change**

PROJECT VALUE = \$14,468,000.00

Bidders must be pre-qualified by the Department in the HIGHWAY CONSTRUCTION category to bid on the above project. An award will not be made to a Contractor who is not pre-qualified by the Department prior to the opening of Proposals.

All prospective Bidders who intend to bid on this project must obtain “Request Proposal Form (R109)”. The blank “Request Proposal Form (R109)” can be obtained at:  
<https://www.mass.gov/prequalification-of-horizontal-construction-firms>.

All prospective Bidders must complete and e-mail an electronic copy of “Request Proposal Form (R109)” to the MassDOT Director of Prequalification for approval:  
[prequal.r109@dot.state.ma.us](mailto:prequal.r109@dot.state.ma.us).

Proposal documents for official bidders are posted on [www.bidx.com](http://www.bidx.com). Other interested parties may receive informational Contract Documents containing the Plans and Special Provisions, free of charge.

Bids will be considered, and the contract awarded in accordance with statutes governing such contracts in accordance with Massachusetts General Laws Chapter 30 § 39M.

The Project Bids File Attachments folder for proposals at [www.bidx.com](http://www.bidx.com) shall be used for submitting at the time of bid required information such as the Bid Bond required document, and other documents that may be requested in the proposal.

**NOTICE TO CONTRACTORS** (Continued)

All parties who wish to have access to information plans and specification must send a “Request for Informational Documents” to [MassDOTBidDocuments@dot.state.ma.us](mailto:MassDOTBidDocuments@dot.state.ma.us).

A Proposal Guaranty in the amount of 5% of the value of the bid is required.

This project is subject to the schedule of prevailing wage rates as determined by the Commissioner of the Massachusetts Department of Labor and Workforce Development, and the Division of Occupational Safety, and the United States Department of Labor.

Plans will be on display and information will be available at the MassDOT Boston Office and at the District Office in WORCESTER.

The Massachusetts Department of Transportation, in accordance with Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby affirmatively ensures that for any contract entered into pursuant to this advertisement, all bidders, including disadvantaged business enterprises, will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin in consideration for an Award.

This Proposal contains the "STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONTRACT SPECIFICATIONS (EXECUTIVE ORDER 11246)". The goals and timetables applicable to this proposal for minority and female participation, expressed in percentage terms for the Contractor's aggregate work force in each trade on all work, are contained in Appendices A and B-80 of the above specifications.

The Contractor (hereinafter includes consultants) will comply with the Acts and Regulations relative to Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, Federal Highway Administration (FHWA), as they may be amended from time to time, which are herein incorporated by reference and made a part of this Contract as contained in Appendices C and D of the above specifications.



**NOTICE TO CONTRACTORS** (Continued)

**PRICE ADJUSTMENTS**

This Contract contains price adjustments for hot mix asphalt and Portland cement mixtures, diesel fuel, and gasoline. For reference the base prices are as follows: liquid asphalt \$610.00 per ton, Portland cement \$425.53 per ton, diesel fuel \$2.865 per gallon, and gasoline \$2.764 per gallon, and Steel Base Price Index 428.4. MassDOT posts the **Price Adjustments** on their Highway Division's website at

<https://www.mass.gov/massdot-contract-price-adjustments>

This Contract contains Price Adjustments for steel. See Document 00813 - PRICE ADJUSTMENT FOR STRUCTURAL STEEL AND REINFORCING STEEL for their application and base prices.

MassDOT projects are subject to the rules and regulations of the Architectural Access Board (521 CMR 1.00 et seq.)

Prospective bidders and interested parties can access this information and more via the internet at [WWW.COMMBUYS.COM](http://WWW.COMMBUYS.COM).

BY: Monica G. Tibbits-Nutt, Secretary and CEO, MassDOT  
Jonathan L. Gulliver, Administrator, MassDOT Highway Division  
SATURDAY, JUNE 29, 2024

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DOCUMENT 00210

REQUIREMENTS OF MASSACHUSETTS GENERAL LAWS  
CHAPTER 30, SECTION 39R;  
CHAPTER 30, SECTION 39O

July 1, 1981, updated October 2016

**M.G.L. c. 30, § 39R. Award of Contracts; Accounting Statements; Annual Financial Statements; Definitions.**

(a) The words defined herein shall have the meaning stated below whenever they appear in this section:

- (1) "Contractor" means any person, corporation, partnership, joint venture, sole proprietorship, or other entity awarded a contract pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A to forty-four H, inclusive, of chapter one hundred and forty-nine, which is for an amount or estimated amount greater than one hundred thousand dollars.
- (2) "Contract" means any contract awarded or executed pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A through forty-four H, inclusive, of chapter one hundred and forty-nine, which is for amount or estimated amount greater than one hundred thousand dollars.
- (3) "Records" means books of original entry, accounts, checks, bank statements and all other banking documents, correspondence, memoranda, invoices, computer printouts, tapes, discs, papers and other documents or transcribed information of any type, whether expressed in ordinary or machine language.
- (4) "Independent Certified Public Accountant" means a person duly registered in good standing and entitled to practice as a certified public accountant under the laws of the place of his residence or principal office and who is in fact independent. In determining whether an accountant is independent with respect to a particular person, appropriate consideration should be given to all relationships between the accountant and that person or any affiliate thereof. Determination of an accountant's independence shall not be confined to the relationships existing in connection with the filing of reports with the awarding authority.
- (5) "Audit", when used in regard to financial statements, means an examination of records by an independent certified public accountant in accordance with generally accepted accounting principles and auditing standards for the purpose of expressing a certified opinion thereon, or, in the alternative, a qualified opinion or a declination to express an opinion for stated reasons.
- (6) "Accountant's Report", when used in regard to financial statements, means a document in which an independent certified public accountant indicates the scope of the audit which he has made and sets forth his opinion regarding the financial statements taken as a whole with a listing of noted exceptions and qualifications, or an assertion to the effect that an overall opinion cannot be expressed. When an overall opinion cannot be expressed the reason therefor shall be stated. An accountant's report shall include as a part thereof a signed statement by the responsible corporate officer attesting that management has fully disclosed all material facts to the independent certified public accountant, and that the audited financial statement is a true and complete statement of the financial condition of the contractor.
- (7) "Management", when used herein, means the chief executive officers, partners, principals or other person or persons primarily responsible for the financial and operational policies and practices of the contractor.
- (8) Accounting terms, unless otherwise defined herein, shall have a meaning in accordance with generally accepted accounting principles and auditing standards.

(b) Subsection (a)(2) hereof notwithstanding, every agreement or contract awarded or executed pursuant to sections thirty-eight A 1/2 to thirty-eight O, inclusive, of chapter seven, or eleven C of chapter twenty-five A, and pursuant to section thirty-nine M of chapter thirty or to section forty-four A through H, inclusive, of chapter one hundred and forty-nine, shall provide that:

- (1) The contractor shall make, and keep for at least six years after final payment, books, records, and accounts which in reasonable detail accurately and fairly reflect the transactions and dispositions of the contractor, and
- (2) Until the expiration of six years after final payment, the office of inspector general, and the commissioner of capital asset management and maintenance shall have the right to examine any books, documents, papers or records of the contractor or of his subcontractors that directly pertain to, and involve transactions relating to, the contractor or his subcontractors, and
- (3) If the agreement is a contract as defined herein, the contractor shall describe any change in the method of maintaining records or recording transactions which materially affect any statements filed with the awarding authority, including in his description the date of the change and reasons therefor, and shall accompany said description with a letter from the contractor's independent certified public accountant approving or otherwise commenting on the changes, and
- (4) If the agreement is a contract as defined herein, the contractor has filed a statement of management on internal accounting controls as set forth in paragraph (c) below prior to the execution of the contract, and
- (5) If the agreement is a contract as defined herein, the contractor has filed prior to the execution of the contracts and will continue to file annually, an audited financial statement for the most recent completed fiscal year as set forth in paragraph (d) below.

(c) Every contractor awarded a contract shall file with the awarding authority a statement of management as to whether the system of internal accounting controls of the contractor and its subsidiaries reasonably assures that:

- (1) transactions are executed in accordance with management's general and specific authorization;
- (2) transactions are recorded as necessary
  - i. to permit preparation of financial statements in conformity with generally accepted accounting principles, and
  - ii. to maintain accountability for assets;
- (3) access to assets is permitted only in accordance with management's general or specific authorization; and
- (4) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference.

Every contractor awarded a contract shall also file with the awarding authority a statement prepared and signed by an independent certified public accountant, stating that he has examined the statement of management on internal accounting controls, and expressing an opinion as to:

- (1) whether the representations of management in response to this paragraph and paragraph (b) above are consistent with the result of management's evaluation of the system of internal accounting controls; and
- (2) whether such representations of management are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to the applicant's financial statements.

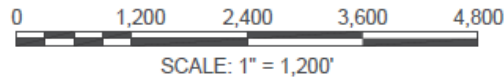
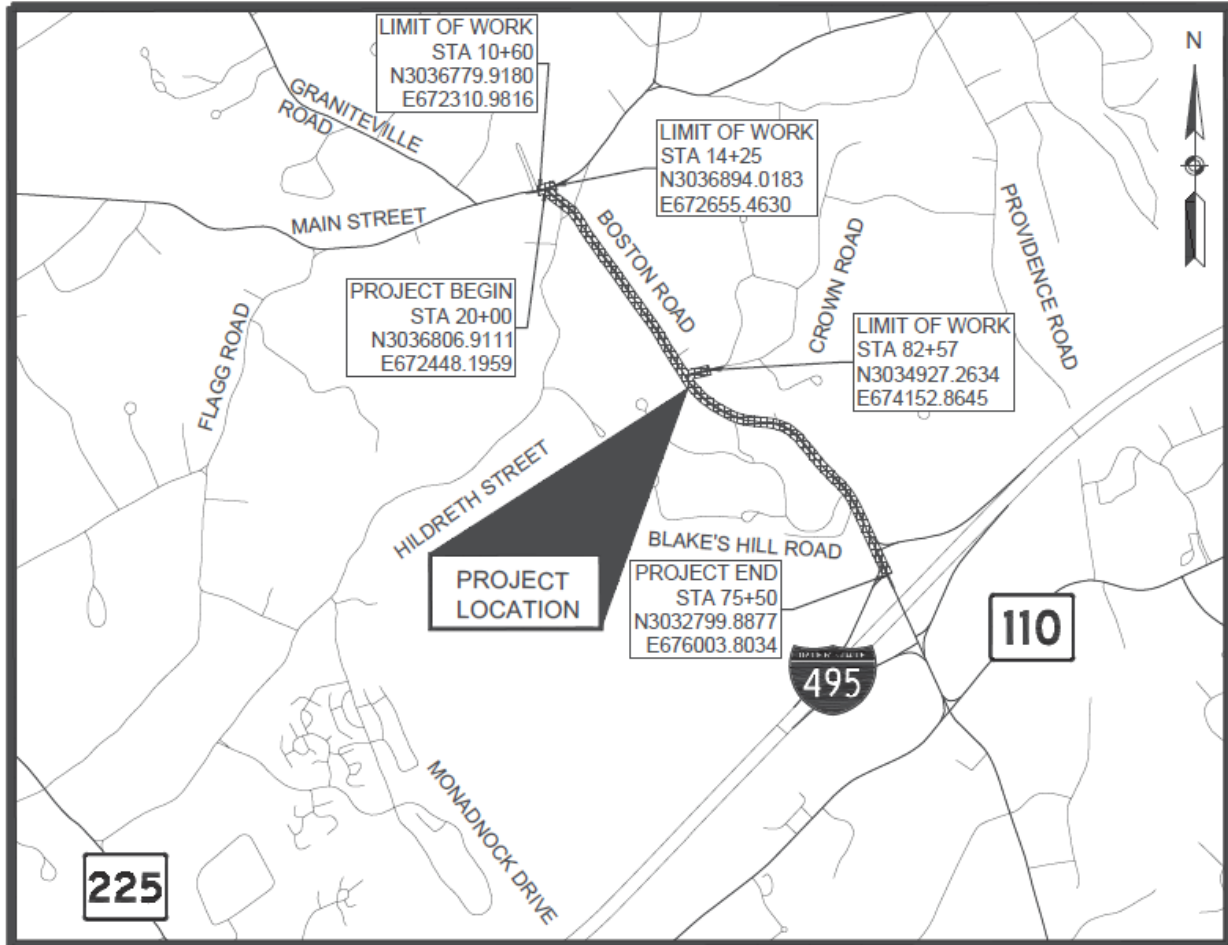


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DOCUMENT 00331

**LOCUS MAP**

**WESTFORD**  
**Federal Aid Project No. STP/CMQ/TAP-0033(038)X**  
**Rehabilitation of Boston Road**



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Final Report   
Interim Report

## CONTRACTOR PROJECT EVALUATION FORM

*For instructions on using this form, see Engineering Directive E-10-002, Dated 4/20/2010*

Date: \_\_\_\_\_

City/Town: \_\_\_\_\_ Contractor: \_\_\_\_\_

Project: \_\_\_\_\_ Address: \_\_\_\_\_

F.A. No. \_\_\_\_\_ Contract Number: \_\_\_\_\_

Bid Price: \_\_\_\_\_ Notice to Proceed: \_\_\_\_\_

Funds: State: \_\_\_\_\_ Fed Aid: \_\_\_\_\_ Current Contract Completion Date: \_\_\_\_\_

Date Work Started: \_\_\_\_\_ Date Work Completed\*: \_\_\_\_\_

Contractor's Superintendent: \_\_\_\_\_

Division: (indicates class of work) Highway: \_\_\_\_\_ Bridge: \_\_\_\_\_ Maintenance: \_\_\_\_\_

\*If work was NOT completed within specified time (including extensions) give reasons on following page.

	Excellent 10	Very Good 9	Average 8	7	Fair 6	5	Poor 4	% Rating
<b>1. Workmanship</b>								x 2=
<b>2. Safety</b>								x 2=
<b>3. Schedule</b>								x 1.5=
<b>4. Home Office Support</b>								x 1=
<b>5. Subcontractors Performance</b>								x 1=
<b>6. Field Supervision/ Superintendent</b>								x 1=
<b>7. Contract Compliance</b>								x 0.5=
<b>8. Equipment</b>								x 0.5=
<b>9. Payment of Accounts</b>								x 0.5=
<b>(use back for additional comments)</b>								<b>Overall Rating:</b>

*(Give explanation of items 1 through 9 on the following page in numerical order if overall rating is below 80%. Use additional sheets if necessary.)*

\_\_\_\_\_  
District Construction Engineer's Signature/Date

\_\_\_\_\_  
Resident Engineer's Signature/Date

\_\_\_\_\_  
Contractor's Signature Acknowledging Report/Date

Contractor Requests Meeting with the District: No  Yes  Date Meeting Held: \_\_\_\_\_

Contractor's Comments/Meeting Notes (extra sheets may be added to this form and noted here if needed): \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



**CONTRACTOR PROJECT EVALUATION FORM (Continued)**

Date: \_\_\_\_\_ Contract Number: \_\_\_\_\_

**INFORMATION FOR DISTRICT HIGHWAY DIRECTORS RELATING TO PREQUALIFICATION**

- A deduction shall be recommended for unsatisfactory performance if computed overall rating is under 80%.
- A deduction may be recommended for this project being completed late due to the Contractor's fault.

**RECOMMENDATIONS FOR DEDUCTIONS FROM CONTRACTORS' ASSIGNED FACTOR**

*(Write Yes or No in space provided)*

I recommend a deduction for Contractor's unsatisfactory performance: \_\_\_\_\_

I recommend a deduction for project completed late: \_\_\_\_\_

Signed: \_\_\_\_\_  
District Highway Director

EXPLANATION OF RATINGS 1 – 9: \_\_\_\_\_

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WORK NOT COMPLETED WITHIN SPECIFIED TIME: \_\_\_\_\_

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Final Report   
 Interim Report

## SUBCONTRACTOR PROJECT EVALUATION FORM

*For instructions on using this form, see Engineering Directive E-10-002, Dated 4/20/2010*

Date: \_\_\_\_\_

City/Town: \_\_\_\_\_ Subcontractor: \_\_\_\_\_

Project: \_\_\_\_\_ Address: \_\_\_\_\_

F.A. No.: \_\_\_\_\_ Contract Number: \_\_\_\_\_

Prime Contractor \_\_\_\_\_ Current Contract Completion Date: \_\_\_\_\_

Date Work Started: \_\_\_\_\_ Date Work Completed\*: \_\_\_\_\_

Subcontractor's Superintendent: \_\_\_\_\_

Type of Work Performed by Subcontractor: \_\_\_\_\_

\*If work was NOT completed within specified time (including extensions) give reasons on following page.

	Excellent 10	Very Good 9	Average 8	7	Fair 6	5	Poor 4	% Rating
<b>1. Workmanship</b>								x 2=
<b>2. Safety</b>								x 2=
<b>3. Schedule</b>								x 1.5=
<b>4. Home Office Support</b>								x 1.5=
<b>5. Field Supervision/ Superintendent</b>								x 1=
<b>6. Contract Compliance</b>								x 1=
<b>7. Equipment</b>								x 0.5=
<b>8. Payment of Accounts</b>								x 0.5=
<b>(use back for additional comments)</b>							<b>Overall Rating:</b>	

*(Give explanation of items 1 through 8 on the following page in numerical order if overall rating is below 80%. Use additional sheets if necessary.)*

\_\_\_\_\_  
 District Construction Engineer's Signature/Date

\_\_\_\_\_  
 Resident Engineer's Signature/Date

\_\_\_\_\_  
 Contractor Signature Acknowledging Report/Date

\_\_\_\_\_  
 Subcontractor Signature Acknowledging Report/Date

Subcontractor Requests Meeting with the District: No  Yes  Date Meeting Held: \_\_\_\_\_

Subcontractor's Comments / Meeting Notes (extra sheets may be added to this form and noted here if needed): \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Contractor's Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**SUBCONTRACTOR PROJECT EVALUATION FORM (Continued)**

Date: \_\_\_\_\_ Contract Number: \_\_\_\_\_

**INFORMATION FOR DISTRICT HIGHWAY DIRECTORS RELATING TO PREQUALIFICATION**

A deduction shall be recommended for unsatisfactory performance if computed overall rating is under 80%.  
A deduction may be recommended for this project being completed late due to the Contractor's fault.

**RECOMMENDATIONS FOR DEDUCTIONS FROM CONTRACTORS' ASSIGNED FACTOR**

*(Write Yes or No in space provided)*

I recommend a deduction for Contractor's unsatisfactory performance: \_\_\_\_\_

I recommend a deduction for project completed late: \_\_\_\_\_

Signed: \_\_\_\_\_  
District Highway Director

EXPLANATION OF RATINGS 1 – 8: \_\_\_\_\_

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WORK NOT COMPLETED WITHIN SPECIFIED TIME: \_\_\_\_\_

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DOCUMENT 00710  
GENERAL CONTRACT PROVISIONS  
Revised: 05/06/24

NOTICE OF AVAILABILITY

The STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES dated 2024, the SUPPLEMENTAL SPECIFICATIONS, the 1996 METRIC CONSTRUCTION AND TRAFFIC STANDARD DETAILS, the 1990 STANDARD DRAWINGS FOR SIGNS AND SUPPORTS; the 1968 STANDARD DRAWINGS FOR TRAFFIC SIGNALS AND HIGHWAY LIGHTING and the 2017 CONSTRUCTION STANDARD DETAILS are available online at <https://www.mass.gov/massdot-highway-division-manuals-and-publications>

SPECIAL PROVISIONS FOR RIGHT-TO-KNOW ACT REQUIREMENTS

The Contractor's attention is directed to Massachusetts General Laws, Chapter 111F, commonly known as the Right-To-Know Act, and to the regulations promulgated pursuant thereto. Among the provisions of the Right-To-Know Act is a requirement that employers make available to employees Materials Safety Data Sheets (MSDS) for any substance on the Massachusetts Substance List (MSL) to which employees are, have been, or may be exposed.

To ensure prompt compliance with these regulations and legislation, the Contractor shall:

1. Deliver to the Department, prior to the start of any work under this contract, copies of MSDS for all MSL substances to be used, stored, processed or manufactured at the worksite by the Contractor.
2. Train employees of the Department, who may be exposed to MSL substances as a result of the Contractor's work under this contract, with regard to those specific substances in accordance with requirements of the Right-To-Know Act.
3. Observe all safety precautions recommended on the MSDS for any MSL substance to be used, stored, processed, or manufactured at the worksite by the Contractor.
4. Inform the Department in writing regarding specific protective equipment recommended in the MSDS for MSL substances to which employees of the Department may be exposed as a result of the Contractor's work under this contract.

The Department shall not be liable for any delay or suspension of work caused by the refusal of its employees to perform any work due to the Contractor's failure to comply with the Right-To-Know Act. The Contractor agrees to hold the Department or the Commissioner of the Department harmless and fully indemnified for any and all claims, demands, fines, actions, complaints, and causes of action resulting from or arising out of the Contractor's failure to comply with the requirements of the Right-To-Know Act.

ALTERNATIVE DISPUTE RESOLUTION

Forum, Choice of Law and Mediations:

Any actions arising out of a contract shall be governed by the laws of Massachusetts and shall be brought and maintained in a State or federal court in Massachusetts which shall have exclusive jurisdiction thereof. MassDOT and the Contractor may both agree to mediation of any claim and will share the costs of such mediation pro rata based on the number of parties involved.

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DOCUMENT 00713

**Subsection 701**  
**Cement Concrete Sidewalks, Pedestrian Curb Ramps, and Driveways**  
**and**  
**Guide to the Interim Subsection 701**  
**Cement Concrete Sidewalk Specification**

(March 31, 2022)

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**SUBSECTION 701: CEMENT CONCRETE SIDEWALKS, PEDESTRIAN CURB RAMPS, AND DRIVEWAYS**

Replace this Subsection with the following:

**INTERIM SUBSECTION 701: CEMENT CONCRETE SIDEWALKS, PEDESTRIAN CURB RAMPS, AND DRIVEWAYS**

**DESCRIPTION**

**701.20: General**

This work shall consist of the construction of cement concrete sidewalks, pedestrian curb ramps, and driveways in accordance with the specifications and within the tolerances established on the plans.

**MATERIALS**

**701.30: General**

Materials shall meet the requirements specified in the following Subsections of Division III, Materials except as noted herein:

Gravel Borrow, Type b.....	M1.03.0
Cement Concrete ( $\geq 4,000$ psi).....	M4.02.00
Preformed Expansion Joint Filler.....	M9.14.0 <sup>[1]</sup>

<sup>[1]</sup> Preformed expansion joint filler shall conform to Subsection M9.14.0 or ASTM D8139.

The following best practices may be incorporated into the cement concrete mix design at no additional cost to the Department as identified herein.

**A. Combined Aggregate System.**

The combined aggregate system for the mix design may be analyzed using the Tarantula Curve, Shilstone Chart, fineness modulus, and coarse aggregate content to enhance the properties of the concrete.

**1. Tarantula Curve.**

The combined aggregate system for the mix design may be analyzed using the Tarantula Curve to evaluate potential properties of the concrete, including workability, segregation, edge slumping, surface finishing, and cohesion.

**Table 701.30-1: Tarantula Curve Particle Size Distribution**

Sieve Opening	Percent by Mass Targets (%)		Percent by Mass Retained (%)		
	Passing	Retained			
1-1/2 in.	100	–	–	–	–
1 in.	92	8	0 – 16	–	–
3/4 in.	82	10	0 – 20	–	–
1/2 in.	69	13	4 – 20	–	–
3/8 in.	56	13	4 – 20	–	–
No. 4	43	13	4 – 20	–	–
No. 8	37	6	0 – 12	Coarse Sand 20 – 40	–
No. 16	31	6	0 – 12		–
No. 30	18	13	4 – 20	Fine Sand 24 – 34	–
No. 50	5	13	4 – 20		–
No. 100	0	5	0 – 10		–
No. 200	0	0	0 – 2		–

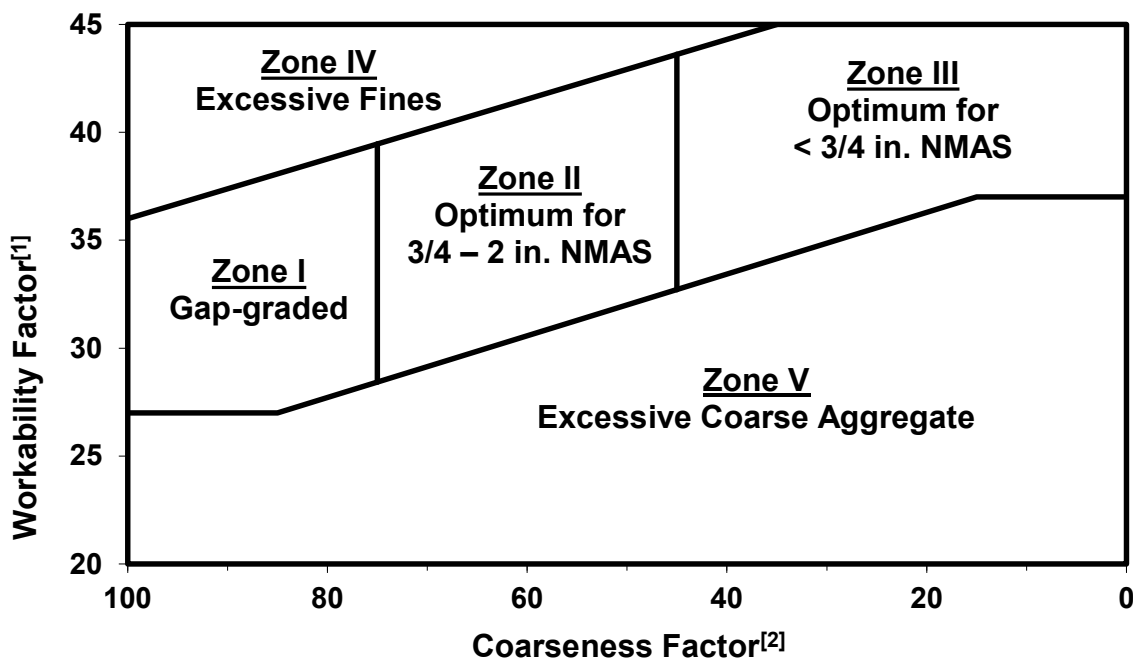
**2. Shilstone Workability-Coarseness Chart.**

The combined aggregate system for the mix design may be analyzed using the Shilstone Workability-Coarseness Chart, to evaluate potential properties of the concrete, including workability.

**Table 701.30-2: Shilstone Workability-Coarseness**

Zone	Property	Cause
Zone I	Gap-graded; High potential for segregation during placement and consolidation; Cracking, blistering, spalling, and scaling	Deficiency in intermediate particles; Non-cohesive
Zone II	Optimum mixture for nominal maximum aggregate size from 2 in. – 3/4 in.	Optimized workability factor and coarseness factor
Zone III	Optimum mixture for nominal maximum aggregate size < 3/4 in.	Optimized workability factor and coarseness factor
Zone IV	Sticky; High potential for segregation during consolidation and finishing; Variable strength, high shrinkage, cracking, curling, spalling, and scaling	Excessive fines
Zone V	Rocky; Lacking plasticity	Excessive amount of coarse and intermediate aggregate

Figure 701.30-1: Shilstone Workability-Coarseness Chart



<sup>[1]</sup> The workability factor is determined by the equation  $WF = W + (C - 564) / 38$ , where WF = workability factor, W = percent passing No. 8 sieve and C = total cementitious materials content.

<sup>[2]</sup> The coarseness factor is determined by the equation  $CF = (Q/R) / 100$ , where CF = coarseness factor, Q = cumulative percent retained on 3/8 in. sieve and R = cumulative percent retained on No. 8 sieve.

**3. Fineness Modulus.**

The combined aggregate system for the mix design may be analyzed using the fineness modulus, to evaluate potential properties of the concrete, including the fineness or coarseness of the mix design and estimating the design proportions of fine and coarse aggregates. The coarseness of the mix design increases as the fineness modulus increases. The fineness modulus is determined by calculating the total cumulative percentages by mass retained on each designated sieve and dividing by 100.

**4. Coarse Aggregate Content.**

The combined aggregate system for the mix design may be analyzed using the coarse aggregate content. The coarse aggregate content is determined by calculating the total cumulative percentages by mass retained on the No. 4 sieve.

**B. Paste System.**

The quality of the paste system is determined by the water-cementitious ratio, air content, cementitious materials, and chemical admixtures incorporated into the mix design.

**1. Water-Cementitious Ratio.**

The water-cementitious ratio for the mix design may be analyzed to evaluate potential properties of the concrete, including strength, concrete and reinforcement bonding, and resistance to freezing, thawing, de-icing, sulfate reaction, corrosion of steel reinforcement, drying shrinkage, cracking, and

volume change from wetting and drying. The water-cementitious ratio is determined by calculating the total water content by mass and dividing by the total cement and supplementary cementitious material (SCM) content by mass. The recommended water-cementitious ratio design target is identified in Table 701.30-3. The water-cementitious ratio shall be less than or equal to 0.45.

**Table 701.30-3: Freezing, Thawing, and De-icing Resistance**

Exposure Class	Severity	Condition	Water-Cementitious Ratio
			Requirement
F3	Very Severe	Exposed to freezing and thawing cycles and accumulation of snow, ice, and de-icing chemicals; Frequent exposure to water	≤ 0.45

## 2. Air Content.

The air content for the mix design may be analyzed to evaluate potential properties of the concrete, including strength and resistance to freezing, thawing, de-icing, and sulfate reaction. The recommended air content design targets are identified in Table 701.30-4.

**Table 701.30-4: Freezing, Thawing, and De-icing Resistance**

Exposure Class	Severity	Condition	Nominal Maximum Aggregate Size (in.)	Air Content Target Recommendation (%)
F3	Very Severe	Exposed to freezing and thawing cycles and accumulation of snow, ice, and de-icing chemicals; Frequent exposure to water	3/8	7.5
			1/2	7.0
			3/4	7.0
			1	6.5
			1 1/2	6.5

## 3. Cement and Supplementary Cementitious Materials Content.

The cement and supplementary cementitious materials content incorporated into the mix design shall promote quality properties of the cement concrete, including resistance to alkali silica reaction, freezing, thawing, de-icing, and sulfate reaction. Incorporation of supplementary cementitious materials (SCM) in cement concrete may affect workmanship properties, including workability, bleed rate, setting time, and other properties. Adequate adjustments in Contractor workmanship practices, including placement, finishing, curing, and other construction practices shall be required to account for these changes in properties and to prevent scaling due to freezing, thawing, and de-icing cycles. The cement and supplementary cementitious materials content shall meet the design criteria identified in Table 701.30-5.

**Table 701.30-5: Alkali Silica Reaction and Freezing, Thawing, and De-icing Resistance<sup>[1][2]</sup>**

Exposure Class	Severity	Condition	Material	Replacement by Weight of Cement (%)
F3	Very Severe	Exposed to freezing and thawing cycles and accumulation of snow, ice, and de-icing chemicals; Frequent exposure to water	Low Alkali Cement ( $\leq 0.60\%$ Alkalinity)	–
			Blended Hydraulic Cement <sup>[3]</sup>	–
			Fly Ash (Class F)	15 – 30
			Slag (Grade 100 or 120)	25 – 50
			Silica Fume	5 – 10
			Total SCM	$\leq 50$
			Total Fly Ash and Silica Fume	$\leq 35$

<sup>[1]</sup> Acceptable replacement by weight of cement for alkali silica reaction resistance shall be determined by the alkali silica reaction resistance performance test results and the criteria identified in Table 701.73-1: Minimum Acceptance Sampling and Testing Requirements.

<sup>[2]</sup> Test results meeting the alkali silica reaction resistance performance criteria of Table 701.30-6: Alternative Performance Evaluation to Alkali Silica Reaction Resistance Design Criteria may supersede the replacement by weight of cement design criteria.

<sup>[3]</sup> SCMs in blended hydraulic cement shall meet the criteria identified for fly ash, slag, and silica fume.

**Table 701.30-6: Alternative Performance Evaluation to Alkali Silica Reaction Resistance Design Criteria**

Method	Quality Characteristic	Criteria
C295	Petrographic Examination for Potential Alkali Aggregate Reactive Constituents and Deleterious Materials in Aggregate <sup>[1]</sup>	–
	Optically Strained, Microfractured or Microcrystalline Quartz (%)	$\leq 5.0$
	Chert or Chalcedony (%)	$\leq 3.0$
	Trydimite or Cristobalite (%)	$\leq 1.0$
	Opal (%)	$\leq 0.5$
	Natural Volcanic Glass (%)	$\leq 3.0$
T 380	Alkali Silica Reaction Resistance: Expansion of Miniature Concrete Prisms at 56 days (%)	$\leq 0.03$ <sup>[2]</sup>

<sup>[1]</sup> Examination of aggregate shall be performed and reported to identify and quantify potential alkali-aggregate reactive constituents and deleterious materials in aggregate, as defined in ASTM C294 Standard Descriptive Nomenclature for Constituents of Concrete Aggregates and ASTM C295 Standard Guide for Petrographic Examination of Aggregates for Concrete.

<sup>[2]</sup> 56-day expansion results greater than 0.03 but less than or equal to 0.04 shall be considered non-reactive if the average two-week rate of expansion from day 56 to day 84 is less than or equal to 0.01%, otherwise, expansion results shall be considered reactive.

#### 4. Chemical Admixtures.

Chemical admixtures may be incorporated into the mix design to enhance the properties of the concrete.

**Table 701.30-7: Chemical Admixtures**

Spec.	Type	Chemical Admixture	Properties
M 194	A	Water-Reducing	Increases Workability and Air Content; Decreases Water Demand (5 – 10%, 3 – 6 in. Slump)
	B	Retarding	Increases Initial and Final Setting Time, Air Content, Long-Term Strength; Offsetting of Accelerating Effect of Hot Weather; Decreases Early-Age Strength
	C	Accelerating	Increases Early-Age Strength; Decreases Initial and Final Setting Time
	D	Water-Reducing and Retarding	Type A and Type B Admixture Properties
	E	Water-Reducing and Accelerating	Type A and Type C Admixture Properties
	F	High Range Water-Reducing	Increases Workability (More Effective than Type A), Air Content, Early-Age Strength, and Ultimate Strength; Decreases Water Demand (12 – 40%, > 6 in. Slump) and Permeability
	G	High Range Water-Reducing and Retarding	Type F and Type B Admixture Properties
	S-SRA	Shrinkage Reducing	Increases Setting Time; Decreases Drying Shrinkage Cracking and Bleed Rate
	S-CRA	Crack Reducing	Decreases Cracking (More Effective than SRAs) and Crack Width
M 154	AEA	Air-Entraining	Increases Cohesion, Workability, Stabilization of Air Bubbles, Resistance to Freezing, Thawing, and De-icing, Resistance to Alkali-Reactive Environment, and Resistance to Sulfate Reaction
M 194 <sup>[1]</sup>	MRWRA	Mid Range Water-Reducing	Type A and Type F Admixture Properties; Increases Workability (Especially Concrete with SCMs); Decreases Water Demand (6 – 12 %, 5 – 8 in. Slump)
C1622	CWA	Cold Weather	Increases Hydration Rate; Decreases Freezing Point of Mixing Water

<sup>[1]</sup> Mid range water-reducing admixtures (MRWRA) may meet either water-reducing (A) or high range water-reducing (F) admixture criteria.

## 5. Paste Content.

The paste content for the mix design may be optimized to enhance potential properties of the concrete, including workability, strength, permeability, and resistance to drying shrinkage and cracking and volume change from wetting and drying. The volume of paste should adequately fill the voids and provide sufficient separation between the aggregate particles to promote workability and effective bonding of particles.

**Table 701.30-8: Paste Content**

Mix Design Characteristic	Recommendation
Volume of Cement Concrete (cf) <sup>[1]</sup>	27
Paste Content (%) <sup>[2]</sup>	≤ 28 <sup>[3]</sup>
Paste Content to Aggregate Void Content Ratio <sup>[4]</sup>	1.25 – 1.75
Excess Volume of Paste for Workability (%) <sup>[5]</sup>	–

<sup>[1]</sup> The volume of cement concrete is determined by the following equation, where W = Weight (lbs.), SG = Specific Gravity, D = Density (pcf), and V = Volume (cf).

$$\begin{aligned}
 V_{\text{CEMENT}} &= W_{\text{CEMENT}} / SG_{\text{CEMENT}} * D_{\text{WATER}} \\
 V_{\text{SCM}} &= W_{\text{SCM}} / SG_{\text{SCM}} * D_{\text{WATER}} \\
 V_{\text{ADMIXTURE}} &= V_{\text{ADMIXTURE in oz.}} / 957.5 \text{ oz. per cf} \\
 V_{\text{WATER}} &= V_{\text{WATER in gal.}} / 7.48 \text{ gal. per cf} \\
 V_{\text{COARSE}} &= W_{\text{COARSE}} / SG_{\text{COARSE}} * D_{\text{WATER}} \\
 V_{\text{FINE}} &= W_{\text{FINE}} / SG_{\text{FINE}} * D_{\text{WATER}} \\
 V_{\text{CONCRETE}} &= V_{\text{CEMENT}} + V_{\text{SCM}} + V_{\text{ADMIXTURE}} + V_{\text{WATER}} + V_{\text{COARSE}} + V_{\text{FINE}} + V_{\text{AIR}}
 \end{aligned}$$

<sup>[2]</sup> The paste content by volume of cement concrete is determined by the following equation, where V = Volume (cf) and PC = Paste Content (%).

$$\begin{aligned}
 V_{\text{PASTE}} &= V_{\text{CEMENT}} + V_{\text{SCM}} + V_{\text{ADMIXTURE}} + V_{\text{WATER}} \\
 PC_{\text{CONCRETE}} &= V_{\text{PASTE}} / V_{\text{CONCRETE}}
 \end{aligned}$$

<sup>[3]</sup> The cracking tendency of structural concrete is significantly reduced when the paste content by volume is less than or equal to 28 percent.

<sup>[4]</sup> The paste content to aggregate void content ratio is determined by the following equation, where D = Density (pcf), SG = Specific Gravity, BD = Bulk Density (pcf), VC = Void Content (%), V = Volume (cf), AVC = Aggregate Void Content (%), PC = Paste Content (%), and R = Ratio. Workability increases as the paste content to aggregate void content ratio increases. Decreased paste content to aggregate void content ratios will result in decreased workability, where water-reducing admixtures provide no benefit.

$$\begin{aligned}
 V_{\text{COARSE}} &= SG_{\text{COARSE}} * D_{\text{WATER}} - BD_{\text{COARSE}} / D_{\text{COARSE}} \\
 V_{\text{FINE}} &= SG_{\text{FINE}} * D_{\text{WATER}} - BD_{\text{FINE}} / D_{\text{FINE}} \\
 V_{\text{AGGREGATE}} &= [(V_{\text{COARSE}} / (V_{\text{COARSE}} + V_{\text{FINE}})) * VC_{\text{COARSE}} + (V_{\text{FINE}} / (V_{\text{COARSE}} + V_{\text{FINE}})) * VC_{\text{FINE}}] \\
 AVC_{\text{CONCRETE}} &= [V_{\text{AGGREGATE}} * ((V_{\text{COARSE}} + V_{\text{FINE}}) / V_{\text{CONCRETE}})]
 \end{aligned}$$

$$R_{PC-AVC} = PC_{CONCRETE} / AVC_{CONCRETE}$$

<sup>[5]</sup> The excess paste content for workability is determined by the following equation, where PC = Paste Content (%), AC = Air Content (%), AVC = Aggregate Void Content (%), and EPC = Excess Paste Content for Workability (%).

$$EPC_{CONCRETE} = PC_{CONCRETE} + AC_{CONCRETE} - AVC_{CONCRETE}$$

### C. Initial Curing Materials.

The materials and procedures used for initial curing methods of cement concrete shall meet the Manufacturer's instructions and recommendations and the requirements specified herein.

Cement concrete with a low to negligible bleeding rate, exposure to highly evaporative environments, high content of silica fume, fine cement, or other fine cementitious material, low water to cementitious ratio, high air content, or water-reducing admixtures have an increased susceptibility to surface drying and plastic shrinkage between placement and finishing operations. Initial curing materials and procedures shall be applied immediately after the bleed water sheen has disappeared from the surface of the concrete or the concrete surface exhibits loss of moisture and surface drying, between placement and finishing operations. Initial curing materials shall not be worked into the surface in subsequent finishing operations.

#### 1. Liquid-Applied Evaporation Reducers.

Liquid-applied evaporation reducers used for initial curing methods shall produce an effective monomolecular film over the bleed water layer, to reduce the rate of evaporation of the bleed water from the surface and plastic shrinkage when the evaporation rate equals or exceeds the bleeding rate.

### D. Intermediate Curing Materials.

The materials and procedures used for intermediate curing methods of cement concrete shall meet the Manufacturer's instructions and recommendations and the requirements specified herein.

In instances where finishing operations have been completed prior to the concrete achieving final set and the concrete surface exhibits loss of moisture and surface drying, the following curing materials and procedures shall be applied immediately to the concrete surface prior to the application of final curing materials, to prevent the loss of moisture without damaging the concrete surface, until final set of the concrete has been achieved and final curing materials have been applied to the concrete surface.

- 701.30.C.1: Liquid-Applied Evaporation Reducers
- 701.30.E.3.a: Liquid Membrane-Forming Compounds for Curing
- 701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing

### E. Final Curing Materials.

The materials and procedures used for final curing methods of cement concrete shall meet the Manufacturer's instructions and recommendations and the requirements specified herein.

Curing water shall be free of deleterious impurities, causing staining and deterioration. The potential staining ability of curing water shall be evaluated by means of CRD-C401 (US Army Corps



of Engineers 1975) for instances where curing water quality is questioned. Curing water shall not exceed a temperature differential of more than 20°F from the internal concrete temperature, to prevent cracking due to temperature gradients causing strain that exceeds the strain capacity of concrete. Curing water shall remain above freezing temperatures throughout the duration of the curing cycle.

Final curing materials and procedures shall be applied to the concrete surface immediately after application of initial and intermediate curing materials, finishing operations, and final set of cement concrete, to prevent the loss of moisture and surface drying.

Materials used for final curing methods of cement concrete shall accommodate all exposed cement concrete surfaces with a continuous application of moisture throughout the entire duration of the final curing method cycle and provide controlled and gradual termination of the final curing method cycle.

Final curing materials applied to the concrete shall allow the concrete to mature sufficiently to achieve its designed and desired properties, including strength, volume stability, permeability, durability, and resistance to freezing, thawing, and de-icing cycles. Insufficient application of final curing materials results in decreased strength and durability of the top surface of concrete.

Protection to the concrete surface and curing materials shall be required in instances where adverse weather conditions are present, until curing operations can be initiated without damaging the surface of the concrete.

Final curing materials and procedures shall be applied to the concrete surface throughout the entire duration of the curing cycle and meet minimum sustained temperature, duration, and strength requirements, as specified in applicable Division II: Construction Details and herein. Controlled and gradual termination of the final curing method cycle shall begin only after all specified conditions are met, until the concrete gradually cools to within 20°F of the ambient temperature.

### **1. Saturated Covers.**

Saturated covers used for final curing methods shall meet AASHTO M 182, Class 3. Saturated covers shall be in good condition, free from holes, tears, or other defects that would render it unsuitable for curing cement concrete and cementitious materials. Saturated covers shall be dried to prevent mildew when storing. Prior to application, saturated covers shall be thoroughly rinsed in water and free of harmful substances that are deleterious or cause discoloration to cement concrete and cementitious materials. Saturated covers shall have sufficient thickness and proper positioning onto the surface to maximize moisture retention. Saturated covers shall contain a sufficient amount of moisture to prevent moisture loss from the surface of cement concrete and cementitious materials. Saturated covers shall have the ability to retain sufficient moisture from continuous watering so that a film of water remains on the surface of cement concrete and cementitious materials throughout the entire duration of the final curing method cycle. Saturated covers shall not absorb water from cement concrete and cementitious materials. Polyethylene film may be applied over the saturated cover to limit the amount of continuous watering required for sufficient moisture retainage. Saturated covers shall accommodate uniform and slow drying of cement concrete and cementitious materials surfaces immediately prior to removal.

## **2. Sheet Materials.**

Sheet materials, including polyethylene film, white burlap-polyethylene sheeting, and reinforced paper, used for final curing methods shall meet ASTM C171 and the requirements specified herein. Sheet materials shall inhibit moisture loss and reduce temperature rise in concrete exposed to radiation from the sun during the final curing method cycle. Adjoining covers shall overlap not less than 12 inches. All edges of the sheet materials shall be secured to maintain a moist environment.

### **a. Polyethylene Film.**

Polyethylene film shall be clear, white, or black in color and consist of a single sheet manufactured from polyethylene resins, be free of visible defects, including tears, wrinkles, and discontinuity. The film shall prohibit mottling and uneven spots from appearing on the surface of concrete, due to variations in temperature, moisture content, or both. Application of additional curing water under the film or application of a polyethylene film bonded to absorbent fabric to the concrete surface may be required to prevent mottling and to retain and evenly distribute the moisture. Polyethylene film shall accommodate concrete surfaces with constant contact without damage. The film shall be sufficient in length to extend beyond the edges of the concrete surface. Edges of adjacent polyethylene film shall overlap a minimum of 6 inches and be tightly sealed with the use of sand, wood planks, pressure-sensitive tape, mastic, or glue to maintain close contact with the concrete surface, retain moisture, and prevent the formation of air pockets throughout the entire duration of the final curing method cycle.

#### **i. White Polyethylene Film.**

White polyethylene film shall minimize heat gain caused by absorption of solar radiation and shall be exclusively used during warm weather applications.

#### **ii. Clear and Black Polyethylene Films.**

Clear and black polyethylene films shall inhibit absorption of solar radiation for cold weather applications.

### **b. White Burlap-Polyethylene Sheeting.**

White burlap-polyethylene sheeting shall be securely bonded to the burlap so to avoid separation of the materials during handling and curing of the concrete.

### **c. Reinforced Impervious Paper.**

Reinforced impervious paper shall be white in color, consist of two sheets of kraft paper cemented together with a bituminous adhesive, and reinforced with embedded cords or strands of fiber running in both directions. Reinforced impervious paper shall be free of holes, tears, and pin holes from deterioration of the paper through repeated use. Reinforced impervious paper shall be treated to prevent tearing when wetted and dried. Reuse of reinforced impervious paper shall be permitted so long as it is able to retain moisture on the surface of concrete. The paper shall be discarded and prohibited from use when moisture is no longer retained in the material.

## **3. Liquid Membrane-Forming Compounds.**

Compounds shall form a continuous, non-yellowing, and durable film with quality moisture-retention properties. Compounds shall maintain the relative humidity of the concrete surface

above 80% for seven days to sustain cement hydration. Compounds shall not affect the original color of the concrete surface. Compounds shall not degrade due to exposure to ultraviolet light from direct sunlight. Compounds shall meet the local and federal allowable Volatile Organic Compound (VOC) content limits.

White-pigmented compounds shall be used in instances where solar-heat gain is concern to the concrete surface. White-pigmented compounds shall be agitated in the container prior to application to prevent pigment from settling out resulting in non-uniform overage and ineffective curing.

Careful considerations shall be made by the Contractor to determine if the evaporation rate is exceeding the rate of bleeding, thus causing the surface to appear dry even though bleeding is still occurring. To diagnose and prevent this condition, the Contractor may place a transparent plastic sheet over a test area of the uncured and unfinished concrete surface and shall determine if any bleed water accumulates under the plastic. Under such conditions, the application of liquid membrane-forming compounds to the concrete surface shall be delayed to prevent bleed water from being sealed below the concrete surface, map cracking of the membrane films, reduction in moisture-retention capability, and the need for reapplication of the compound.

Prior to use, compounds shall be thoroughly mixed, stirred, and agitated per the Manufacturer's instructions and recommendations.

Compounds shall be applied continuously and uniformly to the surface of the concrete per the Manufacturer's instructions and recommendations. Compounds shall be applied immediately after the disappearance of the surface water sheen following final finishing. Applying of the compound immediately after final finishing and before all free water on the surface has evaporated will help prevent the formation of cracks. When using compounds to reduce moisture loss from formed surfaces, the exposed surface shall be wetted immediately after form removal and kept moist until the curing compound is applied. The concrete shall be allowed to reach a uniformly damp appearance with no free water on the surface, and then application of the compound shall begin at once. Delayed application will result in surface drying, absorption of the compound into the concrete, and no forming of a continuous membrane.

The concrete surface shall be damp when the compound is applied. Power-driven spray equipment shall be used for uniform application of compounds on large paving projects. Spray nozzles recommended by the compound Manufacturer and use of windshields shall be arranged by the Contractor to prevent wind-blown loss of compound and to ensure proper coverage application rates are achieved. The compound shall be applied by power sprayer, using appropriate wands and nozzles with pressures between 25 and 100 psi. The Contractor shall fill the power sprayer with curing compound from the Manufacturer's original container in the presence of the Engineer. Any dilution as recommended by the Manufacturer shall take place in the presence of the Engineer. For very small areas such as repairs, the compound shall be applied with a wide, soft-bristled brush or paint roller.

The Contractor shall verify the application rate and procedures are in accordance with the Manufacturer's instructions and recommendations. At least one uniform coat shall be applied at a rate of 150 to 200 ft<sup>2</sup>/gallon. On very deeply textured surfaces, the surface area to be treated shall be at least twice the surface area of the surface. In such cases, two separate applications may be needed, each at 200 ft<sup>2</sup>/gallon or greater if specified by the Manufacturer to achieve the desired

moisture retention rate, with the first being allowed to become tacky before the second is applied. If two coats are necessary to ensure complete coverage, for effective protection the second coat should be applied at right angles to the first. Complete coverage of the surface shall be attained due to the potential for formation of small pinholes in the membrane, which will result in loss of moisture from the concrete. Compounds shall not sag, run off peaks, or collect in grooves.

Compounds and procedures shall be compatible with concrete surfaces receiving subsequent applications or placements of concrete, overlays, coatings, paints, sealers, finishes or other toppings to ensure acceptable bonding to the concrete. Testing to establish compatibility among the curing compound, subsequent surface treatments, concrete moisture content and the actual finished surface texture of the concrete shall be conducted when compatibility is not known. The compound Manufacturer shall be consulted by the Contractor to determine the compatibility of the application. Compounds shall not be applied to concrete surfaces where bonding of subsequent applications or placements is incompatible or is of concern. The use of wax-based curing compounds shall be prohibited in instances where concrete surfaces are subject to additional toppings and vehicular, pedestrian, or other traffic. Deliberate removal of compounds in the presence of the Engineer and in accordance with Manufacturer’s instructions and recommendations shall be conducted as an alternative to compatibility testing, incompatibility, or in instances where bonding is of concern. Bonding of subsequent materials may still be inhibited by the presence of the compound even after the moisture retention characteristics of the compound have diminished.

**a. Liquid Membrane-Forming Compounds for Curing.**

Liquid membrane-forming compounds for curing shall meet ASTM C309, the Manufacturer’s instructions and recommendations, and the requirements specified herein.

***Table 701.30-1: Types of Compounds for Curing***

<b>Type</b>	<b>Description</b>
Type 1	Clear or translucent without dye
Type 1-D	Clear or translucent with fugitive dye
Type 2	White pigmented

***Table 701.30-2: Composition Class of Compounds for Curing***

<b>Type</b>	<b>Description</b>
Class A	Unrestricted composition, generally wax-based products
Class B	ASTM D883 resin-based products

**b. Liquid Membrane-Forming Compounds for Curing and Sealing.**

Liquid membrane-forming compounds for curing and sealing shall meet ASTM C 1315, the Manufacturer’s instructions and recommendations, and the requirements specified herein.

In addition to moisture-retention capabilities compounds shall exhibit specific properties, including alkali resistance, acid resistance, adhesion-promoting quality, and resistance to degradation by ultraviolet light.

**Table 701.30-3: Types of Compounds for Curing and Sealing**

Type	Description
Type I	Clear or translucent
Type II	White pigmented

**Table 701.30-4: Class of Compounds for Curing and Sealing**

Type	Description
Class A	Non-yellowing

**F. Protective Sealing Compounds.**

Protective sealing compounds shall maintain valid listing on the Department Qualified Construction Materials List (QCML) and meet AASHTO M 224, NCHRP Report 244 and the requirements specified herein.

Protective sealing compounds shall sufficiently penetrate the concrete to seal the surface pores and fill the capillaries of the concrete by chemically reacting with the concrete and forming a hydrophobic layer. Protective sealing compounds shall limit the penetration of liquids, gases, and harmful substances into hardened concrete, including water, de-icing agents, and carbon dioxide to protect concrete from freezing, thawing, and de-icing cycles, corrosion of reinforcing steel, and acid attack. Protective sealing compounds shall limit the buildup of vapor pressure between the concrete and the applied sealer. Protective sealing compounds shall retard the penetration of harmful substances into hardened concrete. Protective sealing compounds shall maintain their protective properties during environmental exposure to freezing, thawing, and de-icing cycles. Protective sealing compounds shall not reduce the frictional properties of the concrete. Protective sealing compounds shall not affect the original color of the concrete surface if maintaining the original color is desired by the Department. Protective sealers shall meet the local and federal allowable Volatile Organic Compound (VOC) content limits.

Curing methods conforming to Department specifications shall be applied to the concrete prior to the application of protective sealers. Protective sealers shall not be applied to the concrete for a minimum of 28 days after placement and the surface shall be sufficiently prepared, clean, and dry for at least 24 hours with ambient temperatures exceeding 60°F. Protective sealers shall not be applied to concrete placed where freezing, thawing, and de-icing cycles are expected immediately after, due to the retainage of water in the concrete. Periodic re-application shall be required for protective penetrants requiring multiple applications and for concrete surfaces exhibiting wear to ensure long-term protection of the concrete surface.

**G. Cold Weather Concreting Materials.**

Cold weather concreting shall be defined as the procedures, operations, materials, and equipment required for the mixing, delivery, placement, finishing, curing, and protection of concrete during cold weather conditions, while exposed to air temperatures falling below, or expected to fall below 40°F.

The protection period shall be defined as the minimum duration required to prevent concrete from the negative effects of cold weather exposure. The protection period shall remain in place while

cold weather conditions exist. Controlled and gradual termination of the protection period shall be conducted only after 100% f'c is attained and all specified conditions are met.

The procedures, operations, materials, and equipment selected for cold weather concreting shall adequately maintain specified temperature ranges by addressing all variables, including ambient weather conditions, geometry of the structure, and mix design proportions. Concrete temperatures for cold weather concreting shall meet Table 701.30-5.

**Table 701.30-5: Concrete Temperature Requirements for Cold Weather Concreting**

Phase	Cold Weather Temperature (°F)	Concrete Temperature (°F)
Mixing	30-39	60-75
	0-30	65-80
	< 0	70-85
Placement	< 40	55-75
Protection Period	< 40	55-75
Termination of Protection Period – Allowable Rate of Decrease in 24 Hours	< 40	≤ 50

Cold weather concreting procedures, operations, materials, and equipment shall be developed and performed to prevent damage to concrete due to freezing at early ages, to ensure that the concrete develops the recommended strength for safe removal of forms, to maintain curing conditions that promote quality strength and durability development, to limit rapid temperature fluctuation, and to provide protection consistent with intended serviceability of the structure. The Contractor shall develop and submit to the Department for review and approval, cold weather concreting procedures for the mixing, delivery, placement, finishing, curing, and protection of concrete during cold weather, including:

- Procedures for protecting the subgrade from frost and the accumulation of ice or snow on reinforcement or forms prior to placement
- Methods and requirements for cold weather protection and temperature control of constituent materials incorporated into the mix design
- Chemical admixtures incorporated into the mix design for cold weather protection and temperature control
- Methods and requirements for cold weather protection and temperature control during mixing, delivery, placement, finishing, curing, and protection period
- Curing methods to be used during and following the protection period
- Types of covering, insulation, heating, or enclosures to be provided
- Methods for verification of in-place strength
- Procedures for measuring and recording concrete temperatures
- Procedures for preventing drying during dry, windy conditions

All procedures, operations, materials, and equipment required for adequate protection and curing shall be present and ready for use prior to concrete production.

## **1. Insulating Materials.**

Insulating materials used for cold weather concreting shall meet the requirements specified herein. The thermal resistance of the proposed insulation system shall be determined to meet the concrete temperature range requirements specified herein. Supplemental heat, including hydronic heating systems, shall be applied in instances where insulating materials cannot achieve the concrete temperature requirements.

## **2. Heaters.**

Heaters used for cold weather concreting including direct fired, indirect fired, and hydronic heaters shall meet ANSI A10.10 carbon monoxide limits, safety regulations for ventilation, and the stability, operation, fueling, and maintenance of heaters and the requirements specified herein.

### **a. Direct Fired Heaters.**

Direct fired heaters generate heat to an enclosed space through the combustion of fossil fuels, including oil, kerosene, propane, gasoline, and natural gas. Hot air comprised of carbon dioxide and carbon monoxide combustion products, is discharged into the enclosed space. Direct fired heaters shall be prohibited from heating the air directly surrounding the concrete surface due to calcium carbonate formation interfering with the hydration reaction, from the reaction between the carbon dioxide generated from the combustion of fossil fuels and the calcium hydroxide on the surface of freshly placed concrete, resulting in a soft, chalky, and nondurable concrete surface. Direct fired heaters shall only be used on concrete surfaces protected from fossil fuel combustion products.

### **b. Indirect Fired Heaters.**

Indirect fired heaters generate heat to an enclosed space through the combustion of fossil fuels, including oil, kerosene, propane, gasoline, and natural gas. The carbon dioxide and carbon monoxide combustion products are expelled through venting, resulting in clean heated air discharged into the enclosed space. Indirect fired heaters are suitable for heating the air directly surrounding the concrete surface.

### **c. Hydronic Heaters.**

Hydronic heaters generate heat to an enclosed space through the circulation of the heat-transfer fluid in a closed system of pipes or hoses. The heat-transfer fluid is comprised of a propylene glycol water solution and is heated through the combustion of fossil fuels, including diesel fuel and kerosene. The combustion of fossil fuel occurs outside of the enclosed space and does not expose the concrete surface to the deleterious effects of carbon dioxide.

After the concrete placement achieves final set, polyethylene film or other suitable material shall sufficiently serve as a vapor barrier. The heat-transfer hoses shall be placed on top of the vapor barrier and covered with insulating materials meeting 701.30.G.1. Hydronic heaters shall be used to thaw or preheat subgrades prior to concrete placement and provide supplementary heat to insulating materials. Hydronic heaters shall provide an even distribution of heat to prevent curling and cracking induced by temperature gradients within concrete.

### 3. Enclosures.

Enclosures shall be made of wood, canvas tarpaulins, polyethylene film, or prefabricated rigid plastic. Enclosures shall be airtight, block wind, prevent admittance of cold air, conserve heat, and withstand wind and snow loads. Enclosures shall provide adequate headroom for craftsmen and sufficient space between the concrete and the enclosure to permit free circulation of warm air. Supplementary heat shall be supplied to enclosures by hydronic heaters, live steam, hot forced air, or indirect fired combustion heaters. Icing along the perimeter of the enclosure shall be prevented when live steam is utilized. Heaters and ducts shall be positioned to prevent the hot, dry air from overheating or drying the concrete surface. Insulating materials meeting 701.30.G.1 shall be applied as a vapor barrier to the concrete surface immediate after final set is attained.

#### H. Hot Weather Concreting Materials.

Hot weather concreting shall be defined as the procedures, operations, materials, and equipment required for the mixing, delivery, placement, finishing, bleed water evaporation, curing, and protection of concrete during hot weather conditions, while exposed to air temperatures exceeding, or expected to exceed 80°F; concrete temperatures approaching, or expected to approach 90°F; evaporation rates of surface water approaching, or expected to approach the bleeding rate of the concrete; high solar radiation; low relative humidity; and high wind speed.

The protection period shall be defined as the minimum duration required to prevent concrete from the negative effects of hot weather exposure, including the acceleration of rate of moisture loss and rate of cement hydration, difficulties in curing, increased concrete temperature, increased water demand, accelerated slump loss, increased rate of setting, increased tendency for plastic shrinkage and thermal cracking, increased potential for cold joints, and difficulties in controlling entrained air content. The protection period shall remain in place while hot weather conditions exist. Controlled and gradual termination of the protection period shall be conducted when conditions permit. The allowable rate of temperature decrease shall not exceed 5°F per hour and meet the allowable rate of temperature decrease specified in 701.30.G: Cold Weather Concreting Materials.

The procedures, operations, materials, and equipment selected for hot weather concreting shall adequately maintain specified temperature ranges and evaporation rates by addressing all variables, including ambient weather conditions, geometry of the structure, and mix design proportions. Initial materials meeting 701.30.C: Initial Curing Materials shall be applied to the concrete surface while the concrete and air temperatures, relative humidity of the air, and the wind speed have the capacity to evaporate free water from the fresh concrete surface at a rate that is equal to or greater than bleeding rate of the concrete. The evaporation rate of surface water shall be determined by the following equation:

$$E = (T_c^{2.5} - r * T_a^{2.5})(1 + 0.4V) \times 10^{-6}$$

where E = evaporation rate of water-covered surface (lb/ft<sup>2</sup>/hr), T<sub>c</sub> = concrete temperature of the evaporating surface (°F), r = relative humidity of air surrounding the evaporating surface (%), T<sub>a</sub> = temperature of the air surrounding the evaporative surface (°F), and V = average wind speed 20 inches above the evaporating surface. The air surrounding the evaporating surface shall be defined as the air approximately 4 to 6 feet above the evaporating surface on the windward side and shielded from the sun's rays.



Hot weather concreting procedures, operations, materials, and equipment shall be developed and performed to prevent damage to concrete and promote long-term durability. The Contractor shall develop and submit to the Department for review and approval, hot weather concreting procedures for the mixing, delivery, placement, finishing, curing, and protection of concrete during hot weather, including:

- Procedures for preparing the subgrade prior to placement
- Methods and requirements for hot weather protection and temperature control of constituent materials incorporated into the mix design
- Chemical admixtures incorporated into the mix design for hot weather protection and temperature control
- Methods and requirements for hot weather protection and temperature control during mixing, delivery, placement, finishing, curing, and protection period
- Initial curing methods to be used to reduce surface evaporation
- Curing methods to be used during and following the protection period
- Types of covering, insulation, cooling, or enclosures to be provided
- Evaporation rate and bleeding rate of concrete calculations
- Procedures for measuring and recording concrete temperatures
- Procedures for preventing drying during dry, windy conditions

All procedures, operations, materials, and equipment required for adequate protection and curing shall be present and ready for use prior to concrete production.

## **CONSTRUCTION METHODS**

### **701.40: Pre-Placement**

#### **A. Excavation.**

Excavation of the area shall be in accordance with the applicable portions of Subsection 120: Excavation.

#### **B. Subgrade and Subbase.**

The subgrade for the sidewalks and driveways shall be shaped parallel to the proposed surface of the sidewalks and driveways and thoroughly compacted. All depressions in the subgrade shall be filled with suitable material and again compacted until the surface is smooth and hard. Prior to the placement of the subbase, the Contractor shall inspect the prepared subgrade to ensure that it is in conformance with the required grade and cross-section. Subgrade shall be fine graded to meet the applicable requirements of Subsection 170: Grading.

After the subgrade has been prepared, a gravel subbase shall be placed upon it. After being compacted thoroughly, the subbase shall be at least 8 inches thick and parallel to the proposed surface of the sidewalk. Prior to the placement of the cement concrete, the Contractor shall inspect the prepared subbase material to ensure that it is in conformance with the required grade and cross-section. Subbase material that is not in accordance with the plans or specifications shall be reworked or replaced to meet the applicable requirements of Subsection 170: Grading before the start of cement concrete placement. When placing cement concrete, the compacted subbase shall not be frozen or have standing water.

### **C. Forms.**

Side forms and transverse forms shall be smooth, free from warp, of sufficient strength to resist springing out of shape, of a depth to conform to the thickness of the proposed sidewalk or pedestrian curb ramp and of a type satisfactory to the Engineer.

All mortar or dirt from previously used forms shall be completely removed prior to use. The forms shall be well staked and thoroughly graded and set to the established lines with their upper edge conforming to the grade of the finished sidewalk or pedestrian curb ramp which shall have sufficient pitch to the roadside edge to provide for surface drainage.

All pedestrian curb ramp joints and transition sections which define grade changes shall be formed staked and checked for dimension, grade and slope conformance prior to placing cement concrete.

All forms shall be oiled before placing concrete.

#### **701.41: Placement**

The concrete shall be placed in alternate slabs 30 ft long except as otherwise ordered. The slabs shall be separated by transverse preformed expansion joint filler ½ in. thick.

Preformed expansion joint filler shall be placed adjacent to or around existing structures as directed.

Detectable warning panels conforming to the plans shall be securely incorporated into the work by means acceptable to the Engineer.

On the foundation as specified above, the concrete shall be placed in such quantity that after being thoroughly consolidated in place it shall be 4 in. deep. At driveways, the sidewalks shall be 6 in. deep.

In conveying the concrete from the place of mixing to the place of deposit, the operation shall be conducted in such a manner that no mortar will be lost, and the concrete shall be so handled that the concrete will be of uniform composition throughout, showing neither excess nor lack of mortar in any one place.

The surface of all concrete sidewalks shall be uniformly scored into block units of areas not more than 36 ft<sup>2</sup>. The depth of the scoring shall be at least ½ in. deep and no more than ½ in. wide.

#### **701.42: Initial Curing**

In instances where the bleed water sheen has disappeared from the surface of the concrete or the concrete surface exhibits loss of moisture and surface drying between placement and finishing operations, the Contractor shall apply one of the following initial curing materials and procedures meeting 701.30.C: Initial Curing Materials until finishing operations occur.

- 701.30.C.1: Liquid-Applied Evaporation Reducers

Initial curing materials shall not be worked into the surface in subsequent finishing operations.

**701.43: Finishing**

The finishing of concrete surface shall be done by experienced and competent cement finishers. No finishing operation shall be performed while free water is present. Finishing operations shall be delayed until all bleed water and water sheen has left the surface and the concrete has started to stiffen. After water sheen has disappeared, edging operations, where required, shall be completed. After edging and joining operations, the surface shall be floated. Magnesium floats shall be used for all finishing operations. If necessary tooled joints and edges shall be rerun before and after floating to maintain uniformity. After floating, the surface shall be brushed by drawing a soft-bristled push broom with a long handle over the surface of the concrete to produce a nonslip surface.

**701.44: Intermediate Curing**

In instances where finishing operations have been completed prior to the concrete achieving final set and the concrete surface exhibits loss of moisture and surface drying, the Contractor shall apply one of the following intermediate curing materials and procedures meeting 701.30.D: Intermediate Curing Materials immediately to the concrete surface prior to the application of final curing materials, to prevent the loss of moisture without damaging the concrete surface, until final set of the concrete has been achieved and final curing materials have been applied to the concrete surface.

- 701.30.C.1: Liquid-Applied Evaporation Reducers
- 701.30.E.3.a: Liquid Membrane-Forming Compounds for Curing
- 701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing

**701.45: Final Curing**

The Contractor shall apply one of the following final curing materials and procedures meeting 701.30.E: Final Curing Materials to the concrete surface immediately after application of initial and intermediate curing materials, finishing operations, and final set of cement concrete, to prevent the loss of moisture and surface drying.

- 701.30.E.1: Saturated Covers
- 701.30.E.2: Sheet Materials
- 701.30.E.3.a: Liquid Membrane-Forming Compounds for Curing
- 701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing

The Contractor shall apply final curing materials and procedures to the concrete surface throughout the entire duration of the curing cycle and meet minimum sustained temperature, duration, and strength requirements, as specified in in Table 701.45-1. Controlled and gradual termination of the curing cycle shall begin after all specified conditions are met.

**Table 701.45-1: Termination of Curing Cycle**

Sustained Concrete Temperature	Final Curing Cycle Duration	Compressive Strength <sup>[1]</sup>
50°F ≤ °F ≤ 90°F	≥ Seven (7) days	≥ 70% f <sub>c</sub>

<sup>[1]</sup> Compressive strength cylinders for termination of curing cycle shall be cast and field cured with the same environmental conditions that the sidewalk is subjected to throughout the entire duration of the final curing cycle, per 701.73: Acceptance Sampling and Testing.

**701.46: Protective Sealing**

The Contractor shall apply sealing materials and procedures meeting 701.30.F: Protective Sealing Compounds only if one or more of the following final curing materials and procedures were applied:

- 701.30.E.1: Saturated Covers
- 701.30.E.2: Sheet Materials
- 701.30.E.3.a: Liquid Membrane-Forming Compounds for Curing

Protective sealing compounds shall not be applied to concrete surfaces applied with a final curing material and procedure meeting 701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing.

**701.47: Cold Weather Concreting**

The Contractor shall conduct cold weather concreting procedures, operations, materials, and equipment required for the mixing, delivery, placement, finishing, curing, and protection of concrete, while surfaces are exposed to air temperatures falling below, or expected to fall below 40°F in accordance with 701.30.G: Cold Weather Concreting Materials. All procedures, operations, materials, and equipment required for adequate protection and curing shall be present and ready for use prior to concrete production.

**701.48: Hot Weather Concreting**

The Contractor shall conduct hot weather concreting procedures, operations, materials, and equipment required for the mixing, delivery, placement, finishing, curing, and protection of concrete, while surfaces are exposed to air temperatures exceeding, or expected to exceed 80°F; concrete temperatures approaching, or expected to approach 90°F; evaporation rates of surface water approaching, or expected to approach the bleeding rate of the concrete; high solar radiation; low relative humidity; and high wind speed in accordance with 701.30.H: Hot Weather Concreting Materials. All procedures, operations, materials, and equipment required for adequate protection and curing shall be present and ready for use prior to concrete production

**CONTRACTOR QUALITY CONTROL****701.60: General**

The Contractor shall provide adequate Quality Control (QC) to ensure that all materials and workmanship conform with the specification requirements. The Contractor shall perform QC activities as outlined further below.

**701.61: Contractor Quality Control Plan**

The Contractor shall provide and maintain a Quality Control Plan (QC Plan). The QC Plan should sufficiently document the QC processes of all Contractor parties (i.e. Prime Contractor, Subcontractors, Producers) performing work required under this specification.

**701.62: Production Personnel**

**A. Foreman.**

A foreman shall be present throughout the entire duration of the construction operation with at least one of the following personnel certifications.

- NRMCA Concrete Exterior Finisher Certification
- ACI Concrete Flatwork Technician and Flatwork Finisher

The foreman is responsible for the oversight of the construction operation per the requirements specified in Table 701.62-1.

*Table 701.62-1: Minimum Foreman Activities*

<b>Operation</b>	<b>Foreman</b>	<b>Activity</b>
Oversight	One (1)	Review and compare batch ticket quantities and sources to approved mix design
		Monitors conformance to AASHTO M 157 Standard Specification for Ready-Mixed Concrete
		Monitors conformance to Department specifications
		Monitors Production Personnel activities
		Verifies proper equipment is on hand prior to start of construction
		Monitors equipment, environmental conditions, materials, and workmanship
		Prohibits the use of prohibited equipment and practices
		Acknowledges sampling, testing, and inspection results

**B. Operators.**

Concrete sidewalk shall be constructed by sufficiently staffed, trained, experienced, and qualified equipment operators and craftsmen, who are presently involved in sidewalk construction, throughout the entire duration of the construction operation, per the requirements specified in Table 701.62-2.

**Table 701.62-2: Minimum Operator Activities**

<b>Operation</b>	<b>Operators<sup>[1]</sup></b>	<b>Activity</b>
701.40: Pre-Placement	Two (2)	Apply sufficient base compaction
		Moisten sub-base, free of standing water
		Secure forms, straight and level
		Mark expansion locations
		Prohibited Practices: Placement on frozen sub-grade
701.41: Placement (Concrete Discharging)	Two (2)	Direct concrete trucks
		Handle chute discharge and truck movement
		Assist in preparing concrete for testing
		Direct trucks to washout area
		Provide general help
		Prohibited Practices: Adding constituent materials not in conformance with AASHTO M 157 or without Department consent
701.41: Placement	Two (2)	Localize placement to minimize moving material
		Level concrete in front of the screed
		Operate come-alongs or flat headed shovel to move concrete in form
		Consolidate concrete along form edge to avoid honeycombing
		Operate screed over top of forms in sawing action for surface leveling
		Operate magnesium bull float to push coarse aggregate below the surface and fill in the low spots or depressions
		Prohibited Practices: Toothed raking, dragging of internal vibrator, and internal vibrator to move concrete; steel troweling or floating
701.42: Initial Curing	Apply an initial curing material and procedure per 701.42	
	One (1)	701.30.C.1: Liquid-Applied Evaporation Reducers
701.43: Finishing	Two (2)	Permit bleed water to dissipate and concrete to set
		Operate a hose drag or squeegee to remove water from the surface
		Check surface for flatness, fill/cut as necessary
		Finish surface with magnesium float
		Apply pulled broom finish at proper time to acceptable texture
		Clean broom when excessive mortar adheres
		Remove excess water from broom before use
		Finish edges and joints
		Finish well formed, properly spaced joints to sufficient depth
Prohibited Practices: Steel troweling or floating; adding water to the surface; excessive working of surface; pushing broom across surface		

<sup>[1]</sup> Recommended number of operators.

**Table 701.62-2: Minimum Operator Activities (Continued)**

<b>Operation</b>	<b>Operators<sup>[1]</sup></b>	<b>Activity</b>
701.44: Intermediate Curing	If applicable, apply an intermediate curing material and procedure per 701.44	
	One (1)	701.30.C.1: Liquid-Applied Evaporation Reducers
	One (1)	701.30.E.3.a: Liquid Membrane-Forming Compounds
	One (1)	701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing
701.45: Final Curing	Apply a final curing material and procedure meeting 701.45	
	Four (4)	701.30.E.1: Saturated Covers
	Four (4)	701.30.E.2: Sheet Materials
	One (1)	701.30.E.3.a: Liquid Membrane-Forming Compounds
	One (1)	701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing
701.46: Protective Sealing	One (1)	If applicable, apply a protective sealing material and procedure per 701.46
701.47: Cold Weather Concreting	Four (4)	If applicable, apply cold weather concreting materials and procedures per 701.47 and the Department approved Contractor cold weather concreting plan
701.48: Hot Weather Concreting	Four (4)	If applicable, apply hot weather concreting materials and procedures per 701.48 and the Department approved Contractor hot weather concreting plan

<sup>[1]</sup> Recommended number of operators.

**701.63: Quality Control Inspection**

Quality Control inspection shall be performed and reported on inspection report forms by qualified Quality Control Technicians, to confirm conformance to specifications and to visually inspect equipment, environmental conditions, materials, and workmanship. Quality Control Technicians shall obtain at least one of the following personnel certifications.

- NRMCA Concrete Exterior Finisher Certification
- ACI Concrete Flatwork Technician and Flatwork Finisher

Quality Control inspection report forms shall be completed by the Contractor and submitted to the Department for review.

**DEPARTMENT ACCEPTANCE**

**701.70: General**

Acceptance shall be performed by the Department, including consultants under direct contract with the Department independent of the Contractor, to evaluate the degree of compliance with contract requirements, to monitor each Contractor entity’s Quality Control activities, to determine the

corresponding value for a given product, and to determine the acceptability of all material produced and placed.

**701.71: Acceptance of Contractor Quality Control Plan**

The Department will review the Contractor Quality Control Plan. Department approval shall be subject to conformance with the requirements specified herein.

**701.72: Acceptance Inspection**

Acceptance inspection will be performed and reported by qualified Department (or designee) Acceptance Technicians, to confirm conformance to specifications and to visually inspect equipment, environmental conditions, materials, and workmanship.

**701.73: Acceptance Sampling and Testing**

Acceptance sampling and testing will be performed and reported by qualified Department (or designee) Acceptance Technicians, to provide quality characteristic data used for Department Acceptance determination, per the requirements specified herein.



**Table 701.73-1: Minimum Acceptance Sampling and Testing Requirements**

Property	Method	Quality Characteristic	Sublot Size	Minimum Test Frequency	Point of Sampling	Criteria
Uniformity	T 119	Slump Allowable Tolerance (in.) <sup>[1]</sup>	100 cy	1 per Sublot	Point of Discharge	Target $\pm$ 1.5
Workability	T 119	Segregation Resistance <sup>[2]</sup>	100 cy	1 per Sublot	Point of Discharge	Pass
Thermal	T 309	Concrete Temperature ( $^{\circ}$ F)	100 cy	1 per Sublot	Point of Discharge	50 – 90
Strength	T 22	Compressive Strength at 7 Days for Curing Termination (psi) <sup>[3]</sup>	100 cy	1 per Sublot	Point of Discharge	$\geq$ 70% $f'_c$
		Compressive Strength at 28 Days (psi) <sup>[3]</sup>	100 cy	1 per Sublot	Point of Discharge	$\geq$ 100% $f'_c$
		Compressive Strength at 56 Days (psi) <sup>[3][4]</sup>	100 cy	1 per Sublot	Point of Discharge	$\geq$ 100% $f'_c$
Durability	T 121 T 152 T 196	Freezing and Thawing Resistance: Air Content (%)	100 cy	1 per Sublot	Point of Discharge	5.5 – 8.5
	T 303 or C1567	Alkali Silica Reaction Resistance: Expansion at 14 Days (%)	–	1 per Annual Mix Design Submission Cycle	–	$\leq$ 0.08

<sup>[1]</sup> Test result and the Producer's mix design target shall be within the specified allowable tolerances. Slump shall be reported on the Producer's mix design batch ticket for each delivery.

<sup>[2]</sup> Testing for segregation resistance shall be performed while the concrete is being discharged and during AASHTO T 119 Standard Method of Test for Slump of Hydraulic Cement Concrete. Visual signs of segregation include coarse particles advancing in front of or behind the fine particles and mortar and a tendency for coarse aggregate to separate from the mortar, particularly when the mixture is being consolidated.

<sup>[3]</sup> Three (3) 4 x 8 in. compressive strength cylinders shall be cast and tested for each age per sublot.

<sup>[4]</sup> Testing only required if compressive strength results at 28 days do not conform with specifications.

## COMPENSATION

### 701.80: Method of Measurement

Cement Concrete Sidewalks, Pedestrian Curb Ramps, and Driveways will be measured in square yards.

Excavation will be measured by the cubic yard as specified in 120.80: Method of Measurement.

Gravel Borrow will be measured by the cubic yard as specified in 150.80: Method of Measurement.

Fine grading and compacting will be measured by the square yard as specified in 170.88: Method of Measurement.

**701.81: Basis of Payment**

Cement Concrete Sidewalk, Cement Concrete Pedestrian Curb Ramp, and Cement Concrete Driveway will be paid for at the contract unit price per square yard complete in place, including detectable warning panels and all incidental materials, labor, and equipment necessary to complete the work to the satisfaction of the Engineer.

Gravel will be paid for at the contract unit price per cubic yard under Item 151: Gravel Borrow.

Fine grading and compacting will be paid for at the contract unit price per square yard under Item 170: Fine Grading and Compacting – Subgrade Areas.

Excavation will be paid for at the contract unit price per cubic yard under the excavation items.

**701.82: Payment Items**

701.	Cement Concrete Sidewalk.....	Square Yard
701.1	Cement Concrete Sidewalk Driveways .....	Square Yard
701.2	Cement Concrete Pedestrian Curb Ramp .....	Square Yard

## GUIDE TO THE INTERIM SUBSECTION 701 CEMENT CONCRETE SIDEWALK SPECIFICATION

### MATERIALS ACTIVITIES

Section	Activity	
<b>701.30.A</b>	<b>Combined Aggregate System</b>	
701.30.A.1	The mix design's combined aggregate system should meet Table 701.30-1: Tarantula Curve Particle Size Distribution.	Recommendation
701.30.A.2	The mix design's combined aggregate system should meet Table 701.30-2 / Figure 701.30-1: Shilstone Workability-Coarseness.	Recommendation
701.30.A.3	The mix design's combined aggregate system should be analyzed using the Fineness Modulus.	Recommendation
701.30.A.4	The mix design's combined aggregate system should be analyzed using the Coarse Aggregate Content.	Recommendation
<b>701.30.B</b>	<b>Paste System</b>	
701.30.B.1	The mix design's Water-Cementitious Ratio should be $\leq 0.40$ (Table 701.30-3: Freezing, Thawing, and De-icing Resistance).	Recommendation
701.30.B.1	The mix design's Water-Cementitious Ratio shall be $\leq 0.45$ (Table 701.30-3: Freezing, Thawing, and De-icing Resistance).	Required
701.30.B.2	The mix design's Air Content should approach the recommended Air Content Targets identified in Table 701.30-4: Freezing, Thawing, and De-icing Resistance.	Recommendation
701.30.B.3	The mix design's Cement and Supplementary Cementitious Materials (SCM) Content shall meet Table 701.30-5: Alkali Silica Reaction and Freezing, Thawing, and De-icing Resistance requirements.	Requirement
701.30.B.3	Test results meeting Table 701.30-6: Alternative Performance Evaluation to Alkali Silica Reaction Resistance requirements may be used in lieu of the mix design requirements identified in Table 701.30-5: Alkali Silica Reaction and Freezing, Thawing, and De-icing Resistance requirements.	Optional
701.30.B.4	The mix design should incorporate Chemical Admixtures identified in Table 701.30-7: Chemical Admixtures to enhance the properties of the concrete.	Recommendation
701.30.B.5	The mix design's Paste Content should approach the recommended targets identified in Table 701.30-8: Paste Content.	Recommendation

<b>701.73</b>	<b>Acceptance Sampling and Testing</b>	
T 119	The Slump shall meet Table 701.71-1: Minimum Acceptance Sampling and Testing Requirements ( $\pm 1.5$ from Slump Target identified by the Concrete Producer on the Batch Ticket).	Requirement
T 119	The Segregation Resistance shall meet Table 701.71-1: Minimum Acceptance Sampling and Testing Requirements.	Requirement
T 309	The Concrete Temperature shall meet Table 701.71-1: Minimum Acceptance Sampling and Testing Requirements.	Requirement
T 22	The Compressive Strength (7, 28, and 56 days) shall meet Table 701.71-1: Minimum Acceptance Sampling and Testing Requirements.	Requirement
T 121 T 152 T 196	The Air Content shall meet Table 701.71-1: Minimum Acceptance Sampling and Testing Requirements (5.5 – 8.5%).	Requirement
T 303 or C1567	The resistance to Alkali Silica Reaction shall meet Table 701.71-1: Minimum Acceptance Sampling and Testing Requirements (One per year for mix design verification).	Requirement

**CONTRACTOR ACTIVITIES**

<b>Section</b>	<b>Activity</b>	
<b>701.40</b>	<b>Pre-Placement</b>	
	The Contractor should have a minimum of two (2) Operators.	Recommendation
	The Contractor shall apply sufficient base compaction.	Requirement
	The Contractor shall moisten sub-base, free of standing water.	Requirement
	The Contractor shall secure forms, straight and level.	Requirement
	The Contractor shall mark expansion locations.	Requirement
	The Contractor shall be prohibited from performing the following practices: Placement on frozen sub-grade.	Requirement
<b>701.41</b>	<b>Placement (Concrete Discharging)</b>	
	The Contractor should have a minimum of two (2) Operators.	Recommendation
	The Contractor shall direct concrete trucks.	Requirement
	The Contractor shall handle chute discharge and truck movement.	Requirement
	The Contractor shall assist in preparing concrete for testing.	Requirement
	The Contractor shall direct trucks to washout area.	Requirement
	The Contractor shall provide general help.	Requirement

	The Contractor / Concrete Producer shall be prohibited from performing the following practices: Adding constituent materials not in conformance with AASHTO M 157 or without Department consent.	Requirement
<b>701.41</b>	<b>Placement</b>	
	The Contractor should have a minimum of two (2) Operators.	Recommendation
	The Contractor shall localize placement to minimize moving material.	Requirement
	The Contractor shall level concrete in front of the screed.	Requirement
	The Contractor shall operate come-alongs or flat headed shovel to move concrete in form.	Requirement
	The Contractor shall consolidate concrete along form edge to avoid honeycombing.	Requirement
	The Contractor shall operate screed over top of forms in sawing action for surface leveling.	Requirement
	The Contractor shall operate magnesium bull float to push coarse aggregate below the surface and fill in the low spots or depressions.	Requirement
	The Contractor shall be prohibited from performing the following practices: Toothed raking, dragging of internal vibrator, and internal vibrator to move concrete; steel troweling or floating.	Requirement
<b>701.42</b>	<b>Initial Curing (When Applicable)</b>	
	The Contractor should have a minimum of one (1) Operator.	Recommendation
	The Contractor shall apply 701.30.C.1: Liquid-Applied Evaporation Reducers when applicable.	Required when applicable
<b>701.43</b>	<b>Finishing</b>	
	The Contractor should have a minimum of two (2) Operators.	Recommendation
	The Contractor shall permit bleed water to dissipate and concrete to set.	Requirement
	The Contractor shall operate a hose drag or squeegee to remove water from the surface.	Requirement
	The Contractor shall check surface for flatness, fill/cut as necessary.	Requirement
	The Contractor shall finish surface with magnesium float.	Requirement
	The Contractor shall apply pulled broom finish at proper time to acceptable texture.	Requirement
	The Contractor shall clean broom when excessive mortar adheres.	Requirement
	The Contractor shall remove excess water from broom before use.	Requirement

	The Contractor shall finish edges and joints.	Requirement
	The Contractor shall finish well formed, properly spaced joints to sufficient depth.	Requirement
	The Contractor shall be prohibited from performing the following practices: Steel troweling or floating; adding water to the surface; excessive working of surface; pushing broom across surface.	Requirement
<b>701.44</b>	<b>Intermediate Curing (When Applicable, Apply One of the Methods)</b>	
	The Contractor should have a minimum of one (1) Operator.	Recommendation
	The Contractor shall apply 701.30.C.1: Liquid-Applied Evaporation Reducers when applicable and if selected.	Required when applicable
	The Contractor shall apply 701.30.E.3.a: Liquid Membrane-Forming Compounds when applicable and if selected.	Required when applicable
	The Contractor shall apply 701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing when applicable and if selected.	Required when applicable
<b>701.45</b>	<b>Final Curing (Apply One of the Methods)</b>	
	The Contractor should meet the minimum number of operators identified in Table 701.62-2: Minimum Operator Activities.	Recommendation
	The Contractor shall apply 701.30.E.1: Saturated Covers if selected.	Requirement
	The Contractor shall apply 701.30.E.2: Sheet Materials if selected.	Requirement
	The Contractor shall apply 701.30.E.3.a: Liquid Membrane-Forming Compounds if selected.	Requirement
	The Contractor shall apply 701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing if selected.	Requirement
<b>701.46</b>	<b>Protective Sealing (If Required)</b>	
	The Contractor should have a minimum of one (1) Operator.	Recommendation
	The Contractor shall apply 701.30.F: Protective Sealing Compounds at least 28 days after placement. Application of 701.30.F: Protective Sealing Compounds is <b>NOT REQUIRED IF 701.30.E.3.b: Liquid Membrane-Forming Compounds for Curing and Sealing was applied.</b>	Required if 701.30.E.3.b Curing and Sealing Compound was Not Applied
<b>701.47</b>	<b>Cold Weather Concreting (When Applicable)</b>	
	The Contractor should have a minimum of four (4) Operators.	Recommendation
	The Contractor shall submit a Cold Weather Concreting Plan meeting 701.47.	Required when applicable

	The Contractor shall apply cold weather concreting materials and procedures meeting 701.47 and the Department approved Contractor cold weather concreting plan.	Required when applicable
<b>701.48</b>	<b>Hot Weather Concreting (When Applicable)</b>	
	The Contractor should have a minimum of four (4) Operators.	Recommendation
	The Contractor shall submit a Hot Weather Concreting Plan meeting 701.48.	Required when applicable
	The Contractor shall apply hot weather concreting materials and procedures meeting 701.47 and the Department approved Contractor hot weather concreting plan.	Required when applicable
<b>701.61</b>	<b>Contractor Quality Control Plan</b>	
	The Contractor shall prepare and submit a Quality Control Plan (QC Plan) to the Department for review.	Requirement
<b>701.62</b>	<b>Production Personnel</b>	
701.62.A	Foreman	
	The Contractor shall have a minimum of One (1) Foreman.	Requirement
	A Foreman shall be present throughout the entire duration of the construction operation with at least one of the following personnel certifications. <ul style="list-style-type: none"> <li>• NRMCA Concrete Exterior Finisher Certification</li> <li>• ACI Concrete Flatwork Technician and Flatwork Finisher</li> </ul>	Requirement
	The Contractor’s Foreman shall review and compare batch ticket quantities and sources to approved mix design.	Requirement
	The Contractor’s Foreman shall monitor conformance to AASHTO M 157 Standard Specification for Ready-Mixed Concrete.	Requirement
	The Contractor’s Foreman shall monitor conformance to Department specifications.	Requirement
	The Contractor’s Foreman shall monitor Production Personnel activities.	Requirement
	The Contractor’s Foreman shall verify that proper equipment is on hand prior to start of construction.	Requirement
	The Contractor’s Foreman shall monitors equipment, environmental conditions, materials, and workmanship.	Requirement
	The Contractor’s Foreman shall prohibit the use of prohibited equipment and practices.	Requirement
	The Contractor’s Foreman shall acknowledge sampling, testing, and inspection results.	Requirement

701.62.B	<b>Operators</b>	
	Concrete sidewalk shall be constructed by sufficiently staffed, trained, experienced, and qualified equipment operators and craftsmen, who are presently involved in sidewalk construction, throughout the entire duration of the construction operation, per the requirements specified in Sections 701.40 to 701.48.	Requirement
<b>701.63</b>	<b>Quality Control Inspection</b>	
	<p>Quality Control inspection shall be performed and reported on inspection report forms by qualified Quality Control Technicians, to confirm conformance to specifications and to visually inspect equipment, environmental conditions, materials, and workmanship. Quality Control Technicians shall obtain at least one of the following personnel certifications.</p> <ul style="list-style-type: none"> <li>• NRMCA Concrete Exterior Finisher Certification</li> <li>• ACI Concrete Flatwork Technician and Flatwork Finisher</li> </ul> <p>Quality Control inspection report forms shall be completed by the Contractor and submitted to the Department for review</p>	Requirement



DOCUMENT 00715



## SUPPLEMENTAL SPECIFICATIONS

MARCH 31, 2024

The 2024 *Standard Specifications for Highways and Bridges* are amended by the following modifications, additions and deletions. These Supplemental Specifications prevail over those published in the Standard Specifications.

The Specifications Committee has issued these Supplemental Specifications for inclusion into each proposal until such time as they are updated or incorporated into the next Standard Specifications.

Contractors are cautioned that these Supplemental Specifications are dated and will change as they are updated.

### DIVISION I

### GENERAL REQUIREMENTS AND COVENANTS

### SECTION 4: SCOPE OF WORK

#### Subsection 4.06: Increased or Decreased Contract Quantities

*Replace the second paragraph with the following:*

Where the actual quantity of a pay item varies by more than 25% above or below the estimated quantity stated in the Contract, an equitable adjustment in the Contract Price for that pay item shall be negotiated upon demand of either party regardless of the cause of the variation in quantity. A demand for an equitable adjustment must be submitted to the other party within 30 days after beginning the work of the affected item that is greater than 25% above the bid quantity or within 30 days after completing the work when the actual quantity is 25% less than the bid quantity.

## DIVISION II

### CONSTRUCTION DETAILS

#### DIVISION II: Construction Details

Replace M4.02.15 Cement Mortar with M4.04.0 Grout, Mortar, and Concrete Products where encountered, including in sections 230.40, 485.40, 501.40, 685.40, 940.40A and 983.40.

### SECTION 100: EARTHWORK, GRADING, DEMOLITION, RODENT CONTROL AND BORINGS

#### SECTION 160: CONTROLLED LOW-STRENGTH MATERIAL

##### Section 160: Controlled Low-Strength Material

Add this new Section:

##### DESCRIPTION

#### **160.20: General**

Controlled Low-Strength Material shall be installed in accordance with the relevant provisions of Subsection 150: Embankment, Section 901: Cement Concrete and in accordance with the procedures described herein.

Controlled Low Strength Materials (CLSM) shall be a self-compacting, self-leveling, flowable, excavatable or non-excavatable, low strength, rigid setting, and unshrinkable material, used as an alternative to compacted granular fills, including backfill, structural fill, utility fill, pavement base, subgrade, subbase, base course, conduit bedding, erosion control, and void filling.

##### MATERIALS

#### **160.40: General**

Material for controlled low-strength material shall meet the requirement specified of M4.08.0 Controlled Low-Strength Material. The material shall be specified by the Engineer as one of the following types;

- CLSM – Manual Excavatable ( $\leq 100$  psi)
- CLSM – Mechanical Excavatable (101-300 psi)
- CLSM – Structural Non Excavatable ( $> 300$  psi)

Permeability testing as specified in Table M4.08.0-2 shall be required when the material is placed outside of roadway areas or footings for concrete structures, or as directed by the Engineer.

##### CONSTRUCTION METHODS

#### **160.60: General**

The Contractor shall submit a placement plan for Controlled Low-Strength Material (CLSM). The plan shall include the type of CLSM, detailed descriptions of methods used for placing and containing the controlled density fill and the set time to strength.

The Contractor shall remove all debris prior to placing the fill. Fill shall not be placed against any structural elements or utilities unless approved by the Engineer.

CLSM shall be poured in lifts not exceeding 4 feet to insure stability under the fluid effects of the pour. Care shall be taken to ensure the integrity of the forms or other means of supporting the material until the material sets up.

COMPENSATION

**160.80: Method of Measurement**

Controlled Low-Strength Material shall be measured by the cubic yard in place to the neat lines established on the plans or specified by the Engineer. When backfilling pipes the horizontal neat lines shall be not greater than 3.0 ft. greater than the rated inside diameter of the pipe and vertically from the top of the crushed stone foundation material, if any, or 6 in. below the pipe invert whichever is less to the specified top elevation. A deduction shall be made for the volume of the pipe or conduit encased.

**160.81: Basis of Payment**

Payment under this item shall constitute full compensation for the placement, testing, and all material, equipment and labor to complete the work.

**160.82: Payment Items**

- 160.1      Controlled Low-Strength Material - ..... Cubic Yard  
Manual Excavatable ( $\leq$  100 PSI)
- 160.2      Controlled Low-Strength Material - ..... Cubic Yard  
Mechanical Excavatable (101-300 PSI)
- 160.3      Controlled Low-Strength Material (>300 PSI) ..... Cubic Yard

**SECTION 200: DRAINAGE**

**SECTION 201: BASINS, MANHOLES AND INLETS**

Section 201.40: General

Replace "Cement Mortar ..... M4.02.15" with "Mortar ..... M4.04.0".

**SECTION 690: HIGHWAY GUARD, FENCES AND WALLS**

**SECTION 690: WALLS REMOVED AND RESET**

Section 690.40: General

Replace the last sentence with the following:

Mortar shall meet the requirement of M4.04.0: Grout, Mortar, and Concrete Products.

**SECTION 800: TRAFFIC CONTROL DEVICES**

**SECTION 825: RECTANGULAR RAPID FLASHING BEACONS**

Section 825: Rectangular Rapid Flashing Beacons

Add this new Section:

DESCRIPTION

**825.20: General**

This work shall consist of furnishing and installing a solar-powered, actuated, Rectangular Rapid Flashing Beacon (RRFB) system at the location(s) shown in the Plans.

MATERIALS

**825.40: General**

Rectangular Rapid-Flashing Beacons shall meet the requirements specified in the following Subsections of Division III, Materials:

Cement Concrete.....	M4.02.00
Signal Posts and Bases .....	M10.05.1
APS Pushbuttons.....	M10.09.1
RRFB Assemblies.....	M10.11.0

An RRFB system shall include the following items (quantities shown in the Major Items List found in the Plans):

- Cement Concrete Foundation
- Signal Post and Pedestal Base
- APS Pushbutton
- Light Bar
- Signage
- Enclosure for Controller, Activation Unit, and Battery System
- Solar Panel
- All mounting and supporting hardware and wiring necessary to complete a working system

The Contractor shall supply cement concrete foundations per the Plans.

The Contractor shall supply Schedule 80 aluminum signal posts with a brushed or spun finish and square, pedestal aluminum bases with a natural finish unless otherwise shown in the Plans or Special Provisions.

Each Light Bar shall have a pair of yellow beacons facing one or both directions of traffic, as shown in the Plans.

All sign designs shall conform to the MUTCD. Sign panel information, including dimensions, shall be per the Plans.

The warning signs (MUTCD code W11-2, W11-15, or S1-1 signs – see Plans for sign type), and the diagonal downward arrow sign (W16-7P) signs shall be on Type A substrate, conforming to 828.42: Panels. The sign sheeting shall be fluorescent yellow-green, conforming to ASTM D4956 Type IX.

An R10-25 sign, conforming to the MUTCD, shall be mounted above the APS Pushbutton on a Type A substrate or may be integral to the button assembly.

The solar panel and battery system may be integrated into a single unit or housed separately, per the manufacturer’s design. These may also be co-housed with the Light Bar and/or the Controller and Activation Unit.

The solar panel and battery system shall be sized appropriately to accommodate 300 actuations per day, 365 days a year, for the duration of the repeating flashing sequence shown in the Plans. The sizing calculations shall be based upon solar and temperature conditions for a typical December-January in Massachusetts. The system shall have a minimum autonomy of 5 days.

Each assembly shall be rated for wind speeds of up to 90 mph.

Any proprietary software required for the programming and/or operation of the system during its lifetime shall be included at no additional cost.

**825.41: Shop Drawings**

Within 30 days from the Notice to Proceed the Contractor shall submit shop drawings for the RRFB system, including cutsheets for all components to show conformance with M10.05, M10.09.1, and M10.11.0 and these specifications.

Shop drawings shall include all solar and battery sizing calculations. These calculations shall have Contractor- or manufacturer-supplied, site-specific shading factors applied.

#### **825.42: Material Warranties**

All RRFB components shall include a minimum 1-year manufacturer's replacement warranty for manufacturing or installation defects starting at the date of acceptance by the Engineer. A battery shall be considered defective should it not retain 80% of its original capacity within the warranty period.

### CONSTRUCTION METHODS

#### **825.60: General**

RRFBs shall be installed on new foundations at the locations as shown in the Plans. Bases shall be secured to the foundation in accordance with the manufacturer's specifications.

All systems shall be installed per the manufacturer's instructions.

The location and orientation of the system shall be per the Plans.

The arrow on each APS pushbutton shall be aligned parallel to the direction of travel of the crosswalk.

The Light Bar(s) shall be oriented towards the incoming lane(s).

Solar panels shall be oriented to maximize sunlight gain.

### SYSTEM OPERATION

#### **825.70: APS Pushbuttons**

APS Pushbuttons shall actuate the RRFB system. Upon actuation, an audible speech message shall be broadcast from each pushbutton in the system that says, "Warning lights are flashing," shall be stated twice. This message shall be repeated upon each actuation. No other messages shall be allowed.

While the system is in dark mode, the APS Pushbuttons shall broadcast a locator tone. The locator tone shall have a duration of 0.15 seconds or less and shall repeat at 1-second intervals at all times that the system is in dark mode. The locator tone shall be set 2 to 5 dBA above ambient sound, shall automatically adjust intensity, but cap at a maximum volume of 100 dBA.

APS Pushbuttons shall have all other vibrotactile and percussive indications disabled.

#### **825.71: Light Bar**

The Light Bar shall remain dark until actuated.

Upon actuation, all Light Bars in the system shall be activated simultaneously for a predetermined repeating flash sequence. The flashing rate shall be 75 flashing sequences per minute.

The left and right yellow beacons shall operate using the following sequence:

- A. The yellow beacon on the left-hand side shall be illuminated for approximately 50 milliseconds.
- B. Both yellow beacons shall be dark for approximately 50 milliseconds.
- C. The yellow beacon on the right-hand side shall be illuminated for approximately 50 milliseconds.
- D. Both yellow beacons shall be dark for approximately 50 milliseconds.
- E. The yellow beacon on the left-hand side shall be illuminated for approximately 50 milliseconds.
- F. Both yellow beacons shall be dark for approximately 50 milliseconds.
- G. The yellow beacon on the right-hand side shall be illuminated for approximately 50 milliseconds.
- H. Both yellow beacons shall be dark for approximately 50 milliseconds.
- I. Both yellow beacons shall be illuminated for approximately 50 milliseconds.
- J. Both yellow beacons shall be dark for approximately 50 milliseconds.

K. Both yellow beacons shall be illuminated for approximately 50 milliseconds.

L. Both yellow beacons shall be dark for approximately 250 milliseconds.

The flash rate of each individual RRFB indication, as applied over the full flashing sequence, shall not be more than 5 flashes per second, to avoid frequencies that might cause seizures.

The sequence shall then be repeated until the duration time has been met and then all yellow beacons shall return to dark mode simultaneously. The duration time shall be per the Plans.

The predetermined repeating flash sequence shall be immediately initiated every time a pushbutton detector is actuated. If the RRFBs are already flashing and an actuation is received, it shall restart the duration time. There shall be no delay time programmed between actuations.

COMPENSATION

**825.80: Method of Measurement**

RRFBs will be measured as a single system, 2-Post Assembly or 3-Post Assembly, furnished and installed.

**825.81: Basis of Payment**

The work will be paid for at the contract price each under the respective item for a 2-Post Assembly System or 3-Post Assembly System. Any additional wiring, mounting equipment, or other materials or labor required to for an operating system per the Plans and Specifications shall be considered as incidental to the construction and be included in the contract price.

**825.82: Payment Item**

825.2	RRFB (2-Post Assembly System) .....	Each
825.3	RRFB (3-Post Assembly System) .....	Each

**SECTION 900: STRUCTURES**

**SECTION 970: DAMP-PROOFING**

Subsection 970.30: General

Add the following material to this subsection:

Mortar.....	M4.04.0
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Subsection 970.40: General

Replace the second sentence in the second paragraph with the following;

All holes in concrete surfaces shall be satisfactorily filled with mortar before damp-proofing is applied.

**SECTION 983: REVETMENT**

Subsection 983.64 Special Slope Paving Under Bridges

Replace the last sentence under B. Quarry Stone or Precast Concrete Blocks. with the following:

Mortar shall then be placed in the joints to the top of the paved surface.

Subsection 983.65 Channel Paving and Grouted Channel Paving

Replace the last sentence with the following:

The grout shall conform to M4.04.0: Grout, Mortar, and Concrete Products.

**DIVISION III**  
**MATERIALS SPECIFICATIONS**

**SECTION M4: CEMENT AND CEMENT CONCRETE MATERIALS**

Section M4.02.00 Cement Concrete

Add the following to the end of this section.

**Alkali Silica Reactivity - Resistant Portland Cement Concrete**

All cement concrete and precast/prestressed concrete products shall be alkali silica reactivity-resistant. Proportion Portland cement concrete mixes to include materials that meet either the aggregate requirement or Alkali-Silica Reactivity (ASR) mitigation criteria listed below. Provide cement mill test reports from certified laboratories that show the materials' source, composition and the cement alkali content expressed as sodium oxide equivalent(s) not to exceed 1.4%. Certified test reports according to test procedures as specified in Table A will be required to be submitted with the trial batch submission to RMS for approval every year or whenever the source of material is changed.

Select non-reactive aggregates that meet all the criteria of Table M4.02.00-2. Mitigate the mix as described below when nonreactive aggregates are unavailable. If non-reactive aggregates are used for portland cement concrete mix, 15% by weight of the cementitious content shall be fly ash meeting AASHTO M 295, Type F.

Select a material or a combination of materials that meet the criteria shown in Table M4.02.00-3 to mitigate ASR when concrete mixes must be proportioned with reactive aggregates. Perform verification test according to AASHTO T 303 and ASTM C295 to determine the effectiveness of the resulting mix design against ASR. Use the same proportion of cement and pozzolan for each test mixture as that proposed for the actual mix design. Provide the Department with certified documentation of the mixtures' effectiveness to control ASR.

**Table M4.02.00-2: Tests and Criteria for Proposed Aggregates**

Procedure	Description	Limits
AASHTO T 303: Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction	Mean mortar bar expansion at 14 days. Perform a polynomial fit <sup>(1)</sup> of 4, 7, 11, and 14 days to determine reliability of results	0.08% maximum metamorphic aggregate; 0.10% maximum all other aggregates. Repeat AASHTO T 303 if r <sup>2</sup> is less than 0.95.
ASTM C295: Petrographic Examination of Aggregates for Concrete	Optically strained, microfractured, or microcrystalline quartz	5.0% maximum <sup>(2)</sup>
	Chert or chalcedony	3.0% maximum <sup>(2)</sup>
	Tridymite or cristobolite	1.0% maximum <sup>(2)</sup>
	Opal	0.5% maximum <sup>(2)</sup>
	Natural volcanic glass	3.0% maximum <sup>(2)</sup>
<sup>(1)</sup> Use a second order polynomial of %Exp = A <sup>0</sup> + A <sup>1</sup> SQRT(t) + A <sup>2</sup> t. See publication SD92-04-F. <sup>(2)</sup> Based on the total aggregate sample.		

**Table M4.02.00-3: Mitigation Methods for ASR in Portland Cement Concrete**

Material	Specification	Cementitious Material Percentage <sup>(1)</sup>
Low alkali cement <sup>(2)</sup>	AASHTO M 85	100%
Fly ash - Class F	AASHTO M 295	15% minimum to 30% <sup>(4)</sup> maximum
Silica Fume <sup>(5)</sup>	AASHTO M 307	6% ± 1% <sup>(6)</sup>
Slag Grade 100 and 120	AASHTO M 302	25% minimum to 50% maximum

<sup>(1)</sup> Measure this minimum content of cementitious material as percent by weight of cement plus pozzolan.  
<sup>(2)</sup> This single criterion is not effective in all cases in remediating ASR. Low alkali cement (0.60% maximum <sup>(3)</sup>) must be used in combination with other pozzolanic materials in Table B.  
<sup>(3)</sup>  $\text{Na}_2\text{O equivalent} = \% \text{Na}_2\text{O} + 0.658 (\% \text{K}_2\text{O})$   
<sup>(4)</sup> Fly ash, Type F, shall replace 15% by weight of the design cement content, and any additional fly ash will be considered as fine aggregate.  
<sup>(5)</sup> Silica fume shall only be used in silica fume cement concrete.  
<sup>(6)</sup> The total amount of Type F fly ash and silica fume shall constitute 20% by weight of the design cement content, and any additional fly ash shall be considered as fine aggregate.

**Section M4.02.15 Cement Mortar**

*Delete this section.*

**Section M4.04.0: Grout, Mortar and Concrete Products**

*Replace this section with the following.*

**M4.04.0: Grout, Mortar, and Concrete Products**

Grout, cementitious mortar, and concrete products shall be packaged, dry, and preblended with preformulated constituent materials (excluding mixing water) to produce a material with acceptable quality characteristics and material properties, including time of set, compressive strength, flexural strength, slant shear bond strength, resistance to alkali silica reaction, freezing/thawing, and de-icing cycles, shrinkage, expansion, and sulfate reaction.

Mortar products shall be defined as products containing aggregate of which less than 5% by mass of the total mixture is retained on the 3/8 in. sieve. Mortar products for concrete repairs shall be used only on repair depths of 2 in. or less. Concrete products shall be defined as products containing aggregate of which 5% or more by mass of the total mixture is retained on the 3/8 in. sieve. Concrete products for concrete repairs shall be used only on repair depths greater than 2 in.

The aggregate sources included in the prepackaged product or extended into the product shall meet Section M4.02.02: Aggregates. Grout, cementitious mortar, and concrete products shall only be applied per the requirements provided on the product's technical data sheet. Grout, cementitious mortar, and concrete products shall maintain valid listing on the MassDOT Qualified Construction Materials List (QCML). Grout, cementitious mortar, and concrete products shall meet requirements specified herein.

**A. Technical Data Sheet.**

The Manufacturer shall submit the product's technical data sheet to the Department for review. At a minimum, the product's technical data sheets shall include:

- (a) Product Name
- (b) Manufacturer, including address and contact information
- (c) Packaging
- (d) Yield
- (e) Product Description, including an overview of the product and its intended application(s) and use(s).
- (f) Technical Data, including quality characteristics and corresponding performance criteria with the AASHTO and/or ASTM standard test methods identified.



- (g) Recommended Equipment
- (h) Instructions, including surface preparation, mixing, forming, placing, finishing, curing, and protection from adverse conditions, such as precipitation, cold conditions, and hot conditions.
- (i) Limitations
- (j) Storage and Shelf Life
- (k) Safety

**B. Mix Design Formulation.**

Products that are extended with aggregate not included in the original product packaging shall be formulated per the product's technical data sheet and evaluated through Department mix design evaluation and verification testing. Producers shall report and submit proposed mix design formulations onto the Department issued mix design sheet. The Producer shall select an AASHTO accredited independent laboratory to conduct verification testing. The sampling and testing conducted by the independent laboratory shall be witnessed by the Department.

**C. Product Verification Testing.**

Verification test results shall be within the limits specified herein.

**M4.04.1: Conventional Grout, Cementitious Mortar, and Concrete Products**

Conventional grout, cementitious mortar, and concrete products shall meet the requirements of Section M4: Cement and Cement Concrete Materials, performance criteria of the product's technical data sheet, and the requirements specified herein.

**M4.04.2: Rapid Hardening Cementitious Mortar and Concrete Products**

Rapid hardening cementitious mortar and concrete products shall meet the requirements and performance criteria of the product's technical data sheet, ASTM C928 Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs, and Table M4.04.2-2.

***Table M4.04.2-1: Types of Rapid Hardening Cementitious Products for Concrete Repairs***

<b>Type</b>	<b>Description</b>	<b>Application</b>
R1	General Rapid Hardening	Vertical and Overhead Repairs
R2	Medium Rapid Hardening	Vertical and Overhead Repairs
R3	Very Rapid Hardening	Horizontal, Vertical, and Overhead Repairs

**Table M4.04.2-2: Verification Testing Requirements**

Property	Method	Quality Characteristic		Limits					
				R1		R2		R3	
				Min.	Max.	Min.	Max.	Min.	Max.
Setting	T 197	Initial Set (min.)		Technical Data Sheet					
		Final Set (min.)		Technical Data Sheet					
Strength	T 97 <sup>[1]</sup>	Flexural Strength (psi)	24 Hours	-	-	-	-	650	-
			7 Days	-	-	-	-	-	-
Durability	T 358	Surface Chloride Ion Penetration Resistance (kΩ-cm)	28 Days	21	-	21	-	21	-
			T 161 (A)	Relative Durability Factor		90	-	90	-
		Mass Loss (%)		-	6.0	-	6.0	-	6.0

[1] Not applicable to vertical and overhead repair applications.

**M4.04.3: Mortar Products for Unit Masonry**

Mortar products for unit masonry shall meet the requirements and performance criteria of the product’s technical data sheet and Type M specified in ASTM C270 Standard Specification for Mortar for Unit Masonry. Field proportioned cement mortar for laying brick and block shall be composed of 1 part Portland cement and 2 parts of fine aggregate by volume with a sufficient amount of water to form a workable mixture, while still achieving the properties specified herein.

**M4.04.4: Grout Products for Unit Masonry**

Grout products for unit masonry shall meet the requirements and performance criteria of the product’s technical data sheet and ASTM C476 Standard Specification for Grout for Masonry.

**M4.04.5: Non-Shrink Grout Products**

Non-shrink grout products are intended for use under applied load, including supporting a structure, transfer medium between load-bearing members, shear keys, and other non-shrink applications, where a change in height below initial placement height is to be avoided. Non-shrink grout products shall meet the requirements and performance criteria of the product’s technical data sheet and ASTM C1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

**SECTION M5: PIPE, CULVERT SECTIONS AND CONDUIT**

Section M5.01.0: Joint Material for Pipe

Replace M4.02.15 Cement Mortar with M4.04.0 Grout, Mortar, and Concrete Products in paragraph B.

**SECTION M8: METALS AND RELATED MATERIALS**

Section M8.18.1: Traffic Signal Supports

Delete the heading Posts and the two paragraphs under it. Delete the heading Bases and the three paragraphs under it.

## SECTION M10: TRAFFIC CONTROL DEVICES

### Section M10.05.0: Traffic Signal Structures (General)

Add this new Section:

#### **M10.05.0: Traffic Signal Structures (General)**

The bases of all Traffic Signal Structures shall be supplied with a bonding lug.

### Section M10.05.1: Signal Posts and Bases

Add this new Section:

#### **M10.05.1: Signal Posts and Bases**

All Signal Posts shall be one-piece 4-in. diameter, Schedule 40 or Schedule 80, and machine-threaded.

Signal Posts may be fabricated from aluminum with a brushed or spun finish or from steel with a galvanized finish.

The interior of Signal Posts shall be coated as specified in Underwriters Laboratories UL-6 for enameled conduit, or aluminum conduit conforming to M5.07.1: Electrical Conduit-Rigid Metallic (Type RM), Paragraph C.

Signal Posts Bases shall be fabricated to accept the threads from the Signal Post and locked into place with set screws.

Signal Post Bases shall be fabricated from aluminum with a natural or anodized finish or galvanized cast iron.

Signal Post Bases shall be square or octagonal.

Signal Posts and Bases conform to Table M10.05.1-1.

**Table M10.05.1-1: Signal Post and Base Material Requirements**

Component	Material	Specification
Signal Post	Aluminum	6063-T6 (ASTM B221, B429 or B241)
Signal Post	Steel	ASTM A53, Grade A or B
Signal Post Base	Aluminum	356.0-T6 (ASTM B26, B108)
Signal Post Base	Cast Iron	AASHTO M 105

### Section M10.11.0: RRFB Assemblies

Add this new Section:

#### **M10.11.0: RRFB Assemblies**

Rectangular Rapid Flashing Beacon (RRFB) Assemblies shall consist of a Light Bar and an enclosure for the Controller and Activation Unit.

##### **Light Bar**

The Light Bar shall consist of two rapidly-flashed rectangular-shaped yellow indications, each with an LED-array based pulsing light source. The size of each RRFB indication shall conform to the Construction Standard Details.

The light intensity of the yellow indications during daytime conditions shall meet the minimum specifications for Class 1 yellow peak luminous intensity in the publication "Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles J595," 2005, Society of Automotive Engineers (SAE). A photocell or equivalent device shall be included to reduce the brilliance of the LED beacons during nighttime conditions.

**Controller and Activation Unit**

The enclosure for the Controller and Activation Unit shall be NEMA rated for outdoor use and protection against rain and sleet.

The Controller and Activation Unit shall be powered by a DC battery/solar array system or a 120 VAC service connection.

The Controller and Activation Unit shall be actuated by a pedestrian pushbutton, a passive pedestrian detection device, or both.

Communications between multiple units within the same system shall be via a 900MHz or 2.4 GHz frequency hopping spread spectrum with a minimum range of 200 ft. Multiple channels shall be available to prevent cross-communication between multiple systems located close to each other.

The Controller shall be programmable via an on-board user interface or a no-fee wireless (Wi-Fi, Bluetooth®, etc.) connection and application.

**\*\*<<<<<<<<<<<<<<>>>>>>>>>>>> \*\***

END OF SUPPLEMENTAL SPECIFICATIONS

DOCUMENT 00719

*(Revised September 14, 2023 – for all Federally Aided Projects)*

**SPECIAL PROVISIONS FOR PARTICIPATION BY  
DISADVANTAGED BUSINESS ENTERPRISES**  
(IMPLEMENTING TITLE 49 OF THE CODE OF FEDERAL REGULATIONS, PART 26)

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## POLICY

The Massachusetts Department of Transportation (MassDOT) receives Federal financial assistance from the Federal Highway Administration (FHWA), United States Department of Transportation (U.S. DOT), and as a condition of receiving this assistance, has signed an assurance that it will comply with 49 CFR Part 26 (Participation By Disadvantaged Business Enterprises In Department Of Transportation Financial Assistance Programs). The U.S. DOT Disadvantaged Business Enterprise Program is authorized by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (“SAFETEA-LU”), as amended, at Title 23, United States Code, § 1101.

Accordingly, MassDOT has established a Disadvantaged Business Enterprise (DBE) Program in accordance with 49 CFR Part 26. It is the policy of MassDOT to ensure that DBEs have an equal opportunity to receive and participate in U.S. DOT assisted Contracts, without regard to race, color, national origin, or sex. To this end, MassDOT shall not directly, or through contractual or other arrangements, use criteria or methods of administration that have the effect of defeating or substantially impairing accomplishment of the program objectives stated below:

- ◆ To ensure nondiscrimination in the award and administration of U.S. DOT assisted Contracts;
- ◆ To create a level playing field on which DBEs can compete fairly for U.S. DOT assisted Contracts;
- ◆ To ensure that the DBE Program is narrowly tailored in accordance with applicable law;
- ◆ To ensure that only firms that fully meet 49 CFR Part 26 eligibility standards are permitted to participate as DBEs;
- ◆ To help remove barriers to the participation of DBEs in U.S. DOT assisted Contracts; and
- ◆ To assist the development of firms that can compete successfully in the market place outside the DBE Program.

The Director of Civil Rights of MassDOT has been designated as the DBE Liaison Officer. The DBE Liaison Officer is responsible for implementing all aspects of the DBE Program. Other MassDOT employees are responsible for assisting the Office of Civil Rights in carrying out this obligation. Implementation of the DBE Program is accorded the same priority as compliance with all other legal obligations incurred by MassDOT in its financial assistance agreements with each operating administration of the U.S. DOT. Information on the Federal requirements and MassDOT’s policies and information can be found at:

<b>Type of Info</b>	<b>Website</b>	<b>Description</b>
MassDOT Highway Division Policies and Info	<a href="https://www.mass.gov/disadvantaged-business-enterprise-goals-2019-2022">https://www.mass.gov/disadvantaged-business-enterprise-goals-2019-2022</a>	MassDOT– Highway Div’n Page
For copies of the Code of Federal Regulations	<a href="http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR">http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR</a>	FDsys – US Gov’t Printing Office
For information about the U.S.DOT DBE Program	<a href="https://www.transportation.gov/civil-rights/disadvantaged-business-enterprise">https://www.transportation.gov/civil-rights/disadvantaged-business-enterprise</a>	U.S. DOT/ FHWA page

## 1. DEFINITIONS

As used in these provisions, the terms set out below are defined as follows:

“Broker”, for purposes of these provisions, shall mean a DBE Entity that has entered into a legally binding relationship to provide goods or services delivered or performed by a third party. A broker may be a DBE Entity that arranges or expedites transactions but performs no work or installation services.

“Contractor”, “General” or “Prime” Contractor, “Bidder,” and “DB Entity” shall mean a person, firm, or other entity that has contracted directly with MassDOT to provide contracted work or services.

“Contract” shall mean the Contract for work between the Contractor and MassDOT.

“DBB” or “Design-Bid-Build” shall mean the traditional design, bid and project delivery method consisting of separate contracts between awarding authority and a designer resulting in a fully designed project; and a separate bidding process and Contract with a construction Contractor or Bidder.

“DB” or “Design-Build” shall mean an accelerated design, bid and project delivery method consisting of a single contract between the awarding authority and a DB Entity, consisting of design and construction companies that will bring a project to full design and construction.

“Disadvantaged Business Enterprise” or “DBE” shall mean a for-profit, small business concern:

- (a) that is at least fifty-one (51%) percent owned by one or more individuals who are both socially and economically disadvantaged, or, in the case of any corporation, in which at least fifty-one (51%) percent of the stock is owned by one or more such individuals; and
- (b) where the management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it.

“FHWA” shall mean the Federal Highway Administration,” an agency within U.S. DOT that supports State and local governments in the design, and maintenance of the Nation’s highway system (Federal Aid Highway Program).

“Good faith efforts” shall mean efforts to achieve a DBE participation goal or other requirement of these Special Provisions that, by their scope, intensity, and appropriateness to the objective, can reasonably be expected to fulfill the program requirement. Such efforts must be deemed acceptable by MassDOT.

“Joint Venture” shall mean an association of a DBE firm and one or more other firms to carry out a single, for-profit business enterprise, for which the parties combine their property, capital, efforts, skills and knowledge, and in which the DBE is responsible for a distinct, clearly defined portion of the work of the Contract and whose share in the capital contribution, control, management, risks, and profits of the joint venture are commensurate with its ownership interest.

“Approved Joint Venture” shall mean a joint venture, as defined above, which has been approved by MassDOT’s Prequalification Office and Office of Civil Rights for DBE participation on a particular Contract.

"Manufacturer" shall mean a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles or equipment required under the contract and of the general character described by the specifications.

"Regular Dealer" shall mean a DBE firm that owns, operates, or maintains a store, warehouse, or other establishment in which materials, supplies, articles or equipment of the general character described by the specifications and required under the Contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business.

- (a) To be a regular dealer, the firm must be an established, regular business that engages, as its principal business, and under its own name, in the purchase and sale of the products in question.
- (b) A person may be a regular dealer in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating, or maintaining a place of business as provided above if the person both owns and operates distribution equipment for the products. Any supplementing of regular dealers' own distribution equipment shall be by long term lease agreement and not on an ad hoc or contract by contract basis.
- (c) Packagers, brokers, manufacturers' representatives, or other persons who arrange or expedite transactions are not regular dealers within the meaning of this definition.

"Responsive" and "Responsible" refers to the bidder's submittal meeting all of the requirements of the advertised request for proposal. The term responsible refers to the ability of the Contractor to perform the work. This ability can be determined prior to bid invitations.

"Small Business or Small Business Concern" shall mean a small business concern or company as defined in Section 3 of the Small Business Act and SBA regulations implementing it (13 CFR Part 121); and is a business that does not exceed the cap on annual average gross receipts established by the U.S. Secretary of Transportation pursuant to 49 CFR Part 26.65; see also 49 CFR Part 26.39.

"SDO" shall mean the Massachusetts Supplier Diversity Office, formerly known as the State Office of Minority and Women Business Assistance (SOMWBA). In 2010, SOMWBA was abolished and the SDO was established. *See* St. 2010, c. 56. The SDO has assumed all the functions of SOWMBA. SDO is an agency within the Commonwealth of Massachusetts Executive office of Administration and Finance (ANF) Operational Services Division (OSD). The SDO mandate is to help promote the development of business enterprises and non-profit organizations owned and operated by minorities and women.

"Socially and economically disadvantaged individuals" shall mean individuals who are citizens of the United States (or lawfully admitted permanent residents) and who are:

- (a) Individuals found by SDO to be socially and economically disadvantaged individuals on a case by case basis.
- (b) Individuals in the following groups, members of which are rebuttably presumed to be socially and economically disadvantaged:



- (1) "Black Americans" which includes persons having origin in any of the Black racial groups of Africa; (2) "Hispanic Americans" which include persons of Mexican, Puerto Rican, Cuban, Dominican, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race; (3) "Native Americans" which include persons who are American Indians, Eskimos, Aleuts, or Native Hawaiians; (4) "Asian Pacific Americans" which includes persons whose origins are from Japan, China, Taiwan, Korea, Burma (Myanmar), Vietnam, Laos, Cambodia (Kampuchea), Thailand, Malaysia, Indonesia, the Philippines, Brunei, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands (Republic of Palau), the Commonwealth of the Northern Marianas Islands, Macao, Fiji, Tonga, Kiribati, Tuvalu, Nauru, Federated States of Micronesia, or Hong Kong; (5) "Subcontinent Asian Americans" which includes persons whose origins are from India, Pakistan, Bangladesh, Bhutan, the Maldives Islands, Nepal or Sri Lanka; (6) Women; or (7) Any additional groups whose members are designated as socially and economically disadvantaged by the Small Business Administration (SBA), at such time as the SBA designation becomes effective.

Other terms and definitions applicable to the U.S. DOT DBE Program may be found at 49 CFR Part 26 and related appendices and guidance pages.

## 2. DBE PARTICIPATION

### a. Goal

On this Contract, MassDOT has established the following goal(s) for participation by firms owned and controlled by socially and economically disadvantaged persons. At least half of the goal must be met in the form of DBE Subcontractor construction activity as opposed to material supplies or other services. The applicable goal remains in effect throughout the life of the contract regardless of whether pre-identified DBE Subcontractors remain on the Project or under Contract.

Design-Bid-Build Projects: DBE Participation Goal 9 %  
(One half of this goal shall be met in the form of Subcontractor construction activity)

Design-Build Projects: DBE Design Participation Goal \_\_\_\_% and DBE Construction Participation Goal \_\_\_\_%  
(One half of the Construction Goal shall be met in the form of Subcontractor construction activity)

### b. Bidders List

Pursuant to the provisions of 49 CFR Part 26.11(c), Recipients such as MassDOT, must collect from all Bidders who seek work on Federally assisted Contracts the firm full company name(s), addresses and telephone numbers of all firms that have submitted bids or quotes to the Bidders in connection with this Project. All bidders should refer to the Special Provision Document "A00801" of the Project proposal for this requirement.

In addition, MassDOT must provide to U.S. DOT, information concerning contractors firm status as a DBE or non-DBE, the age of the firm, and the annual gross receipts of the firm within a series of brackets (e.g., less than \$500,000; \$500,000–\$1 million; \$1–2 million; \$2–5 million, etc.). The status, firm age, and annual gross receipt information will be sought by MassDOT regularly prior to setting its DBE participation goal for submission to U.S. DOT. MassDOT will survey each individual firm for this information directly.

Failure to comply with a written request for this information within fifteen (15) business days may result in the suspension of bidding privileges or other such sanctions, as provided for in Section 9 of this provision, until the information is received.

### **3. CONTRACTOR ASSURANCES**

No Contractor or any Subcontractor shall discriminate on the basis of race color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in all respects and as applicable prior to, or subsequent to, award of U.S. DOT assisted Contracts. The Contractor agrees to affirmatively seek out and consider DBE firms as Contractors, Subcontractors, and/or suppliers of materials and services for this Contract. No Contract will be approved until MassDOT has reviewed Bidders'/Contractors' affirmative actions concerning DBEs. Failure to carry out these requirements is a material breach of this Contract which may result in the termination of the Contract or such other remedy as MassDOT or FHWA deem appropriate.

### **4. REQUIRED SUBCONTRACT PROVISIONS**

The Prime Contractor shall include the provisions of Section 3 above in every subcontract, making those provisions binding on each Subcontractor; in addition, the Prime Contractor shall include a copy of this Special Provision, in its entirety, in every subcontract with a DBE firm which is, or may be, submitted for credit toward the Contract participation goal.

### **5. ELIGIBILITY OF DBES**

Only firms that have been certified by SDO and confirmed by MassDOT as eligible in accordance with 49 CFR Part 26 to participate as DBEs on federally aided MassDOT Contracts may be used on this Contract for credit toward the DBE participation goal.

#### **a. Massachusetts DBE Directory**

MassDOT makes available to all bidders the most current Massachusetts Disadvantaged Business Enterprise Directory. This directory is made available for Contractors' convenience and is informational only. The Directory lists those firms that have been certified as eligible in accordance with the criteria of 49 CFR Part 26 to participate as DBEs on federally aided MassDOT contracts. The Directory also lists the kinds of work each firm is certified to perform but does not constitute an endorsement of the quality of performance of any business and does not represent MassDOT Subcontractor approval.

Contractors are encouraged to make use of the DBE Directory maintained by SDO on the Internet. This listing is updated daily and may be accessed at the SDO's website at:

<https://www.diversitycertification.mass.gov/BusinessDirectory/BusinessDirectorySearch.aspx>

#### **b. DBE Certification**

A firm must apply to SDO, currently acting as certification agent for MassDOT, for DBE certification to participate on federally aided MassDOT Contracts. A DBE application may be made in conjunction with a firm's application to SDO for certification to participate in state-funded minority and women business enterprise programs or may be for DBE certification only. An applicant for DBE certification must identify the area(s) of work it seeks to perform on U.S. DOT funded projects.

### **c. Joint Venture Approval**

To obtain recognition as an approved DBE Joint Venture, the parties to the joint venture must provide to MassDOT's Office of Civil Rights and Prequalification Office, at least fourteen (14) business days before the bid opening date, an Affidavit of DBE/Non-DBE Joint Venture in the form attached hereto, and including, but not limited to the following:

1. a copy of the Joint Venture Agreement;
2. a description of the distinct, clearly defined portion of the contract work that the DBE will perform with its own forces; and,
3. all such additional information as may be requested by MassDOT for the purpose of determining whether the joint venture is eligible.

### **6. COUNTING DBE PARTICIPATION TOWARDS DBE PARTICIPATION GOALS**

In order for DBE participation to count toward the Contract participation goal, the DBE(s) must have served a commercially useful function in the performance of the Contract and must have been paid in full for acceptable performance.

#### **a. Commercially Useful Function**

- (1) In general, a DBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. With respect to materials and supplies used on the Contract, the DBE must be responsible for negotiating price, determining quality and quantity, ordering the material, installing (where applicable) and paying for the material itself.
- (2) To determine whether a DBE is performing a commercially useful function, MassDOT will evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the Contract is commensurate with the work it is actually performing and the DBE credit claimed for its performance of the work, and other relevant factors.
- (3) A DBE does not perform a commercially useful function if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of DBE participation. In determining whether a DBE is such an extra participant, MassDOT will examine similar transactions, particularly those in which DBEs do not participate.

#### **b. Counting Participation Toward The Contract Participation Goal**

DBE participation which serves a commercially useful function shall be counted toward the DBE participation goal in accordance with the Provisions of 49 CFR Part 26.55(a) to (h), as follows:

- (1) When a DBE participates in a construction Contract, MassDOT will count the value of the work performed by the DBE's own forces. MassDOT will count the cost of supplies and materials obtained by the DBE for the work of its contract, including supplies purchased or equipment leased by the DBE. Supplies, labor, or equipment the DBE Subcontractor uses, purchases, or leases from the Prime Contractor or any affiliate of the Prime Contractor will not be counted.

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- (2) MassDOT will count the entire amount of fees or commissions charged by a DBE firm for providing bona fide services, such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of a U.S. DOT assisted Contract, toward DBE participation goals, provided it is determined that the fee is reasonable and not excessive as compared with fees customarily allowed for similar services.
  - (3) When a DBE performs as a participant in a joint venture, MassDOT will count toward DBE participation goals a portion of the total dollar value of the contract that is equal to the distinct, clearly defined portion of the work of the Contract that the DBE performs with its own forces.
  - (4) MassDOT will use the following factors in determining whether a DBE trucking company is performing a commercially useful function:
    - (i) the DBE must be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract; there cannot be a contrived arrangement for the purpose of meeting DBE participation goals.
    - (ii) the DBE must itself own and operate at least one fully licensed, insured, and operational truck used on the Contract.
    - (iii) the Contractor will receive DBE credit for the total value of the transportation services the DBE provides on the Contract using trucks owned, insured, and operated by the DBE itself and using drivers the DBE employs alone.
    - (iv) the DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The Contractor who has a contract with a DBE who leases trucks from another DBE will receive credit for the total value of the transportation services of the lease.
    - (v) the DBE may also lease trucks from a non-DBE firm, including an owner-operator. The Contractor who has a Contract with a DBE who leases trucks from a non-DBE is entitled to credit for the total value of the transportation services provided by non-DBE lessees not to exceed the value of transportation services provided by DBE-owned trucks on the Contract. Additional participation by non-DBE lessees receives credit only for the fee or commission it receives as a result of the lease arrangement, fee or commission it receives as a result of the lease arrangement. The DBE does not receive credit for the total value of the transportation services provided by the lessee, since these services are not provided by a DBE.
    - (vi) the lease must indicate that the DBE has exclusive use of, and control over, the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. Leased trucks must display the name and identification number of the DBE.
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- (5) MassDOT will count the Prime Contractor's expenditures with DBEs for materials or supplies toward DBE participation goals as follows:
- (i) if the materials or supplies are obtained from a DBE manufacturer, as defined in Section 1 above, MassDOT will count one hundred (100%) percent of the cost of the materials or supplies toward DBE participation goals, provided the DBE meets the other requirements of the regulations.
  - (ii) if the materials or supplies are purchased from a DBE regular dealer, as defined in Section 1 above, MassDOT will count sixty (60%) percent of the cost of the materials or supplies toward the Contract participation goal, provided the DBE meets the other requirements of the regulations.
  - (iii) for materials or supplies purchased from a DBE which is neither a manufacturer nor a regular dealer, MassDOT will count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site toward the Contract participation goal, provided that MassDOT determines the fees to be reasonable and not excessive as compared with fees customarily allowed for similar services; the cost of the materials and supplies themselves will not be counted; and provided the DBE meets the other requirements of the regulations.

### **c. Joint Check Policy**

MassDOT recognizes that the use of joint checks may be a business practice required by material suppliers and vendors in the construction industry. A joint check is a two-party check issued by a/the Prime Contractor to a DBE third party such as a regular dealer of material or supplies. The Prime Contractor issues the check as payor to the DBE and the third party jointly as payees to guarantee payment to the third party for materials or supplies obtained or to be used by the DBE. FHWA has established criteria to ensure that DBEs are in fact performing a commercially useful function ("CUF") while using a joint check arrangement. Contractors and DBEs must meet and conform to these conditions and criteria governing the use of joint checks.

In the event that a Contractor or DBE Subcontractor desires to use a joint check, MassDOT will require prior notice and will closely monitor the arrangement for compliance with FHWA regulations and guidance. MassDOT may allow a joint check arrangement and give credit to a Contractor for use of the DBE where one or more of the following conditions exist:

- The use of a joint check is in fact required by this type of vendor or supplier as a standard industry practice that applies to all Contractors (DBEs and non-DBEs); or is required by a specific vendor or supplier;
- Payment for supplies or materials would be delayed for an unreasonably extended period without the joint check arrangement;
- The DBE (or any of its Subcontractors) has a pattern or history of not paying a vendor or supplier within a reasonable time or has not established enough of a credit history with the supplier or vendor; and/or
- The presence of severe adverse economic conditions, where credit resources may be limited and such practices may be necessary or required to effect timely payments.

Other factors MassDOT may consider:

- Whether there is a requirement by the Prime Contractor that a DBE should use a specific vendor or supplier to meet their Subcontractor specifications;
- Whether there is a requirement that a DBE use the Prime Contractor's negotiated price;
- The independence of the DBE;
- Whether approval has been sought prior to use of a joint check arrangement; and
- Whether any approved joint check arrangement has exceeded a reasonable period of use;
- The operation of the joint check arrangement; and
- Whether the DBE has made an effort to establish alternate arrangements for following periods ( i.e., the DBE must show it can, or has, or why it has not, established or increased a credit line with the vendor or supplier).

Even with the use of a Joint Check, both the Contractor and DBE remain responsible for compliance with all other elements under 49 CFR § 26.55 (c) (1), and must still be able to prove that a commercially useful function is being performed for the Contractor.

#### **d. Joint Check Procedure(s)**

- The DBE advises its General or Prime Contractor that it will have to use a Joint Check and provide proof of such requirement.
- The General or the Prime Contractor submits a request for approval to MassDOT, using MassDOT's approved Joint Check Request form (Document B00855) and by notification on the DBE Letter of Intent (Document B00854), and any other relevant documents. Requests that are not initiated during the bid process should be made in writing and comply with the procedure.
- The MassDOT Office of Civil Rights will review the request and render a decision as part of the approval process for DBE Schedules and Letters of Intent.
- Review and Approval will be project specific and relevant documents will be made part of the project Contract file.
- Payments should be made in the name of both the DBE and vendor or supplier. Payments should be issued and signed by the Contractor as only the guarantor for prompt payment of purchases to the vendor or supplier. The payment to the vendor or supplier should be handled by the DBE (i.e. if possible, funds or the joint check should be processed by the DBE and sent by the DBE to the vendor or supplier).
- MassDOT may request copies of cancelled checks (front and back) and transmittal information to verify any payments made to the DBE and vendor or supplier.
- MassDOT may request other information and documents, and may ask questions of the Contractor, Subcontractor and vendor or supplier prior to, during, and after the project performance to ascertain whether the Subcontractor is performing a commercially useful function and all parties are complying with DBE Program policies and procedures as part of the Subcontractor approval process.

## 7. AWARD DOCUMENTATION AND PROCEDURES

- a. The two lowest bidders/the two bidders with the lowest price per quality score point, shall submit, by the close of business on the third (3<sup>rd</sup>) business day after the bid opening, a completed Schedule of Participation by DBEs (Document B00853) which shall list:
- (1) The full company name, address and telephone number of each DBE with whom the bidder intends to make a commitment.
  - (2) The contract item(s), by number(s) and quantity(ies), if applicable, or specific description of other business activity to be performed by each DBE as set forth in the Letters of Intent. The Bidder shall list only firms which have the capacity to perform, manage and supervise the work proposed in accordance with the requirements of 49 CFR Part 26 and Section **6.b** of these Special Provisions.
  - (3) The total dollar amount to be paid to each DBE. (Bidders are cautioned that at least one half of the participation goal must be met with construction activity work.)
  - (4) The total dollar amount to be paid to each DBE that is eligible for credit toward the DBE participation goal under the counting rules set out in Section **6.b**.
  - (5) The total creditable DBE participation as a percentage of the total bid price.
- b. All firms listed on the Schedule must be currently certified.
- c. The two lowest bidders/the two bidders with the lowest price per quality score point, shall each submit, with their Schedules of Participation, fully completed, signed Letters of Intent (Document B00854) from each of the DBEs listed on the Schedule. The Letters of Intent shall be in the form attached and shall identify specifically the contract activity the DBE proposes to perform, expressed as contract item number, if applicable, description of the activity, NAICS code, quantity, unit price and total price. In the event of discrepancy between the Schedule and the Letter of Intent, the Letter of Intent shall govern.
- d. Evidence of good faith efforts will be evaluated by MassDOT in the selection of the lowest responsible bidder.

All information requested by MassDOT for the purpose of evaluating the Contractor's efforts to achieve the participation goal must be provided within three (3) calendar days and must be accurate and complete in every detail. The apparent low bidder's attainment of the DBE participation goal or a satisfactory demonstration of good faith efforts is a prerequisite for award of the Contract.

- e. Failure to meet, or to demonstrate good faith efforts to meet, the requirements of these Special Provisions shall render a bid non-responsive. Therefore, in order to be eligible for award, the bidder (1) must list all DBE's it plans to employ on the Schedule of Participation; and provide the required Letters of Intent for, DBE participation which meets or exceeds the Contract goal in accordance with the terms of these Special Provisions or (2) must demonstrate, to the satisfaction of MassDOT, that good faith efforts were made to achieve the participation goal. MassDOT will adhere to the guidance provided in Appendix A to 49 CFR Part 26 on the determination of a Contractor's good faith efforts to meet the DBE participation goal(s) set forth in Section 2 herein.

- f. If MassDOT finds that the percentage of DBE participation submitted by the bidder on its Schedule does not meet the Contract participation goal, or that Schedule and Letters of Intent were not timely filed, and that the bidder has not demonstrated good faith efforts to comply with these requirements, it shall propose that the bidder be declared ineligible for award. In that case, the bidder may request administrative reconsideration. Such requests must be sent in writing within three (3) calendar days of receiving notice of proposed ineligibility to: The Office of the General Counsel, Massachusetts Department of Transportation, 10 Park Plaza, Boston, MA, 02116.
- g. If, after administrative reconsideration, MassDOT finds that the bidder has not shown that sufficient good faith efforts were made to comply with the requirements of these Special Provisions, it shall reject the bidder's proposal and may retain the proposal guaranty.
- h. Actions which constitute evidence of good faith efforts to meet a DBE participation goal include, but are not limited to, the following examples, which are set forth in 49 CFR Part 26, Appendix A:
- (1) Soliciting through all reasonable and available means (e.g., attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified DBEs who have the capability to perform the work of the Contract. The bidder must solicit this interest within sufficient time to allow the DBEs to respond to the solicitation. The bidder must determine with certainty if the DBEs are interested by taking appropriate steps to follow up initial solicitations.
  - (2) Selecting portions of the work to be performed by DBEs in order to increase the likelihood that the DBE participation goal will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the Prime Contractor might otherwise prefer to perform these work items with its own forces.
  - (3) Providing interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.
  - (4) Negotiating in good faith with interested DBEs. It is the bidder's responsibility to make a portion of the work available to DBE Subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE Subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone number of DBEs that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBEs to perform the work.

A bidder using good business judgment would consider a number of factors in negotiating with Subcontractors, including DBE Subcontractors, and would take a firm's price and capabilities as well as Contract participation goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBEs is not in itself sufficient reason for a bidder's failure to meet the Contract DBE participation goal, as long as such costs are reasonable. Also, the ability or desire of a Prime Contractor to perform the work of a Contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Prime Contractors are not, however, required to accept higher quotes from DBEs if the price difference is excessive or unreasonable.



- (5) Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. Contractors should be careful of adding additional requirements of performance that would in effect limit participation by DBEs or any small business. The Contractor's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. nonunion employee status) are not legitimate causes for the rejection or non-solicitation of bids in the Contractor's efforts to meet the Contract participation goal.
- (6) Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by the recipient or contractor.
- (7) Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.
- (8) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case by case basis to provide assistance in the recruitment and placement of DBEs.

## 8. COMPLIANCE

- a. All activity performed by a DBE for credit toward the Contract participation goal must be performed, managed and supervised by the DBE in accordance with all commercially useful function requirements of 49 CFR Part 26. The Prime Contractor shall not enter into, or condone, any other arrangement.
- b. The Prime Contractor shall not perform with its own organization, or assign to any other business, an activity designated for the DBE(s) named on the Schedule(s) submitted by the Prime Contractor under Section 7 or under paragraph **8.f** of this section, without the approval of MassDOT in accordance with the requirements of paragraphs **8.f** and **8.j** of this section.
- c. MassDOT may suspend payment for any activity that was not performed by the DBE to whom the activity was committed on the approved Schedule of Participation, or that was not performed in accordance with the requirements of Section 6.
- d. MassDOT retains the right to approve or disapprove of any or all Subcontractors. Requests by the Prime Contractor for approval of participation by a DBE Subcontractor for credit toward the Contract participation goal must include, in addition to any other requirements for Subcontractor approval, the following:
  - (1) A copy of the proposed subcontract. The subcontract must be for at least the dollar amount, and for the work described, in the Bidder's Schedule of Participation.
  - (2) A resume stating the qualifications and experience of the DBE Superintendent and/or foreperson who will supervise the on-site work. A new resume will be required for any change in supervisory personnel during the progress of the work.
  - (3) A Schedule of Operations indicating when the DBE is expected to perform the work.
  - (4) A list of (1) equipment owned by the DBE to be used on the Project, and (2) equipment to be leased by the DBE for use on the Project.

- (5) A list of: (1) all projects (public and private) which the DBE is currently performing; (2) all projects (public and private) to which the DBE is committed; and (3) all projects (public and private) to which the DBE intends to make a commitment. For each Contract, list the contracting organization, the name and telephone number of a contact person for the contracting organization, the dollar value of the work, a description of the work, and the DBE's work schedule for each project.
- e. If, pursuant to the Subcontractor approval process, MassDOT finds that a DBE Subcontractor does not have sufficient experience or resources to perform, manage and supervise work of the kind proposed in accordance with the requirements of 49 CFR Part 26, approval of the DBE Subcontractor may be denied. In the event of such denial, the Prime Contractor shall proceed in accordance with the requirements paragraphs **8.f** and **8.j** of this section.
- f. If, for reasons beyond its control, the Prime Contractor cannot comply with its DBE participation commitment in accordance with the Schedule of Participation submitted under Section 7, the Prime Contractor shall submit to MassDOT the reasons for its inability to comply with its obligations and shall submit, and request approval for, a revised Schedule of Participation. If approved by MassDOT, the revised Schedule shall govern the Prime Contractor's performance in meeting its obligations under these Special Provisions.
- g. A Prime Contractor's compliance with the participation goal in Section 2 shall be determined by reference to the established percentage of the total contract price, provided, however, that no decrease in the dollar amount of a bidder's commitment to any DBE shall be allowed without the approval of MassDOT.
- h. If the contract amount is increased, the Prime Contractor may be required to submit a revised Schedule of Participation in accordance with paragraphs **8.f** and **8.j** of this section.
- i. In the event of the decertification of a DBE scheduled to participate on the Contract for credit toward the participation goal, but not under subcontract, the Contractor shall proceed in accordance with paragraphs **8.f** and **8.j** of this section.
- j. The Prime Contractor shall notify MassDOT immediately of any facts that come to its attention indicating that it may or will be unable to comply with any aspect of its DBE obligation under this Contract.
- k. Any notice required by these Special Provisions shall be given in writing to: (1) the Resident Engineer; (2) the District designated Compliance Officer; and (3) the DBE Liaison Officer, MassDOT Office of Civil Rights, 10 Park Plaza, – 3rd Floor - West, Boston, MA, 02116 and cc'd to the Deputy Chief of External Programs.
- l. The Prime Contractor and its Subcontractors shall comply with MassDOT's Electronic Reporting System Requirements (MassDOT Document 00821) and submit all information required by MassDOT related to the DBE Special Provisions through the Equitable Business Opportunity Solution ("EBO"). MassDOT reserves the right to request reports in the format it deems necessary anytime during the performance of the Contract.
- m. Termination of DBE by Prime Contractor
- (1) A Prime Contractor shall not terminate a DBE Subcontractor or an approved substitute DBE firm without the prior written consent of MassDOT. This includes, but is not limited to, instances in which a Prime Contractor seeks to perform work originally designated for a DBE Subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm.

- (2) MassDOT may provide such written consent only if MassDOT agrees, for reasons stated in its concurrence document, that the Prime Contractor has good cause to terminate the DBE firm.
- (3) For purposes of this paragraph, good cause includes the following circumstances:
  - (i) The DBE Subcontractor fails or refuses to execute a written contract;
  - (ii) The DBE Subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Good cause, however, does not exist if the failure or refusal of the DBE Subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the Prime Contractor;
  - (iii) The DBE Subcontractor fails or refuses to meet the Prime Contractor's reasonable, nondiscriminatory bond requirements.
  - (iv) The DBE Subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness;
  - (v) The DBE Subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant 2 CFR Parts 180, 215 and 1,200 or applicable State law;
  - (vi) (vii) MassDOT has determined that the listed DBE Subcontractor is not a responsible contractor;
  - (vii) The listed DBE Subcontractor voluntarily withdraws from the Project and provides written notice of its withdrawal;
  - (viii) The listed DBE is ineligible to receive DBE credit for the type of work required;
  - (ix) A DBE owner dies or becomes disabled with the result that the listed DBE Contractor is unable to complete its work on the Contract;
  - (x) Other documented good cause that MassDOT determines compels the termination of the DBE Subcontractor. Good cause, however, does not exist if the Prime Contractor seeks to terminate a DBE it relied upon to obtain the Contract so that the Prime Contractor can self-perform the DBE work or substitute another DBE or non-DBE Contractor after Contract Award.
- (4) Before transmitting to MassDOT a request to terminate and/or substitute a DBE Subcontractor, the Prime Contractor must give notice in writing to the DBE Subcontractor, with a copy to MassDOT, of its intent to request to terminate and/or substitute, and the reason for the request.
- (5) The Prime Contractor must give the DBE five (5) business days to respond to the Prime Contractor's notice. The DBE must advise MassDOT and the Contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why MassDOT should not approve the Prime Contractor's action. If required in a particular case as a matter of public necessity (e.g., safety), MassDOT may provide a response period shorter than five (5) business days.
- (6) In addition to post-award terminations, the provisions of this section apply to pre-award deletions of or substitutions for DBE firms.

**n. Prompt Payment.**

Contractors are required to promptly pay Subcontractors under this Prime Contract within ten (10) business days from the receipt of each payment the Prime Contractor receives from MassDOT. Failure to comply with this requirement may result in the withholding of payment to the Prime Contractor until such time as all payments due under this provision have been received by the Subcontractor(s) and/or referral to the Prequalification Committee for action which may affect the Contractor's prequalification status.

**9. SANCTIONS**

If the Prime Contractor does not comply with the terms of these Special Provisions and cannot demonstrate to the satisfaction of MassDOT that good faith efforts were made to achieve such compliance, MassDOT may, in addition to any other remedy provided for in the Contract, and notwithstanding any other provision in the Contract:

- a.** Retain, in connection with final acceptance and final payment processing, an amount determined by multiplying the total contract amount by the percentage in Section 2, less the amount paid to approved DBE(s) for work performed under the Contract in accordance with the provisions of Section 8.
- b.** Suspend, terminate or cancel this Contract, in whole or in part, and call upon the Prime Contractor's surety to perform all terms and conditions in the Contract.
- c.** In accordance with 720 CMR 5.05(1)(f), modify or revoke the Prime Contractor's Prequalification status or recommend that the Prime Contractor not receive award of a pending Contract. The Prime Contractor may appeal the determination of the Prequalification Committee in accordance with the provisions of 720 CMR 5.06.
- d.** Initiate debarment proceedings pursuant to M.G.L. c. 29 §29F and, as applicable, 2 CFR Parts 180, 215 and 1,200.
- e.** Refer the matter to the Massachusetts Attorney General for review and prosecution, if appropriate, of any false claim or pursuant to M.G.L. c. 12, §§ 5A to 5O (the Massachusetts False Claim Act).
- f.** Refer the matter to the U.S. DOT's Office of the Inspector General or other agencies for prosecution under Title 18, U.S.C. § 1001, 49 CFR Parts 29 and 31, and other applicable laws and regulations.

**10. FURTHER INFORMATION; ENFORCEMENT, COOPERATION AND CONFIDENTIALITY.**

- a.** Any proposed DBE, bidder, or Contractor shall provide such information as is necessary in the judgment of MassDOT to ascertain its compliance with the terms of this Special Provision. Further, pursuant to 49 CFR, Part 26.107:

- (1) If you are a firm that does not meet the eligibility criteria of 49 CFR, Parts 26.61 to 26.73 (“subpart D”), that attempts to participate in a DOT- assisted program as a DBE on the basis of false, fraudulent, or deceitful statements or representations or under circumstances indicating a serious lack of business integrity or honesty, MassDOT or FHWA may initiate suspension or debarment proceedings against you under 49 CFR Part 29.
  - (2) If you are a firm that, in order to meet DBE Contract participation goals or other DBE Program requirements, uses or attempts to use, on the basis of false, fraudulent or deceitful statements or representations or under circumstances indicating a serious lack of business integrity or honesty, another firm that does not meet the eligibility criteria of subpart D, FHWA may initiate suspension or debarment proceedings against you under 49 CFR Part 29.
  - (3) In a suspension or debarment proceeding brought either under subparagraph a.(1) or b.(2) of this section, the concerned operating administration may consider the fact that a purported DBE has been certified by a recipient. Such certification does not preclude FHWA from determining that the purported DBE, or another firm that has used or attempted to use it to meet DBE participation goals, should be suspended or debarred.
  - (4) FHWA may take enforcement action under 49 CFR Part 31, Program Fraud and Civil Remedies, against any participant in the DBE Program whose conduct is subject to such action under 49 CFR Part 31.
  - (5) FHWA may refer to the Department of Justice, for prosecution under 18 U.S.C. 1001 or other applicable provisions of law, any person who makes a false or fraudulent statement in connection with participation of a DBE in any DOT-assisted program or otherwise violates applicable Federal statutes.
- b. Pursuant to 49 CFR Part 26.109, the rules governing information, confidentiality, cooperation, and intimidation or retaliation are as follows:
  - (1) Availability of records.
    - (i) In responding to requests for information concerning any aspect of the DBE Program, FHWA complies with provisions of the Federal Freedom of Information and Privacy Acts (5 U.S.C. 552 and 552a). FHWA may make available to the public any information concerning the DBE Program release of which is not prohibited by Federal law.
    - (ii) MassDOT shall safeguard from disclosure to unauthorized persons information that may reasonably be considered as confidential business information, consistent with Federal and Massachusetts General Law (M.G.L. c. 66, § 10, M.G.L. c. 4, §7 (26), 950 CMR 32.00).
  - (2) Confidentiality of information on complainants. Notwithstanding the provisions of subparagraph b.(1) of this section, the identity of complainants shall be kept confidential, at their election. If such confidentiality will hinder the investigation, proceeding or hearing, or result in a denial of appropriate administrative due process to other parties, the complainant must be advised for the purpose of waiving the privilege. Complainants are advised that, in some circumstances, failure to waive the privilege may result in the closure of the investigation or dismissal of the proceeding or hearing.

- (3) Cooperation. All participants in FHWA's DBE Program (including, but not limited to, recipients, DBE firms and applicants for DBE certification, complainants and appellants, and Contractors using DBE firms to meet Contract participation goals) are required to cooperate fully and promptly with U.S. DOT and recipient compliance reviews, certification reviews, investigations, and other requests for information. Failure to do so shall be a ground for appropriate action against the party involved (e.g., with respect to recipients, a finding of noncompliance; with respect to DBE firms, denial of certification or removal of eligibility and/or suspension and debarment; with respect to a complainant or appellant, dismissal of the complaint or appeal; with respect to a Contractor which uses DBE firms to meet participation goals, findings of non-responsibility for future Contracts and/or suspension and debarment).
- (4) Intimidation and retaliation. No recipient, Contractor, or any other participant in the program, may intimidate, threaten, coerce, or discriminate against any individual or firm for the purpose of interfering with any right or privilege secured by this part or because the individual or firm has made a complaint, testified, assisted, or participated in any manner in an investigation, proceeding, or hearing under this part. If any recipient or contractor violates this prohibition, that entity is in noncompliance with this 49 CFR Part 26.

## 11. LIST OF ADDITIONAL DOCUMENTS.

- a. The following documents shall be completed and signed by the bidder and designated DBEs in accordance with Section 7 - Award Documentation and Procedures. These documents must be returned by the bidder to MassDOT's Bid Document Distribution Center:
- Schedule of DBE Participation (Document B00853)
  - Letter of Intent (Document B00854)
  - DBE Joint Check Arrangement Approval Form (Document B00855), if Contractor and DBE plan, or if DBE is required to use a Joint Check
- b. The following document shall be signed and returned by Contractor and Subcontractors/DBEs to the MassDOT District Office overseeing the Project, as applicable:
- Contractor/Subcontractor Certification Form (Document No. 00859) (a checklist of other documents to be included with every subcontract (DBEs and non-DBEs alike)).
- c. The following document shall be provided to MassDOT's Office of Civil Rights and Prequalification Office at least fourteen (14) business days before the bid opening date, if applicable:
- Affidavit of DBE/Non-DBE Joint Venture (Document B00856)
- d. The following document shall be provided to MassDOT's District Office of Civil Rights within 30 calendar days after the work of the DBE is completed, or no later than 30 calendar days after the work of the DBE is on a completed and processed CQE. This document shall be completed and submitted by the Prime Contractor:
- Certificate of Completion by a Minority/Women or Disadvantaged Business Enterprise (M/W/DBE) (Form No. CSD-100)

**REQUIRED CONTRACT PROVISIONS  
FEDERAL-AID CONSTRUCTION CONTRACTS**

- I. General
- II. Nondiscrimination
- III. Non-segregated Facilities
- IV. Davis-Bacon and Related Act Provisions
- V. Contract Work Hours and Safety Standards Act Provisions
- VI. Subletting or Assigning the Contract
- VII. Safety: Accident Prevention
- VIII. False Statements Concerning Highway Projects
- IX. Implementation of Clean Air Act and Federal Water Pollution Control Act
- X. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion
- XI. Certification Regarding Use of Contract Funds for Lobbying
- XII. Use of United States-Flag Vessels:

**ATTACHMENTS**

A. Employment and Materials Preference for Appalachian Development Highway System or Appalachian Local Access Road Contracts (included in Appalachian contracts only)

**I. GENERAL**

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under title 23, United States Code, as required in 23 CFR 633.102(b) (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services). 23 CFR 633.102(e).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider. 23 CFR 633.102(e).

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services) in accordance with 23 CFR 633.102. The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in solicitation-for-bids or request-for-proposals documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract). 23 CFR 633.102(b).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work

performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract. 23 CFR 633.102(d).

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. 23 U.S.C. 114(b). The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors. 23 U.S.C. 101(a).

**II. NONDISCRIMINATION** (23 CFR 230.107(a); 23 CFR Part 230, Subpart A, Appendix A; EO 11246)

The provisions of this section related to 23 CFR Part 230, Subpart A, Appendix A are applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR Part 60, 29 CFR Parts 1625-1627, 23 U.S.C. 140, Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), Title VI of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d et seq.), and related regulations including 49 CFR Parts 21, 26, and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding \$10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR Part 60, and 29 CFR Parts 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with 23 U.S.C. 140, Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and Title VI of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d et seq.), and related regulations including 49 CFR Parts 21, 26, and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR Part 230, Subpart A, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

**1. Equal Employment Opportunity:** Equal Employment Opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (see 28 CFR Part 35, 29 CFR Part 1630, 29 CFR Parts 1625-1627, 41 CFR Part 60 and 49 CFR Part 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140, shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR Part 35 and 29 CFR Part 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract. 23 CFR 230.409 (g)(4) & (5).

b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, sexual orientation, gender identity, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

**2. EEO Officer:** The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

**3. Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action or are substantially involved in such action, will be made fully cognizant of and will implement the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer or other knowledgeable company official.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

**4. Recruitment:** When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

**5. Personnel Actions:** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to ensure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action



within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

#### 6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs (i.e., apprenticeship and on-the-job training programs for the geographical area of contract performance). In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

**7. Unions:** If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. 23 CFR 230.409. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide

sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

**8. Reasonable Accommodation for Applicants / Employees with Disabilities:** The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established thereunder. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

**9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:** The contractor shall not discriminate on the grounds of race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors, suppliers, and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

#### 10. Assurances Required:

a. The requirements of 49 CFR Part 26 and the State DOT's FHWA-approved Disadvantaged Business Enterprise (DBE) program are incorporated by reference.

b. The contractor, subrecipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate, which may include, but is not limited to:

- (1) Withholding monthly progress payments;
- (2) Assessing sanctions;
- (3) Liquidated damages; and/or
- (4) Disqualifying the contractor from future bidding as non-responsible.

c. The Title VI and nondiscrimination provisions of U.S. DOT Order 1050.2A at Appendixes A and E are incorporated by reference. 49 CFR Part 21.

**11. Records and Reports:** The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women.

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on [Form FHWA-1391](#). The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

### III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of more than \$10,000. 41 CFR 60-1.5.

As prescribed by 41 CFR 60-1.8, the contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location under the contractor's control where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

### IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding \$2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size), in accordance with 29 CFR 5.5. The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. 23 U.S.C. 113. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. 23 U.S.C. 101. Where applicable law requires that projects be treated as a project on a Federal-aid highway, the provisions of this subpart will apply regardless of the location of the project. Examples include: Surface Transportation Block Grant Program projects funded under 23 U.S.C. 133 [excluding recreational trails projects], the Nationally Significant Freight and Highway

Projects funded under 23 U.S.C. 117, and National Highway Freight Program projects funded under 23 U.S.C. 167.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 "Contract provisions and related matters" with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

#### 1. Minimum wages (29 CFR 5.5)

a. *Wage rates and fringe benefits.* All laborers and mechanics employed or working upon the site of the work (or otherwise working in construction or development of the project under a development statute), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act ([29 CFR part 3](#))), the full amount of basic hourly wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. As provided in paragraphs (d) and (e) of 29 CFR 5.5, the appropriate wage determinations are effective by operation of law even if they have not been attached to the contract. Contributions made or costs reasonably anticipated for bona fide fringe benefits under the Davis-Bacon Act ([40 U.S.C. 3141\(2\)\(B\)](#)) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.e. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics must be paid the appropriate wage rate and fringe benefits on the wage determination for the classification(s) of work actually performed, without regard to skill, except as provided in paragraph 4. of this section. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph 1.c. of this section) and the Davis-Bacon poster (WH-1321) must be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. *Frequently recurring classifications.* (1) In addition to wage and fringe benefit rates that have been determined to be prevailing under the procedures set forth in [29 CFR part 1](#), a wage determination may contain, pursuant to § 1.3(f), wage and fringe benefit rates for classifications of laborers and mechanics for which conformance requests are regularly submitted pursuant to paragraph 1.c. of this section, provided that:

(i) The work performed by the classification is not performed by a classification in the wage determination for which a prevailing wage rate has been determined;

(ii) The classification is used in the area by the construction industry; and

(iii) The wage rate for the classification bears a reasonable relationship to the prevailing wage rates contained in the wage determination.

(2) The Administrator will establish wage rates for such classifications in accordance with paragraph 1.c.(1)(iii) of this section. Work performed in such a classification must be paid at no less than the wage and fringe benefit rate listed on the wage determination for such classification.

c. *Conformance.* (1) The contracting officer must require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract be classified in conformance with the wage determination. Conformance of an additional classification and wage rate and fringe benefits is appropriate only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is used in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) The conformance process may not be used to split, subdivide, or otherwise avoid application of classifications listed in the wage determination.

(3) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken will be sent by the contracting officer by email to [DBAconformance@dol.gov](mailto:DBAconformance@dol.gov). The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(4) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer will, by email to [DBAconformance@dol.gov](mailto:DBAconformance@dol.gov), refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(5) The contracting officer must promptly notify the contractor of the action taken by the Wage and Hour Division

under paragraphs 1.c.(3) and (4) of this section. The contractor must furnish a written copy of such determination to each affected worker or it must be posted as a part of the wage determination. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraph 1.c.(3) or (4) of this section must be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

d. *Fringe benefits not expressed as an hourly rate.* Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor may either pay the benefit as stated in the wage determination or may pay another bona fide fringe benefit or an hourly cash equivalent thereof.

e. *Unfunded plans.* If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, That the Secretary of Labor has found, upon the written request of the contractor, in accordance with the criteria set forth in § 5.28, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

f. *Interest.* In the event of a failure to pay all or part of the wages required by the contract, the contractor will be required to pay interest on any underpayment of wages.

## 2. Withholding (29 CFR 5.5)

a. *Withholding requirements.* The contracting agency may, upon its own action, or must, upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to satisfy the liabilities of the prime contractor or any subcontractor for the full amount of wages and monetary relief, including interest, required by the clauses set forth in this section for violations of this contract, or to satisfy any such liabilities required by any other Federal contract, or federally assisted contract subject to Davis-Bacon labor standards, that is held by the same prime contractor (as defined in § 5.2). The necessary funds may be withheld from the contractor under this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract that is subject to Davis-Bacon labor standards requirements and is held by the same prime contractor, regardless of whether the other contract was awarded or assisted by the same agency, and such funds may be used to satisfy the contractor liability for which the funds were withheld. In the event of a contractor's failure to pay any laborer or mechanic, including any apprentice or helper working on the site of the work all or part of the wages required by the contract, or upon the contractor's failure to submit the required records as discussed in paragraph 3.d. of this section, the contracting agency may on its own initiative and after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

b. *Priority to withheld funds.* The Department has priority to funds withheld or to be withheld in accordance with paragraph

2.a. of this section or Section V, paragraph 3.a., or both, over claims to those funds by:

- (1) A contractor's surety(ies), including without limitation performance bond sureties and payment bond sureties;
- (2) A contracting agency for its procurement costs;
- (3) A trustee(s) (either a court-appointed trustee or a U.S. trustee, or both) in bankruptcy of a contractor, or a contractor's bankruptcy estate;
- (4) A contractor's assignee(s);
- (5) A contractor's successor(s); or
- (6) A claim asserted under the Prompt Payment Act, [31 U.S.C. 3901–3907](#).

### 3. Records and certified payrolls (29 CFR 5.5)

*a. Basic record requirements (1) Length of record retention.* All regular payrolls and other basic records must be maintained by the contractor and any subcontractor during the course of the work and preserved for all laborers and mechanics working at the site of the work (or otherwise working in construction or development of the project under a development statute) for a period of at least 3 years after all the work on the prime contract is completed.

*(2) Information required.* Such records must contain the name; Social Security number; last known address, telephone number, and email address of each such worker; each worker's correct classification(s) of work actually performed; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in [40 U.S.C. 3141\(2\)\(B\)](#) of the Davis-Bacon Act); daily and weekly number of hours actually worked in total and on each covered contract; deductions made; and actual wages paid.

*(3) Additional records relating to fringe benefits.* Whenever the Secretary of Labor has found under paragraph 1.e. of this section that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in [40 U.S.C. 3141\(2\)\(B\)](#) of the Davis-Bacon Act, the contractor must maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits.

*(4) Additional records relating to apprenticeship.* Contractors with apprentices working under approved programs must maintain written evidence of the registration of apprenticeship programs, the registration of the apprentices, and the ratios and wage rates prescribed in the applicable programs.

*b. Certified payroll requirements (1) Frequency and method of submission.* The contractor or subcontractor must submit weekly, for each week in which any DBA- or Related Acts-covered work is performed, certified payrolls to the contracting

agency. The prime contractor is responsible for the submission of all certified payrolls by all subcontractors. A contracting agency or prime contractor may permit or require contractors to submit certified payrolls through an electronic system, as long as the electronic system requires a legally valid electronic signature; the system allows the contractor, the contracting agency, and the Department of Labor to access the certified payrolls upon request for at least 3 years after the work on the prime contract has been completed; and the contracting agency or prime contractor permits other methods of submission in situations where the contractor is unable or limited in its ability to use or access the electronic system.

*(2) Information required.* The certified payrolls submitted must set out accurately and completely all of the information required to be maintained under paragraph 3.a.(2) of this section, except that full Social Security numbers and last known addresses, telephone numbers, and email addresses must not be included on weekly transmittals. Instead, the certified payrolls need only include an individually identifying number for each worker ( e.g., the last four digits of the worker's Social Security number). The required weekly certified payroll information may be submitted using Optional Form WH-347 or in any other format desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division website at <https://www.dol.gov/sites/dolgov/files/WHD/legacy/files/wh347.pdf> or its successor website. It is not a violation of this section for a prime contractor to require a subcontractor to provide full Social Security numbers and last known addresses, telephone numbers, and email addresses to the prime contractor for its own records, without weekly submission by the subcontractor to the contracting agency.

*(3) Statement of Compliance.* Each certified payroll submitted must be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor, or the contractor's or subcontractor's agent who pays or supervises the payment of the persons working on the contract, and must certify the following:

(i) That the certified payroll for the payroll period contains the information required to be provided under paragraph 3.b. of this section, the appropriate information and basic records are being maintained under paragraph 3.a. of this section, and such information and records are correct and complete;

(ii) That each laborer or mechanic (including each helper and apprentice) working on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in [29 CFR part 3](#); and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification(s) of work actually performed, as specified in the applicable wage determination incorporated into the contract.

*(4) Use of Optional Form WH-347.* The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 will satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(3) of this section.

(5) *Signature.* The signature by the contractor, subcontractor, or the contractor's or subcontractor's agent must be an original handwritten signature or a legally valid electronic signature.

(6) *Falsification.* The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under [18 U.S.C. 1001](#) and [31 U.S.C. 3729](#).

(7) *Length of certified payroll retention.* The contractor or subcontractor must preserve all certified payrolls during the course of the work and for a period of 3 years after all the work on the prime contract is completed.

c. *Contracts, subcontracts, and related documents.* The contractor or subcontractor must maintain this contract or subcontract and related documents including, without limitation, bids, proposals, amendments, modifications, and extensions. The contractor or subcontractor must preserve these contracts, subcontracts, and related documents during the course of the work and for a period of 3 years after all the work on the prime contract is completed.

d. *Required disclosures and access (1) Required record disclosures and access to workers.* The contractor or subcontractor must make the records required under paragraphs 3.a. through 3.c. of this section, and any other documents that the contracting agency, the State DOT, the FHWA, or the Department of Labor deems necessary to determine compliance with the labor standards provisions of any of the applicable statutes referenced by § 5.1, available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and must permit such representatives to interview workers during working hours on the job.

(2) *Sanctions for non-compliance with records and worker access requirements.* If the contractor or subcontractor fails to submit the required records or to make them available, or refuses to permit worker interviews during working hours on the job, the Federal agency may, after written notice to the contractor, sponsor, applicant, owner, or other entity, as the case may be, that maintains such records or that employs such workers, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available, or to permit worker interviews during working hours on the job, may be grounds for debarment action pursuant to § 5.12. In addition, any contractor or other person that fails to submit the required records or make those records available to WHD within the time WHD requests that the records be produced will be precluded from introducing as evidence in an administrative proceeding under [29 CFR part 6](#) any of the required records that were not provided or made available to WHD. WHD will take into consideration a reasonable request from the contractor or person for an extension of the time for submission of records. WHD will determine the reasonableness of the request and may consider, among other things, the location of the records and the volume of production.

(3) *Required information disclosures.* Contractors and subcontractors must maintain the full Social Security number and last known address, telephone number, and email address

of each covered worker, and must provide them upon request to the contracting agency, the State DOT, the FHWA, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or other compliance action.

#### 4. Apprentices and equal employment opportunity (29 CFR 5.5)

a. *Apprentices (1) Rate of pay.* Apprentices will be permitted to work at less than the predetermined rate for the work they perform when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship (OA), or with a State Apprenticeship Agency recognized by the OA. A person who is not individually registered in the program, but who has been certified by the OA or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice, will be permitted to work at less than the predetermined rate for the work they perform in the first 90 days of probationary employment as an apprentice in such a program. In the event the OA or a State Apprenticeship Agency recognized by the OA withdraws approval of an apprenticeship program, the contractor will no longer be permitted to use apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(2) *Fringe benefits.* Apprentices must be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringe benefits must be paid in accordance with that determination.

(3) *Apprenticeship ratio.* The allowable ratio of apprentices to journeyworkers on the job site in any craft classification must not be greater than the ratio permitted to the contractor as to the entire work force under the registered program or the ratio applicable to the locality of the project pursuant to paragraph 4.a.(4) of this section. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in paragraph 4.a.(1) of this section, must be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under this section must be paid not less than the applicable wage rate on the wage determination for the work actually performed.

(4) *Reciprocity of ratios and wage rates.* Where a contractor is performing construction on a project in a locality other than the locality in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyworker's hourly rate) applicable within the locality in which the construction is being performed must be observed. If there is no applicable ratio or wage rate for the locality of the project, the ratio and wage rate specified in the contractor's registered program must be observed.

b. *Equal employment opportunity.* The use of apprentices and journeyworkers under this part must be in conformity with

the equal employment opportunity requirements of Executive Order 11246, as amended, and [29 CFR part 30](#).

c. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. 23 CFR 230.111(e)(2). The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeyworkers shall not be greater than permitted by the terms of the particular program.

**5. Compliance with Copeland Act requirements.** The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract as provided in 29 CFR 5.5.

**6. Subcontracts.** The contractor or subcontractor must insert FHWA-1273 in any subcontracts, along with the applicable wage determination(s) and such other clauses or contract modifications as the contracting agency may by appropriate instructions require, and a clause requiring the subcontractors to include these clauses and wage determination(s) in any lower tier subcontracts. The prime contractor is responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in this section. In the event of any violations of these clauses, the prime contractor and any subcontractor(s) responsible will be liable for any unpaid wages and monetary relief, including interest from the date of the underpayment or loss, due to any workers of lower-tier subcontractors, and may be subject to debarment, as appropriate. 29 CFR 5.5.

**7. Contract termination: debarment.** A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

**8. Compliance with Davis-Bacon and Related Act requirements.** All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract as provided in 29 CFR 5.5.

**9. Disputes concerning labor standards.** As provided in 29 CFR 5.5, disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

**10. Certification of eligibility.** a. By entering into this contract, the contractor certifies that neither it nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of [40 U.S.C. 3144\(b\)](#) or § 5.12(a).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of [40 U.S.C. 3144\(b\)](#) or § 5.12(a).

c. The penalty for making false statements is prescribed in the U.S. Code, Title 18 Crimes and Criminal Procedure, [18 U.S.C. 1001](#).

**11. Anti-retaliation.** It is unlawful for any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, or to cause any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, any worker or job applicant for:

a. Notifying any contractor of any conduct which the worker reasonably believes constitutes a violation of the DBA, Related Acts, this part, or [29 CFR part 1](#) or [3](#);

b. Filing any complaint, initiating or causing to be initiated any proceeding, or otherwise asserting or seeking to assert on behalf of themselves or others any right or protection under the DBA, Related Acts, this part, or [29 CFR part 1](#) or [3](#);

c. Cooperating in any investigation or other compliance action, or testifying in any proceeding under the DBA, Related Acts, this part, or [29 CFR part 1](#) or [3](#); or

d. Informing any other person about their rights under the DBA, Related Acts, this part, or [29 CFR part 1](#) or [3](#).

## V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

Pursuant to 29 CFR 5.5(b), the following clauses apply to any Federal-aid construction contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchpersons and guards.

**1. Overtime requirements.** No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek. 29 CFR 5.5.

**2. Violation; liability for unpaid wages; liquidated damages.** In the event of any violation of the clause set forth in paragraph 1. of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages and interest from the date of the underpayment. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or

mechanic, including watchpersons and guards, employed in violation of the clause set forth in paragraph 1. of this section, in the sum currently provided in 29 CFR 5.5(b)(2)\* for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph 1. of this section.

\* \$31 as of January 15, 2023 (See 88 FR 88 FR 2210) as may be adjusted annually by the Department of Labor, pursuant to the Federal Civil Penalties Inflation Adjustment Act of 1990.

### 3. Withholding for unpaid wages and liquidated damages

a. *Withholding process.* The FHWA or the contracting agency may, upon its own action, or must, upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to satisfy the liabilities of the prime contractor or any subcontractor for any unpaid wages; monetary relief, including interest; and liquidated damages required by the clauses set forth in this section on this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act that is held by the same prime contractor (as defined in § 5.2). The necessary funds may be withheld from the contractor under this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract that is subject to the Contract Work Hours and Safety Standards Act and is held by the same prime contractor, regardless of whether the other contract was awarded or assisted by the same agency, and such funds may be used to satisfy the contractor liability for which the funds were withheld.

b. *Priority to withheld funds.* The Department has priority to funds withheld or to be withheld in accordance with Section IV paragraph 2.a. or paragraph 3.a. of this section, or both, over claims to those funds by:

- (1) A contractor's surety(ies), including without limitation performance bond sureties and payment bond sureties;
- (2) A contracting agency for its procurement costs;
- (3) A trustee(s) (either a court-appointed trustee or a U.S. trustee, or both) in bankruptcy of a contractor, or a contractor's bankruptcy estate;
- (4) A contractor's assignee(s);
- (5) A contractor's successor(s); or
- (6) A claim asserted under the Prompt Payment Act, [31 U.S.C. 3901](#)–3907.

**4. Subcontracts.** The contractor or subcontractor must insert in any subcontracts the clauses set forth in paragraphs 1. through 5. of this section and a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor is responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs 1. through 5. In the

event of any violations of these clauses, the prime contractor and any subcontractor(s) responsible will be liable for any unpaid wages and monetary relief, including interest from the date of the underpayment or loss, due to any workers of lower-tier subcontractors, and associated liquidated damages and may be subject to debarment, as appropriate.

**5. Anti-retaliation.** It is unlawful for any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, or to cause any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, any worker or job applicant for:

- a. Notifying any contractor of any conduct which the worker reasonably believes constitutes a violation of the Contract Work Hours and Safety Standards Act (CWHSSA) or its implementing regulations in this part;
- b. Filing any complaint, initiating or causing to be initiated any proceeding, or otherwise asserting or seeking to assert on behalf of themselves or others any right or protection under CWHSSA or this part;
- c. Cooperating in any investigation or other compliance action, or testifying in any proceeding under CWHSSA or this part; or
- d. Informing any other person about their rights under CWHSSA or this part.

### VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System pursuant to 23 CFR 635.116.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term "perform work with its own organization" in paragraph 1 of Section VI refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions: (based on longstanding interpretation)

- (1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
- (2) the prime contractor remains responsible for the quality of the work of the leased employees;

- (3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and
- (4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract. 23 CFR 635.102.

2. Pursuant to 23 CFR 635.116(a), the contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. Pursuant to 23 CFR 635.116(c), the contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract. (based on long-standing interpretation of 23 CFR 635.116).

5. The 30-percent self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements. 23 CFR 635.116(d).

## VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR Part 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract. 23 CFR 635.108.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and

health standards (29 CFR Part 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704). 29 CFR 1926.10.

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

## VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR Part 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 11, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."



## IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT (42 U.S.C. 7606; 2 CFR 200.88; EO 11738)

This provision is applicable to all Federal-aid construction contracts in excess of \$150,000 and to all related subcontracts. 48 CFR 2.101; 2 CFR 200.327.

By submission of this bid/proposal or the execution of this contract or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, subcontractor, supplier, or vendor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal Highway Administration and the Regional Office of the Environmental Protection Agency. 2 CFR Part 200, Appendix II.

The contractor agrees to include or cause to be included the requirements of this Section in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements. 2 CFR 200.327.

## X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost \$25,000 or more – as defined in 2 CFR Parts 180 and 1200. 2 CFR 180.220 and 1200.220.

### 1. Instructions for Certification – First Tier Participants:

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction. 2 CFR 180.320.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default. 2 CFR 180.325.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances. 2 CFR 180.345 and 180.350.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180, Subpart I, 180.900-180.1020, and 1200. "First Tier Covered Transactions" refers to any covered transaction between a recipient or subrecipient of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a recipient or subrecipient of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction. 2 CFR 180.330.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold. 2 CFR 180.220 and 180.300.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. 2 CFR 180.300; 180.320, and 180.325. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. 2 CFR 180.335. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the System for Award Management website (<https://www.sam.gov/>). 2 CFR 180.300, 180.320, and 180.325.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default. 2 CFR 180.325.

\* \* \* \* \*

**2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:**

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency, 2 CFR 180.335;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property, 2 CFR 180.800;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification, 2 CFR 180.700 and 180.800; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default. 2 CFR 180.335(d).

(5) Are not a corporation that has been convicted of a felony violation under any Federal law within the two-year period preceding this proposal (USDOT Order 4200.6 implementing appropriations act requirements); and

(6) Are not a corporation with any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability (USDOT Order 4200.6 implementing appropriations act requirements).

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant should attach an explanation to this proposal. 2 CFR 180.335 and 180.340.

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**3. Instructions for Certification - Lower Tier Participants:**

(Applicable to all subcontracts, purchase orders, and other lower tier transactions requiring prior FHWA approval or estimated to cost \$25,000 or more - 2 CFR Parts 180 and 1200). 2 CFR 180.220 and 1200.220.

a. By signing and submitting this proposal, the prospective lower tier participant is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which

this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances. 2 CFR 180.365.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180, Subpart I, 180.900 – 180.1020, and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. "First Tier Covered Transactions" refers to any covered transaction between a recipient or subrecipient of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a recipient or subrecipient of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated. 2 CFR 1200.220 and 1200.332.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold. 2 CFR 180.220 and 1200.220.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the System for Award Management website (<https://www.sam.gov/>), which is compiled by the General Services Administration. 2 CFR 180.300, 180.320, 180.330, and 180.335.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily

excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment. 2 CFR 180.325.

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**4. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:**

a. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals:

(1) is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency, 2 CFR 180.355;

(2) is a corporation that has been convicted of a felony violation under any Federal law within the two-year period preceding this proposal (USDOT Order 4200.6 implementing appropriations act requirements); and

(3) is a corporation with any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability. (USDOT Order 4200.6 implementing appropriations act requirements)

b. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant should attach an explanation to this proposal.

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**XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING**

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed \$100,000. 49 CFR Part 20, App. A.

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or

cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such recipients shall certify and disclose accordingly.

**XII. USE OF UNITED STATES-FLAG VESSELS:**

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, or any other covered transaction. 46 CFR Part 381.

This requirement applies to material or equipment that is acquired for a specific Federal-aid highway project. 46 CFR 381.7. It is not applicable to goods or materials that come into inventories independent of an FHWA funded-contract.

When oceanic shipments (or shipments across the Great Lakes) are necessary for materials or equipment acquired for a specific Federal-aid construction project, the bidder, proposer, contractor, subcontractor, or vendor agrees:

1. To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels. 46 CFR 381.7.

2. To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b)(1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Office of Cargo and Commercial Sealift (MAR-620), Maritime Administration, Washington, DC 20590. (MARAD requires copies of the ocean carrier's (master) bills of lading, certified onboard, dated, with rates and charges. These bills of lading may contain business sensitive information and therefore may be submitted directly to MARAD by the Ocean Transportation Intermediary on behalf of the contractor). 46 CFR 381.7.

**ATTACHMENT A - EMPLOYMENT AND MATERIALS  
PREFERENCE FOR APPALACHIAN DEVELOPMENT  
HIGHWAY SYSTEM OR APPALACHIAN LOCAL ACCESS  
ROAD CONTRACTS (23 CFR 633, Subpart B, Appendix B)**

This provision is applicable to all Federal-aid projects funded under the Appalachian Regional Development Act of 1965.

1. During the performance of this contract, the contractor undertaking to do work which is, or reasonably may be, done as on-site work, shall give preference to qualified persons who regularly reside in the labor area as designated by the DOL wherein the contract work is situated, or the subregion, or the Appalachian counties of the State wherein the contract work is situated, except:

a. To the extent that qualified persons regularly residing in the area are not available.

b. For the reasonable needs of the contractor to employ supervisory or specially experienced personnel necessary to assure an efficient execution of the contract work.

c. For the obligation of the contractor to offer employment to present or former employees as the result of a lawful collective bargaining contract, provided that the number of nonresident persons employed under this subparagraph (1c) shall not exceed 20 percent of the total number of employees employed by the contractor on the contract work, except as provided in subparagraph (4) below.

2. The contractor shall place a job order with the State Employment Service indicating (a) the classifications of the laborers, mechanics and other employees required to perform the contract work, (b) the number of employees required in each classification, (c) the date on which the participant estimates such employees will be required, and (d) any other pertinent information required by the State Employment Service to complete the job order form. The job order may be placed with the State Employment Service in writing or by telephone. If during the course of the contract work, the information submitted by the contractor in the original job order is substantially modified, the participant shall promptly notify the State Employment Service.

3. The contractor shall give full consideration to all qualified job applicants referred to him by the State Employment Service. The contractor is not required to grant employment to any job applicants who, in his opinion, are not qualified to perform the classification of work required.

4. If, within one week following the placing of a job order by the contractor with the State Employment Service, the State Employment Service is unable to refer any qualified job applicants to the contractor, or less than the number requested, the State Employment Service will forward a certificate to the contractor indicating the unavailability of applicants. Such certificate shall be made a part of the contractor's permanent project records. Upon receipt of this certificate, the contractor may employ persons who do not normally reside in the labor area to fill positions covered by the certificate, notwithstanding the provisions of subparagraph (1c) above.

5. The provisions of 23 CFR 633.207(e) allow the contracting agency to provide a contractual preference for the use of mineral resource materials native to the Appalachian region.

6. The contractor shall include the provisions of Sections 1 through 4 of this Attachment A in every subcontract for work which is, or reasonably may be, done as on-site work.

DOCUMENT 00811

SPECIAL PROVISIONS  
MONTHLY PRICE ADJUSTMENT FOR HOT MIX ASPHALT (HMA) MIXTURES  
Revised: 02/03/2023

This provision applies to all projects using greater than 100 tons of hot mix asphalt (HMA) mixtures containing liquid asphalt cement as stipulated in the Notice to Contractors section of the bid documents.

Price Adjustments will be based on the variance in price, for the liquid asphalt component only, between the Base Price and the Period Price. They shall not include transportation or other charges. Price Adjustments will occur on a monthly basis.

**Base Price**

The Base Price of liquid asphalt on a project as listed in the Notice to Contractors section of the bid documents is a fixed price determined by the Department at the time of the bid using the same method as the determination of the Period Price detailed below. The Base Price shall be used in all bids.

**Period Price**

The Period Price is the price of liquid asphalt for each monthly period as determined by the Department using the average selling price per standard ton of PG64-28 paving grade (primary binder classification) asphalt, FOB manufacturer's terminal, as listed under the "East Coast Market - New England, Boston, Massachusetts area" section of the Poten & Partners, Inc. "Asphalt Weekly Monitor". This average selling price is listed in the issue having a publication date of the second Friday of the month and will be posted as the Period Price for that month. The Department will post this Period Price on its website at <https://www.mass.gov/service-details/massdot-current-contract-price-adjustments> following its receipt of the relevant issue of the "Asphalt Weekly Monitor". Poten and Partners has granted the Department the right to publish this specific asphalt price information sourced from the Asphalt Weekly Monitor.

**Price Adjustment Determination, Calculation and Payment**

The Contract Price of the HMA mixture will be paid under the respective item in the Contract. Price Adjustments, as herein provided, either upwards or downwards, will be made after the work has been performed using the monthly period price for the month during which the work was performed.

Price Adjustments will be paid only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.

The Price Adjustment applies only to the actual virgin liquid asphalt content in the mixture placed on the job in accordance with the approved Job Mix Formula.

Price Adjustments will be separate payment items. The pay item numbers are 999.401 for a positive price adjustment (a payment) and 999.402 for a negative price adjustment (a deduction). Price Adjustments will be calculated using the following equation:

Price Adjustment = Tons of HMA Placed X Liquid Asphalt Content % X RAP Factor X (Period Price - Base Price)

No Price Adjustment will be allowed beyond the Completion Date of this Contract, unless there is a Department-approved extension of time.

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DOCUMENT 00812

SPECIAL PROVISIONS  
 MONTHLY PRICE ADJUSTMENT FOR DIESEL FUEL AND GASOLINE –  
 ENGLISH UNITS  
 Revised: 02/01/2021

This monthly fuel price adjustment is inserted in this contract because the national and worldwide energy situation has made the future cost of fuel unpredictable. This adjustment will provide for either additional compensation to the Contractor or repayment to the Commonwealth, depending on an increase or decrease in the average price of diesel fuel or gasoline.

This adjustment will be based on fuel usage factors for various items of work developed by the Highway Research Board in Circular 158, dated July 1974. These factors will be multiplied by the quantities of work done in each item during each monthly period and further multiplied by the variance in price from the Base Price to the Period Price.

The Base Price of Diesel Fuel and Gasoline will be the price as indicated in the Department’s web site <https://www.mass.gov/service-details/massdot-current-contract-price-adjustments> for the month in which the contract was bid, which includes State Tax.

The Period Price will be the average of prices charged to the State, including State Tax for the bulk purchases made during each month.

This adjustment will be effected only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.

No adjustment will be paid for work done beyond the extended completion date of any contract.

Any adjustment (increase or decrease) to estimated quantities made to each item at the time of final payment will have the fuel price adjustment figured at the average period price for the entire term of the project for the difference of quantity.

The fuel price adjustment will apply only to the following items of work at the fuel factors shown:

ITEMS COVERED	FUEL FACTORS	
	Diesel	Gasoline
Excavation: and Borrow Work: Items 120, 120.1, 121, 123, 124, 125, 127, 129.3, 140, 140.1, 141, 142, 143, 144, 150, 150.1, 151 and 151.1 (Both Factors used)	0.29 Gallons / CY.	0.15 Gallons / CY
Surfacing Work: All Items containing Hot Mix Asphalt	2.90 Gallons / Ton	Does Not Apply

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## DOCUMENT 00813

## SPECIAL PROVISIONS

## PRICE ADJUSTMENTS FOR STRUCTURAL STEEL AND REINFORCING STEEL

June 13, 2024

This special provision applies to all projects containing the use of structural steel and/or reinforcing steel as specified elsewhere in the Contract work. It applies to all structural steel and all reinforcing steel, as defined below, on the project. Compliance with this provision is mandatory, i.e., there are no “opt-in” or “opt-out” clauses. Price adjustments will be handled as described below and shall only apply to unfabricated reinforcing steel bars and unfabricated structural steel material, consisting of rolled shapes, plate steel, sheet piling, pipe piles, steel castings and steel forgings.

Price adjustments will be variances between Base Prices and Period Prices. Base Prices and Period Prices are defined below.

Price adjustments will only be made if the variances between Base Prices and Period Prices are 5% or more. A variance can result in the Period Price being either higher or lower than the Base Price. Once the 5% threshold has been achieved, the adjustment will apply to the full variance between the Base Price and the Period Price.

Price adjustments will be calculated by multiplying the number of pounds of unfabricated structural steel material or unfabricated reinforcing steel bars on a project by the index factor calculated as shown below under Example of a Period Price Calculation.

Price adjustments will *not* include guardrail panels or the costs of shop drawing preparation, handling, fabrication, coatings, transportation, storage, installation, profit, overhead, fuel costs, fuel surcharges, or other such charges not related to the cost of the unfabricated structural steel and unfabricated reinforcing steel.

The weight of steel subject to a price adjustment shall not exceed the final shipping weight of the fabricated part by more than 10%.

Base Prices and Period Prices are defined as follows:

Base Prices of unfabricated structural steel and unfabricated reinforcing steel on a project are fixed prices determined by the Department and found in the table below. While it is the intention of the Department to make this table comprehensive, some of a project’s unfabricated structural steel and/or unfabricated reinforcing steel may be inadvertently omitted. Should this occur, the Contractor shall bring the omission to the Department’s attention so that a contract alteration may be processed that adds the missing steel to the table and its price adjustments to the Contract.

The Base Price Date is the month and year of the most recent finalized period price index at the time that MassDOT opened bids for the project. The Base Price Index for this contract is the Steel PPI listed in the Notice to Contractors.

Period Prices of unfabricated structural steel and unfabricated reinforcing steel on a project are variable prices that have been calculated using the Period Price Date and an index of steel prices to adjust the Base Price.

The Period Price Date is the date the steel was delivered to the fabricator as evidenced by an official bill of lading submitted to the Department containing a description of the shipped materials, weights of the shipped materials and the date of shipment. This date is used to select the Period Price Index.

The index used for the calculation of Period Prices is the U.S. Department of Labor Bureau of Labor Statistics Producer Price Index (PPI) Series ID WPU101702 (Not Seasonally Adjusted, Group: Metals and Metal Products, Item: Semi-finished Steel Mill Products.) As this index is subject to revision for a period of up to four (4) months after its original publication, no price adjustments will be made until the index for the period is finalized, i.e., the index is no longer suffixed with a “(P)”.

Period Prices are determined as follows:

Period Price = Base Price X Index Factor

Index Factor = Period Price Index / Base Price Index

Example of a Period Price Calculation:

Calculate the Period Price for December 2009 using a Base Price from March 2009 of \$0.82/Pound for 1,000 Pounds of ASTM A709 (AASHTO M270) Grade A36 Structural Steel Plate.

The Period Price Date is December 2009. From the PPI website\*, the Period Price Index = 218.0.

The Base Price Date is March 2009. From the PPI website\*, the Base Price Index = 229.4.

Index Factor = Period Price Index / Base Price Index = 218.0 / 229.4 = 0.950

Period Price = Base Price X Index Factor = \$0.82/Pound X 0.950 = \$0.78/Pound

Since \$0.82 - \$0.78 = \$0.04 is less than 5% of \$0.82, no price adjustment is required.

If the \$0.04 difference shown above was greater than 5% of the Base Price, then the price adjustment would be 1,000 Pounds X \$0.04/Pound = \$40.00. Since the Period Price of \$0.78/Pound is less than the Base Price of \$0.82/Pound, indicating a drop in the price of steel between the bid and the delivery of material, a credit of \$40.00 would be owed to MassDOT. When the Period Price is higher than the Base Price, the price adjustment is owed to the Contractor.

\* To access the PPI website and obtain a Base Price Index or a Period Price Index, go to

<http://data.bls.gov/cgi-bin/srgate>

End of example.

The Contractor will be paid for unfabricated structural steel and unfabricated reinforcing steel under the respective contract pay items for all components constructed of either structural steel or reinforced Portland cement concrete under their respective Contract Pay Items.

Price adjustments, as herein provided for, will be paid separately as follows:

Structural Steel

Pay Item Number 999.449 for positive (+) pay adjustments (payments to the Contractor)

Pay Item Number 999.457 for negative (-) pay adjustments (credits to MassDOT Highway Division)

Reinforcing Steel

Pay Item Number 999.466 for positive (+) pay adjustments (payments to the Contractor)

Pay Item Number 999.467 for negative (-) pay adjustments (credits to MassDOT Highway Division)

No price adjustment will be made for price changes after the Contract Completion Date, unless the MassDOT Highway Division has approved an extension of Contract Time for the Contract.

TABLE

Steel Type	Price per Pound	
1	ASTM A615/A615M Grade 60 (AASHTO M31 Grade 60 or 420) Reinforcing Steel	\$0.66
2	ASTM A27 (AASHTO M103) Steel Castings, H-Pile Points & Pipe Pile Shoes (See Note below.)	\$0.91
3	ASTM A668 / A668M (AASHTO M102) Steel Forgings	\$0.91
4	ASTM A108 (AASHTO M169) Steel Forgings for Shear Studs	\$0.94
5	ASTM A709/A709M Grade 36 / AASHTO M270M/M270 Grade 36 or 250 Structural Steel Plate	\$1.01
6	ASTM A709/A709M Grade 36 / AASHTO M270M/M270 Grade 36 or 250 Structural Steel Shapes	\$0.93
7	ASTM A709/A709M Grade 50 / AASHTO M270M/M270 Grade 50 or 345 Structural Steel Plate	\$1.01
8	ASTM A709/A709M Grade 50 / AASHTO M270M/M270 Grade 50 or 345 Structural Steel Shapes	\$0.93
9	ASTM A709/A709M Grade 50WT / AASHTO M270M/M270 Grade 50WT or 345WT Structural Steel Plate	\$1.05
10	ASTM A709/A709M Grade 50WT / AASHTO M270M/M270 Grade 50WT or 345WT Structural Steel Shapes	\$0.94
11	ASTM A709/A709M Grade 50W / AASHTO M270M/M270 Grade 50W 345W Structural Steel Plate	\$1.05
12	ASTM A709/A709M Grade 50W / AASHTO M270M/M270 Grade 50W or 345W Structural Steel Shapes	\$0.94
13	ASTM A709/A709M Grade HPS 50W / AASHTO M270M/M270 Grade HPS 50W or 345W Structural Steel Plate	\$1.10
14	ASTM A709/A709M Grade HPS 70W / AASHTO M270M/M270 Grade HPS 70W or 485W Structural Steel Plate	\$1.17
15	ASTM A514/A514M-05 Grade HPS 100W / AASHTO M270M/M270 Grade HPS 100W or 690W Structural Steel Plate	\$1.79
16	ASTM A992/A992M Grade 50S / AASHTO M270M/M270 Grade 50S or 345S Structural Steel Plate	\$1.05
17	ASTM A992/A992M Grade 50S / AASHTO M270M/M270 Grade 50S or 345S Structural Steel Shapes	\$0.94
18	ASTM A276 Type 316 Stainless Steel	\$5.33
19	ASTM A240 Type 316 Stainless Steel	\$5.33
20	ASTM A148 Grade 80/50 Steel Castings (See Note below.)	\$1.84
21	ASTM A53 Grade B Structural Steel Pipe	\$1.17
22	ASTM A500 Grades A, B, 36 & 50 Structural Steel Pipe	\$1.17
23	ASTM A252, Grades 240 (36 KSI) & 414 (60 KSI) Pipe Pile	\$0.92
24	ASTM 252, Grade 2 Permanent Steel Casing	\$0.92
25	ASTM A36 (AASHTO M183) for H-piles, steel supports and sign supports	\$0.99
26	ASTM A328 / A328M, Grade 50 (AASHTO M202) Steel Sheetpiling	\$1.76
27	ASTM A572 / A572M, Grade 50 Sheetpiling	\$1.76
28	ASTM A36/36M, Grade 50	\$1.01
29	ASTM A570, Grade 50	\$0.99
30	ASTM A572 (AASHTO M223), Grade 50 H-Piles	\$1.01
31	ASTM A1085 Grade A (50 KSI) Steel Hollow Structural Sections (HSS), heat-treated per ASTM A1085 Supplement S1	\$1.17
32	AREA 140 LB Rail and Track Accessories	\$0.60

**NOTE:** Steel Castings are generally used only on moveable bridges. Cast iron frames, grates and pipe are not "steel" castings and will not be considered for price adjustments.

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DOCUMENT 00814

SPECIAL PROVISIONS  
PRICE ADJUSTMENT FOR PORTLAND CEMENT CONCRETE MIXES

January 12, 2009

This provision applies to all projects using greater than 100 Cubic Yards (76 Cubic Meters) of Portland cement concrete containing Portland cement as stipulated in the Notice to Contractors section of the Bid Documents. This Price Adjustment will occur on a monthly basis.

The Price Adjustment will be based on the variance in price for the Portland cement component only from the Base Price to the Period Price. It shall not include transportation or other charges.

The Base Price of Portland cement on a project is a fixed price determined at the time of bid by the Department by using the same method as for the determination of the Period Price (see below) and found in the Notice to Contractors.

The Period Price of Portland cement will be determined by using the latest published price, in dollars per ton (U.S.), for Portland cement (Type I) quoted for Boston, U.S.A. in the **Construction Economics** section of *ENR Engineering News-Record* magazine or at the ENR website <http://www.enr.com> under **Construction Economics**. The Period Price will be posted on the MassDOT website the Wednesday immediately following the publishing of the monthly price in ENR, which is normally the first week of the month.

The Contract Price of the Portland cement concrete mix will be paid under the respective item in the Contract. The price adjustment, as herein provided, upwards or downwards, will be made after the work has been performed, using the monthly period price for the month during which the work was performed.

The price adjustment applies only to the actual Portland cement content in the mix placed on the job in accordance with the Standard Specifications for Highways and Bridges, Division III, Section M4.02.01. No adjustments will be made for any cement replacement materials such as fly ash or ground granulated blast furnace slag.

The Price Adjustment will be a separate payment item. It will be determined by multiplying the number of cubic yards of Portland cement concrete placed during each monthly period times the Portland cement content percentage times the variance in price between the Base Price and Period Price of Portland cement.

This Price Adjustment will be paid only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.

No Price Adjustment will be allowed beyond the Completion Date of this Contract, unless there is a Department-approved extension of time.

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DOCUMENT 00820

**THE COMMONWEALTH OF MASSACHUSETTS  
SUPPLEMENTAL EQUAL EMPLOYMENT OPPORTUNITY,  
NON-DISCRIMINATION AND AFFIRMATIVE ACTION PROGRAM**

I. Definitions

For purposes of this contract,

"Minority" means a person who meets one or more of the following definitions:

- (a) American Indian or Native American means: all persons having origins in any of the original peoples of North America and who are recognized as an Indian by a tribe or tribal organization.
- (b) Asian means: All persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian sub-continent, or the Pacific Islands, including, but Not limited to China, Japan, Korea, Samoa, India, and the Philippine Islands.
- (c) Black means: All persons having origins in any of the Black racial groups of Africa, including, but not limited to, African-Americans, and all persons having origins in any of the original peoples of the Cape Verdean Islands.
- (d) Eskimo or Aleut means: All persons having origins in any of the peoples of Northern Canada, Greenland, Alaska, and Eastern Siberia.
- (e) Hispanic means: All persons having their origins in any of the Spanish-speaking peoples of Mexico, Puerto Rico, Cuba, Central or South America, or the Caribbean Islands.

"State construction contract" means a contract for the construction, reconstruction, installation, demolition, maintenance or repair of a building or capital facility, or a contract for the construction, reconstruction, alteration, remodeling or repair of a public work undertaken by a department, agency, board, or commission of the commonwealth.

"State assisted construction contract" means a contract for the construction, reconstruction, installation, demolition, maintenance or repair of a building or capital facility undertaken by a political subdivision of the commonwealth, or two or more political subdivisions thereof, an authority, or other instrumentality and whose costs of the contract are paid for, reimbursed, grant funded, or otherwise supported, in whole or in part, by the commonwealth.

II. Equal Opportunity, Non-Discrimination and Affirmative Action

During the performance of this Contract, the Contractor and all subcontractors (hereinafter collectively referred to as "the Contractor") for a state construction contract or a state assisted construction contract, for him/herself, his/her assignees and successors in interest, agree to comply with all applicable equal employment opportunity, non-discrimination and affirmative action requirements, including but not limited to the following:

In connection with the performance of work under this contract, the Contractor shall not discriminate against any employee or applicant for employment because of race, color, religious creed, national origin, sex, sexual orientation, genetic information, military service, age, ancestry or disability, shall not discriminate in the selection or retention of subcontractors, and shall not discriminate in the procurement of materials and rentals of equipment.

The aforesaid provision shall include, but not be limited to, the following: employment upgrading, demotion, or transfer; recruitment advertising, layoff or termination; rates of pay or other forms of compensation; conditions or privileges of employment; and selection for apprenticeship or on-the-job training opportunity. The Contractor shall comply with the provisions of chapter 151B of the Massachusetts General Laws, as amended, and all other applicable anti-discrimination and equal opportunity laws, all of which are herein incorporated by reference and made a part of this Contract.

The Contractor shall post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the Massachusetts Commission Against Discrimination setting forth the provisions of the Fair Employment Practices Law of the Commonwealth (Massachusetts General Laws Chapter 151 B).

In connection with the performance of work under this contract, the Contractor shall undertake, in good faith, affirmative action measures to eliminate any discriminatory barriers in the terms and conditions of employment on the grounds of race, color, religious creed, national origin, sex, sexual orientation, genetic information, military service, age, ancestry or disability. Such affirmative action measures shall entail positive and aggressive measures to ensure nondiscrimination and to promote equal opportunity in the areas of hiring, upgrading, demotion or transfer, recruitment, layoff or termination, rate of compensation, apprenticeship and on-the-job training programs. A list of positive and aggressive measures shall include, but not be limited to, advertising employment opportunities in minority and other community news media; notifying minority, women and other community-based organizations of employment opportunities; validating all job specifications, selection requirements, and tests; maintaining a file of names and addresses of each worker referred to the Contractor and what action was taken concerning such worker; and notifying the administering agency in writing when a union with whom the Contractor has a collective bargaining agreement has failed to refer a minority or woman worker. These and other affirmative action measures shall include all actions required to guarantee equal employment opportunity for all persons, regardless of race, color, religious creed, national origin, sex, sexual orientation, genetic information, military service, age, ancestry or disability. One purpose of this provision is to ensure to the fullest extent possible an adequate supply of skilled tradesmen for this and future Commonwealth public construction projects.

### III. Minority and Women Workforce Participation

Pursuant to his/her obligations under the preceding section, the Contractor shall strive to achieve on this project the labor participation goals contained herein. Said participation goals shall apply in each job category on this project including but not limited to bricklayers, carpenters, cement masons, electricians, ironworkers, operating engineers and those classes of work enumerated in Section 44F of Chapter 149 of the Massachusetts General Laws. The participation goals for this project shall be 15.3% for minorities and 6.9% for women. The participation goals, as set forth herein, shall not be construed as quotas or set-asides; rather, such participation goals will be used to measure the progress of the Commonwealth's equal opportunity, non-discrimination and affirmative action program. Additionally, the participation goals contained herein should not be seen or treated as a floor or as a ceiling for the employment of particular individuals or group of individuals.



#### IV. Liaison Committee

At the discretion of the agency that administers the contract for the construction project there may be established for the life of the contract a body to be known as the Liaison Committee. The Liaison Committee shall be composed of one representative each from the agency or agencies administering the contract for the construction project, hereinafter called the administering agency, a representative from the Office of Affirmative action, and such other representatives as may be designated by the administering agency. The Contractor (or his/her agent, if any, designated by him/her as the on-site equal employment opportunity officer) shall recognize the Liaison Committee as an affirmative action body, and shall establish a continuing working relationship with the Liaison Committee, consulting with the Liaison Committee on all matters related to minority recruitment, referral, employment and training.

#### V. Reports and Records

The Contractor shall prepare projected workforce tables on a quarterly basis when required by the administering agency. These shall be broken down into projections, by week, of workers required in each trade. Copies shall be furnished one week in advance of the commencement of the period covered, and also, when updated, to the administering agency and the Liaison Committee when required.

The Contractor shall prepare weekly reports in a form approved by the administering agency, unless information required is required to be reported electronically by the administering agency, the number of hours worked in each trade by each employee, identified as woman, minority, or non-minority. Copies of these shall be provided at the end of each such week to the administering agency and the Liaison Committee.

Records of employment referral orders, prepared by the Contractor, shall be made available to the administering agency on request.

The Contractor will provide all information and reports required by the administering agency on instructions issued by the administering agency and will permit access to its facilities and any books, records, accounts and other sources of information which may be determined by the administering agency to effect the employment of personnel. This provision shall apply only to information pertinent to the Commonwealth's supplementary non-discrimination, equal opportunity and access and opportunity contract requirements. Where information required is in the exclusive possession of another who fails or refuses to furnish this information, the Contractor shall so certify to the administering agency and shall set forth what efforts he has made to obtain the information.

#### VI. Access to Work Site

A designee of the administering agency and a designee of the Liaison Committee shall each have a right to access the work site.

#### VII. Solicitations for Subcontracts, and for the Procurement of Materials and Equipment

In all solicitations either by competitive bidding or negotiation made by the Contractor either for work to be performed under a subcontract or for the procurement of materials or equipment, each potential subcontractor or supplier shall be notified in writing by the Contractor of the Contractor's obligations under this contract relative to non-discrimination and equal opportunity.

## VIII. Sanctions

Whenever the administering agency believes the General or Prime Contractor or any subcontractor may not be operating in compliance with the provisions of the Fair Employment Practices Law of the Commonwealth (Massachusetts General Laws Chapter 151B), the administering agency may refer the matter to the Massachusetts Commission Against Discrimination ("Commission") for investigation.

Following the referral of a matter by the administering agency to the Massachusetts Commission Against Discrimination, and while the matter is pending before the MCAD, the administering agency may withhold payments from contractors and subcontractors when it has documentation that the contractor or subcontractor has violated the Fair Employment Practices Law with respect to its activities on the Project, or if the administering agency determines that the contractor has materially failed to comply with its obligations and the requirements of this Section. The amount withheld shall not exceed a withhold of payment to the General or Prime Contractor of 1/100 or 1% of the contract award price or \$5,000, whichever sum is greater, or, if a subcontractor is in non-compliance, a withhold by the administering agency from the General Contractor, to be assessed by the General Contractor as a charge against the subcontractor, of 1/100 or 1% of the subcontractor price, or \$1,000 whichever sum is greater, for each violation of the applicable law or contract requirements. The total withheld from anyone General or Prime Contractor or subcontractor on a Project shall not exceed \$20,000 overall. No withhold of payments or investigation by the Commission or its agent shall be initiated without the administering agency providing prior notice to the Contractor.

If, after investigation, the Massachusetts Commission Against Discrimination finds that a General or Prime Contractor or subcontractor, in commission of a state construction contract or state-assisted construction contract, violated the provisions of the Fair Employment Practices Law, the administering agency may convert the amount withheld as set forth above into a permanent sanction, as a permanent deduct from payments to the General or Prime Contractor or subcontractor, which sanction will be in addition to any such sanctions, fines or penalties imposed by the Massachusetts Commission Against Discrimination.

No sanction enumerated under this Section shall be imposed by the administering agency except after notice to the General or Prime Contractor or subcontractor and an adjudicatory proceeding, as that term is used, under Massachusetts General Laws Chapter 30A, has been conducted.

## IX. Severability

The provisions of this section are severable, and if any of these provisions shall be held unconstitutional by any court of competent jurisdiction, the decision of such court shall not affect or impair any of the remaining provisions.

X. Contractor's Certification

After award and prior to the execution of any contract for a state construction contract or a state assisted construction contract, the Prime or General Contractor shall certify that it will comply with all provisions of this Document 00820 Supplemental Equal Employment Opportunity, Non-Discrimination and Affirmative Action Program, by executing Document 00859 Contractor/Subcontractor Certification Form.

XI. Subcontractor Requirements

Prior to the award of any subcontract for a state construction contract or a state assisted construction contract, the Prime or General Contractor shall provide all prospective subcontractors with a complete copy of this Document 00820 entitled "Supplemental Equal Employment Opportunity, Non-Discrimination and Affirmative Action Program" and will incorporate the provisions of this Document 00820 into any and all contracts or work orders for all subcontractors providing work on the Project. In order to ensure that the said subcontractor's certification becomes a part of all subcontracts under the prime contract, the Prime or General Contractor shall certify in writing to the administering agency that it has complied with the requirements as set forth in the preceding paragraph by executing Document 00859 Contractor/Subcontractor Certification Form.

*Rev'd 03/07/14*

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## DOCUMENT 00821

ELECTRONIC REPORTING REQUIREMENTS  
CIVIL RIGHTS PROGRAMS AND CERTIFIED PAYROLL

Implemented on March 2, 2009

Revised June 04, 2019

The Massachusetts Department Of Transportation (MassDOT) has replaced the CHAMP reporting system with Equitable Business Opportunity Solution (EBO), a new web-based civil rights reporting software system. This system is capable of handling both civil rights reporting requirements and certified payrolls. The program's functions include the administration of Equal Employment Opportunity (EEO) requirements, On-The-Job Training requirements (OJT), Disadvantage Business Enterprise (DBE) and/or Minority / Women's Business Enterprise (M/WBE) subcontracting requirements, and the electronic collection of certified payrolls associated with MassDOT projects. In addition, this system is used to generate various data required as part of the American Recovery and Reinvestment Act (ARRA). Contractors are responsible for all coordination with all sub-contractors to ensure timely and accurate electronic submission of all required data.

## Contractor and Sub-Contractor EBO User Certification

All contractors and sub-contractors must use the EBO software system. The software vendor, Internet Government Solutions (IGS), has developed an online EBO Training Module that is available to contractors and sub-contractors. This module is a self-tutorial which allows all users in the company to access the training, complete the tutorial, and become certified as EBO users for a one time fee of \$75.00. This is the only cost to contractors and sub-contractors associated with the EBO software system. The online EBO Training Module can be accessed at [www.ebotraining.com](http://www.ebotraining.com). Click the "Register My Company" button on the login page to begin your training registration. Questions regarding EBO online training should be directed to Gerry Anguilano, IGS at (440) 238-1684.

MassDOT will track contractors and sub-contractors who have successfully completed the on-line training module. All persons performing civil rights program and/or certified payroll functions should be EBO certified.

## Vetting of Firms and Designated Firm Individuals

Contractors must authorize a Primary Log-In ID Holder who has completed EBO on-line training to have access to the EBO system by completing and submitting the "Request For EBO System Log-In/Password Form" located on the MassDOT website at: <https://www.mass.gov/how-to/how-to-get-an-ebo-login>. Contractors must also agree to comply with the EBO system user agreement located on the MassDOT website.

All subcontracts entered into on a project must include language that identifies the submission and training requirements that the sub-contractor must perform. Sub-contractors will be approved by the respective District Office of MassDOT through the existing approval process. When new sub-contractors, who have not previously worked for MassDOT, are initially selected by a general contractor, the new sub-contractor must be approved by the District before taking the EBO on-line training module.

## Interim Reporting Requirements

Until MassDOT is satisfied that the EBO system is fully operational and functioning as designed, contractors and sub-contractors will be required to submit certified payrolls manually. There will be a transition period where dual reporting, through manual and electronic submission, will be required. MassDOT, however, will notify contractors and sub-contractors when they may cease manual submission of certified payrolls.

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DOCUMENT 00859

**CONTRACTOR/SUBCONTRACTOR CERTIFICATION FORM ‡**

*The contractor shall submit this completed document 00859 to MassDOT for each subcontract.*

\_\_\_\_\_ (Contractor) Date: \_\_\_\_\_

\_\_\_\_\_ (Subcontractor)  District Approved Subcontractor

Contract No: 126590 Project No. 609035 Federal Aid No.: STP/CMQ/TAP-0033(038)X

Location: WESTFORD

Project Description: Rehabilitation of Boston Road

**PART 1 CONTRACTOR CERTIFICATION:** I hereby certify, as an authorized official of this company, that to the best of my knowledge, information and belief, the company is in compliance with all applicable federal and state laws, rules, and regulations governing fair labor and employment practices, that the company will not discriminate in their employment practices, that the company will make good faith efforts to comply with the minority employee and women employee workforce participation ratio goals and specific affirmative action steps contained in Contract Document 00820 The Commonwealth of Massachusetts Supplemental Equal Employment Opportunity, Non-Discrimination and Affirmative Action Program, and that the company will comply with the special provisions and documentation indicated below (as checked).

I further hereby certify, as an authorized official of this company, that the special provisions and documentation indicated below (as checked) have been or are included in, and made part of, the Subcontractor Agreement entered into with the firm named above.

**This is not a Federally-aided construction project**

**Document #**

- 00718 –Participation By Minority Or Women's Business Enterprises and SDVOBE†
- 00761 –Certification Regarding Debarment, Suspension, Ineligibility, and Voluntary Exclusion
- 00820 – MA Supplemental Equal Employment Opportunity, Non-Discrimination, and Affirmative Action Program
- 00821 – Electronic Reporting Requirements, Civil Rights Programs, and Certified Payroll
- 00859 – Contractor/Subcontractor Certification Form (this document)
- 00860 – MA Employment Laws
- 00861 – Applicable State Wage Rates in the Contract Proposal\*\*
- B00842 – MA Schedule of Participation By Minority or Women Business Enterprises (M/WBEs)†
- B00843 – MA Letter of Intent – M/WBEs†
  - \*\* Does not apply to Material Suppliers, unless performing work on-site
  - † Applies only if Subcontractor is a M/WBE; only include these forms for the particular M/WBE Entity
- B00844 - Schedule of Participation By SDVOBE
- B00845 - Letter of Intent – SDVOBE
- B00846 – M/WBE or SDVOBE Joint Check Arrangement Approval Form
- B00847 – Joint Venture Affidavit

**This is a Federally-aided construction project (Federal Aid Number is present)**

**Document #**

- 00719 – Special Provisions for Participation by Disadvantaged Business Enterprises†
- 00760 - Form FHWA 1273 - Required Contract Provisions for Federal-Aid Construction Contracts
- 00820 – MA Supplemental Equal Employment Opportunity, Non-Discrimination and Affirmative Action Program
- 00821 – Electronic Reporting Requirements, Civil Rights Programs and Certified Payroll
- 00859 – Contractor/Subcontractor Certification Form (this document)
- 00860 – MA Employment Laws
- 00870 – Standard Federal Equal Employment Opportunity Construction Contract Specifications Executive Order 11246, (41 CFR Parts 60-4.2 and 60-4.3 (Solicitations and Equal Opportunity Clauses)\*
- 00875 – Federal Trainee Special Provisions



- B00853 – Schedule of Participation by Disadvantaged Business Enterprise†
- B00854 – Letter of Intent – DBEs†
- B00855 – DBE Joint Check Arrangement Approval Form
- B00856 – Joint Venture Affidavit
- 00861/00880 - Applicable state and federal wage rates from Contract Proposal\*\*

\*Applicable only to Contracts or Subcontracts in excess of \$10,000

\*\*Does not apply to Material Suppliers, unless performing work on-site

† Applies only if Subcontractor is a DBE; only include these forms for the particular DBE Entity

Signed this \_\_\_\_\_ Day of \_\_\_\_\_, 20\_\_\_\_ Under The Pains And Penalties Of Perjury.

(Print Name and Title)

(Authorized Signature)

**PART 2**

**PART 2. SUBCONTRACTOR CERTIFICATION:** I hereby certify, as an authorized official of this company, that the required documents in Part 1 above were physically incorporated in our Agreement/Subcontract with the Contractor and give assurance that this company will fully comply or make every good faith effort to comply with the same. I further certify that:

1. This company recognizes that if this is a Federal-Aid Project, then this Contract is covered by the equal employment opportunity laws administered and enforced by the United States Department of Labor (“USDOL”), Office of Federal Contract Compliance Programs (“OFCCP”). By signing below, we acknowledge that this company has certain reporting obligations to the OFCCP, as specified by 41 CFR Part 60-4.2.
2. This company further acknowledges that any contractor with fifty (50) or more employees on a Federal-aid Contract with a value of fifty-thousand (\$50,000) dollars or more must annually file an EEO-1 Report (SF 100) to the EEOC, Joint Reporting Committee, on or before September 30th, each year, as specified by 41 CFR Part 60-1.7a.
3. For more information regarding the federal reporting requirements, please contact the USDOL, OFCCP Regional Office, at 1-646-264-3170 or EEO-1, Joint Reporting Committee at 1-866-286-6440. You may also find guidance at: <http://www.dol.gov/ofccp/TAGuides/consttag.pdf> or <http://www.wdol.gov/dba.aspx#0>.
4. This company  has,  has not, participated in a previous contract or subcontract subject to the Equal Opportunity clauses set forth in 41 CFR Part 60-4 and Executive Order 11246, and where required, has filed with the Joint Reporting Committee, the Director of the Office of Federal Contract Compliance Programs or the EEO Commission all reports due under the applicable filing requirements.
5. This company is in full compliance with applicable Federal and Commonwealth of Massachusetts laws, rules, and regulations and is not currently debarred or disqualified from bidding on or participating in construction contracts in any jurisdiction of the United States. See : <https://www.mass.gov/service-details/contractors-and-vendors-suspended-or-debarred-by-massdot>
6. This company is properly registered and in good standing with the Office of the Secretary of the Commonwealth.

Signed this \_\_\_\_\_ Day of \_\_\_\_\_, 20\_\_\_\_, Under The Pains And Penalties Of Perjury.

Firm: \_\_\_\_\_

Address: \_\_\_\_\_

(Print Name and Title)

Telephone Number: \_\_\_\_\_

Federal I.D. Number: \_\_\_\_\_

(Authorized Signature)

Estimated Start Date: \_\_\_\_\_

Estimated Completion Date: \_\_\_\_\_

Estimated Dollar Amount: \_\_\_\_\_

(Date)



DOCUMENT 00860

**COMMONWEALTH OF MASSACHUSETTS PUBLIC EMPLOYMENT LAWS**

Revised February 20, 2019

The Contractor's attention is directed to Massachusetts General Laws, Chapter 149, Sections 26 through 27H, and 150A. This contract is considered to fall within the ambit of that law, which provides that in general, the Prevailing Rate or Total Rate must be paid to employees working on projects funded by the Commonwealth of Massachusetts or any political subdivision including Massachusetts Department of Transportation (MassDOT).

A Federal Aid project is also subject to the Federal Minimum Wage Rate law for construction. When comparing a state minimum wage rate, monitored by the Massachusetts Attorney General, versus federal minimum wage rate, monitored by the U.S. Department of Labor Wage and Hour Division, for a particular job classification the higher wage is at all times to be paid to the affected employee.

Every contractor or subcontractor engaged in this contract to which sections twenty-seven and twenty-seven A apply will keep a true and accurate record of all mechanics and apprentices, teamsters, chauffeurs and laborers employed thereon, showing the name, address and occupational classification of each such employee on this contract, and the hours worked by, and the wages paid to, each such employee, and shall furnish to the MassDOT's Resident Engineer, on a weekly basis, a copy of said record, in a form approved by MassDOT and in accordance with M.G.L. c. 149, § 27B, signed by the employer or his/her authorized agent under the penalties of perjury.

Each such contractor or subcontractor shall preserve its payroll records for a period of three years from the date of completion of the contract.

The Prevailing Wage Rate generally includes the following:

Minimum Hourly Wage + Employer Contributions to Benefit Plans = Prevailing Wage Rate or Total Rate

Any employer who does not make contributions to Benefit Plans must pay the total Prevailing Wage Rate directly to the employee.

Any deduction from the Prevailing Wage Rate or Total Rate for contributions to benefit plans can only be for a Health & Welfare, Pension, or Supplementary Unemployment plan meeting the requirements of the Employee Retirement Income Security Act (ERISA) of 1974. The maximum allowable deduction for these benefits from the prevailing wage rate cannot be greater than the amount allowed by Executive Office of Labor (EOL) for the specified benefits. Any additional expense of providing benefits to the employees is to be borne by the employer and cannot be deducted from the Minimum Hourly Wage. If the employer's benefit expense is less than that so provided by EOL the difference will be paid directly to the employee. The rate established must be paid to all employees who perform work on the project.

When an employer makes deductions from the Minimum Hourly Wage for an employee's contribution to social security, state taxes, federal taxes, and/or other contribution programs, allowed by law, the employer shall furnish each employee a suitable pay slip, check stub or envelope notifying the employee of the amount of the deductions.

No contractor or subcontractor contracting for any part of the contract week shall require or permit any laborer or mechanic to be employed on such work in excess of forty hours in any workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times his basic rate of pay for all hours worked in excess of forty hours in such workweek, whichever is the greater number of overtime hours.

Apprentice Rates are permitted only when there is an Apprentice Agreement registered with the Massachusetts Division of Apprentice Training in accordance with M.G.L. c. 23, § 11E-11L.

The Prevailing Wage Rates issued for each project shall be the rates paid for the entire project. The Prevailing Wage Rates must be posted on the job site at all times and be visible from a public way.

In addition, each such contractor and subcontractor shall furnish to the MassDOT's Resident Engineer, within fifteen days after completion of its portion of the work, a statement, executed by the contractor or subcontractor or by any authorized officer or employee of the contractor or subcontractor who supervises the payment of wages, in the following form:

STATEMENT OF COMPLIANCE

Date: \_\_\_\_\_

I, \_\_\_\_\_ do hereby state:  
(Name of signatory party) (Title)

That I pay or supervise the payment of the persons employed by:

\_\_\_\_\_  
(Contractor or Subcontractor)

on the \_\_\_\_\_  
(MassDOT Project Location and Contract Number)

and that all mechanics and apprentices, teamsters, chauffeurs and laborers employed on said project have been paid in accordance with wages determined under the provisions of sections twenty-six and twenty-seven of chapter one hundred and forty-nine of the General Laws.

Signature \_\_\_\_\_

Title \_\_\_\_\_

The above-mentioned copies of payroll records and statements of compliance shall be available for inspection by any interested party filing a written request to the MassDOT's Resident Engineer for such inspection and copying.

Massachusetts General Laws c. 149, §27, requires annual updates to prevailing wage schedules for all public construction contracts lasting longer than one year. MassDOT will request the required updates and furnish them to the Contractor. The Contractor is required to pay no less than the wage rates indicated on the annual updated wage schedules.

MassDOT will request the updates no later than two weeks before the anniversary of the Notice to Proceed date of the contract to allow for adequate processing by the Department of Labor Standards (DLS). The effective date for the new rates will be the anniversary date of the contract (i.e. the notice to proceed date), regardless of the date of issuance on the schedule from DLS.

All bidders are cautioned that the aforementioned laws require that employers pay to covered employees no less than the applicable minimum wages. In addition, the same laws require that the applicable prevailing wages become incorporated as part of this contract. The prevailing minimum wage law establishes serious civil and criminal penalties for violations, including imprisonment and exclusion from future public contracts. Bidders are cautioned to carefully read the relevant sections of the Massachusetts General Laws.

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DOCUMENT 00861

# STATE PREVAILING WAGE RATES

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MAURA HEALEY  
Governor

KIM DRISCOLL  
Lt. Governor

Proposal No. 609035- 126590  
**THE COMMONWEALTH OF MASSACHUSETTS**  
**EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT**  
**DEPARTMENT OF LABOR STANDARDS**

**Prevailing Wage Rates**

**As determined by the Director under the provisions of the  
Massachusetts General Laws, Chapter 149, Sections 26 to 27H**

LAUREN JONES  
Secretary

MICHAEL FLANAGAN  
Director

**Awarding Authority:** MassDOT Highway  
**Contract Number:** 126590 **City/Town:** WESTFORD  
**Description of Work:** WESTFORD: Federal Aid Project No. STP/CMQ/TAP-0033(038)X Rehabilitation of Boston Road  
**Job Location:** Along Boston Road

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**Information about Prevailing Wage Schedules for Awarding Authorities and Contractors**

- **The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor.** For multi-year CM AT RISK projects, the awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. The annual update requirement is not applicable to 27F "rental of equipment" contracts. **The updated wage schedule must be provided to all contractors, including general and sub-contractors, working on the construction project.**
- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the "Wage Request Number" on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule if it has not opened bids or selected a contractor within 90 days of the date of issuance of the wage schedule. For CM AT RISK projects (bid pursuant to G.L. c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27. The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or a sub-contractor.
- Apprentices working on the project are required to be registered with the Massachusetts Division of Apprentice Standards (DAS). Apprentices must keep their apprentice identification card on their persons during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. **Any apprentice not registered with DAS regardless of whether they are registered with another federal, state, local, or private agency must be paid the journeyworker's rate.**
- Every contractor or subcontractor working on the construction project must submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee's name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. For a sample payroll reporting form go to <http://www.mass.gov/dols/pw>.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Contractors must obtain the wage schedules from awarding authorities. Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and criminal penalties.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may file a complaint with the Fair Labor Division of the office of the Attorney General at (617) 727-3465.

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
<b>Construction</b>						
(2 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2024	\$39.95	\$15.07	\$18.67	\$0.00	\$73.69
	12/01/2024	\$39.95	\$15.07	\$20.17	\$0.00	\$75.19
	01/01/2025	\$39.95	\$15.57	\$20.17	\$0.00	\$75.69
	06/01/2025	\$40.95	\$15.57	\$20.17	\$0.00	\$76.69
	12/01/2025	\$40.95	\$15.57	\$21.78	\$0.00	\$78.30
	01/01/2026	\$40.95	\$16.17	\$21.78	\$0.00	\$78.90
	06/01/2026	\$41.95	\$16.17	\$21.78	\$0.00	\$79.90
	12/01/2026	\$41.95	\$16.17	\$23.52	\$0.00	\$81.64
	01/01/2027	\$41.95	\$16.77	\$23.52	\$0.00	\$82.24
(3 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2024	\$40.02	\$15.07	\$18.67	\$0.00	\$73.76
	12/01/2024	\$40.02	\$15.07	\$20.17	\$0.00	\$75.26
	01/01/2025	\$40.02	\$15.57	\$20.17	\$0.00	\$75.76
	06/01/2025	\$41.02	\$15.57	\$20.17	\$0.00	\$76.76
	12/01/2025	\$41.02	\$15.57	\$21.78	\$0.00	\$78.37
	01/01/2026	\$41.02	\$16.17	\$21.78	\$0.00	\$78.97
	06/01/2026	\$42.02	\$16.17	\$21.78	\$0.00	\$79.97
	12/01/2026	\$42.02	\$16.17	\$23.52	\$0.00	\$81.71
	01/01/2027	\$42.02	\$16.77	\$23.52	\$0.00	\$82.31
(4 & 5 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2024	\$40.14	\$15.07	\$18.67	\$0.00	\$73.88
	12/01/2024	\$40.14	\$15.07	\$20.17	\$0.00	\$75.38
	01/01/2025	\$40.14	\$15.57	\$20.17	\$0.00	\$75.88
	06/01/2025	\$41.14	\$15.57	\$20.17	\$0.00	\$76.88
	12/01/2025	\$41.14	\$15.57	\$21.78	\$0.00	\$78.49
	01/01/2026	\$41.14	\$16.17	\$21.78	\$0.00	\$79.09
	06/01/2026	\$42.14	\$16.17	\$21.78	\$0.00	\$80.09
	12/01/2026	\$42.14	\$16.17	\$23.52	\$0.00	\$81.83
	01/01/2027	\$42.14	\$16.77	\$23.52	\$0.00	\$82.43
ADS/SUBMERSIBLE PILOT <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$103.05	\$9.40	\$23.12	\$0.00	\$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						
AIR TRACK OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$39.28	\$9.65	\$17.80	\$0.00	\$66.73
	12/01/2024	\$40.61	\$9.65	\$17.80	\$0.00	\$68.06
	06/01/2025	\$42.00	\$9.65	\$17.80	\$0.00	\$69.45
	12/01/2025	\$43.38	\$9.65	\$17.80	\$0.00	\$70.83
	06/01/2026	\$44.82	\$9.65	\$17.80	\$0.00	\$72.27
	12/01/2026	\$46.26	\$9.65	\$17.80	\$0.00	\$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
ASBESTOS REMOVER - PIPE / MECH. EQUIPT. <i>HEAT &amp; FROST INSULATORS LOCAL 6 (BOSTON)</i>	06/01/2024	\$41.80	\$14.50	\$11.05	\$0.00	\$67.35
	12/01/2024	\$42.80	\$14.50	\$11.05	\$0.00	\$68.35
	06/01/2025	\$43.80	\$14.50	\$11.05	\$0.00	\$69.35
	12/01/2025	\$44.80	\$14.50	\$11.05	\$0.00	\$70.35

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ASPHALT RAKER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
ASPHALT RAKER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$38.78	\$9.65	\$17.80	\$0.00	\$66.23
	12/01/2024	\$40.11	\$9.65	\$17.80	\$0.00	\$67.56
	06/01/2025	\$41.50	\$9.65	\$17.80	\$0.00	\$68.95
	12/01/2025	\$42.88	\$9.65	\$17.80	\$0.00	\$70.33
	06/01/2026	\$44.32	\$9.65	\$17.80	\$0.00	\$71.77
	12/01/2026	\$45.76	\$9.65	\$17.80	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$56.03	\$15.30	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.48	\$15.30	\$16.40	\$0.00	\$89.18
	06/01/2025	\$58.78	\$15.30	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.23	\$15.30	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.53	\$15.30	\$16.40	\$0.00	\$93.23
	12/01/2026	\$62.98	\$15.30	\$16.40	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$56.03	\$15.30	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.48	\$15.30	\$16.40	\$0.00	\$89.18
	06/01/2025	\$58.78	\$15.30	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.23	\$15.30	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.53	\$15.30	\$16.40	\$0.00	\$93.23
	12/01/2026	\$62.98	\$15.30	\$16.40	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BARCO-TYPE JUMPING TAMPER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$39.28	\$9.65	\$17.80	\$0.00	\$66.73
	12/01/2024	\$40.61	\$9.65	\$17.80	\$0.00	\$68.06
	06/01/2025	\$42.00	\$9.65	\$17.80	\$0.00	\$69.45
	12/01/2025	\$43.38	\$9.65	\$17.80	\$0.00	\$70.83
	06/01/2026	\$44.82	\$9.65	\$17.80	\$0.00	\$72.27
	12/01/2026	\$46.26	\$9.65	\$17.80	\$0.00	\$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
BOILER MAKER <i>BOILERMAKERS LOCAL 29</i>	01/01/2024	\$48.12	\$7.07	\$20.60	\$0.00	\$75.79

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - BOILERMAKER - Local 29**

**Effective Date - 01/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	\$31.28	\$7.07	\$13.22	\$0.00	\$51.57
2	65	\$31.28	\$7.07	\$13.22	\$0.00	\$51.57
3	70	\$33.68	\$7.07	\$14.23	\$0.00	\$54.98
4	75	\$36.09	\$7.07	\$15.24	\$0.00	\$58.40
5	80	\$38.50	\$7.07	\$16.25	\$0.00	\$61.82
6	85	\$40.90	\$7.07	\$17.28	\$0.00	\$65.25
7	90	\$43.31	\$7.07	\$18.28	\$0.00	\$68.66
8	95	\$45.71	\$7.07	\$19.32	\$0.00	\$72.10

**Notes:**

**Apprentice to Journeyworker Ratio:1:4**

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING)	02/01/2024	\$60.26	\$11.49	\$22.90	\$0.00	\$94.65
BRICKLAYERS LOCAL 3 (LOWELL)	08/01/2024	\$62.36	\$11.49	\$22.90	\$0.00	\$96.75
	02/01/2025	\$63.66	\$11.49	\$22.90	\$0.00	\$98.05
	08/01/2025	\$65.81	\$11.49	\$22.90	\$0.00	\$100.20
	02/01/2026	\$67.16	\$11.49	\$22.90	\$0.00	\$101.55
	08/01/2026	\$69.36	\$11.49	\$22.90	\$0.00	\$103.75
	02/01/2027	\$70.76	\$11.49	\$22.90	\$0.00	\$105.15



<b>Classification</b>	<b>Effective Date</b>	<b>Base Wage</b>	<b>Health</b>	<b>Pension</b>	<b>Supplemental Unemployment</b>	<b>Total Rate</b>
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**Apprentice - BRICK/PLASTER/CEMENT MASON - Local 3 Lowell**

**Effective Date - 02/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.13	\$11.49	\$22.90	\$0.00	\$64.52
2	60	\$36.16	\$11.49	\$22.90	\$0.00	\$70.55
3	70	\$42.18	\$11.49	\$22.90	\$0.00	\$76.57
4	80	\$48.21	\$11.49	\$22.90	\$0.00	\$82.60
5	90	\$54.23	\$11.49	\$22.90	\$0.00	\$88.62

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.18	\$11.49	\$22.90	\$0.00	\$65.57
2	60	\$37.42	\$11.49	\$22.90	\$0.00	\$71.81
3	70	\$43.65	\$11.49	\$22.90	\$0.00	\$78.04
4	80	\$49.89	\$11.49	\$22.90	\$0.00	\$84.28
5	90	\$56.12	\$11.49	\$22.90	\$0.00	\$90.51

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

<b>BULLDOZER/GRADER/SCRAPER</b> <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

<b>CAISSON &amp; UNDERPINNING BOTTOM MAN</b> <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2024	\$46.63	\$9.65	\$18.22	\$0.00	\$74.50
	12/01/2024	\$48.10	\$9.65	\$18.22	\$0.00	\$75.97
	06/01/2025	\$49.60	\$9.65	\$18.22	\$0.00	\$77.47
	12/01/2025	\$51.10	\$9.65	\$18.22	\$0.00	\$78.97
	06/01/2026	\$52.65	\$9.65	\$18.22	\$0.00	\$80.52
	12/01/2026	\$54.15	\$9.65	\$18.22	\$0.00	\$82.02

For apprentice rates see "Apprentice- LABORER"

<b>CAISSON &amp; UNDERPINNING LABORER</b> <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2024	\$45.48	\$9.65	\$18.22	\$0.00	\$73.35
	12/01/2024	\$46.95	\$9.65	\$18.22	\$0.00	\$74.82
	06/01/2025	\$48.45	\$9.65	\$18.22	\$0.00	\$76.32
	12/01/2025	\$49.95	\$9.65	\$18.22	\$0.00	\$77.82
	06/01/2026	\$51.50	\$9.65	\$18.22	\$0.00	\$79.37
	12/01/2026	\$53.00	\$9.65	\$18.22	\$0.00	\$80.87

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CAISSON & UNDERPINNING TOP MAN <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2024	\$45.81	\$9.65	\$18.22	\$0.00	\$73.68
	12/01/2024	\$47.28	\$9.65	\$18.22	\$0.00	\$75.15
	06/01/2025	\$48.78	\$9.65	\$18.22	\$0.00	\$76.65
	12/01/2025	\$50.28	\$9.65	\$18.22	\$0.00	\$78.15
	06/01/2026	\$51.83	\$9.65	\$18.22	\$0.00	\$79.70
	12/01/2026	\$53.33	\$9.65	\$18.22	\$0.00	\$81.20

For apprentice rates see "Apprentice- LABORER"

CARBIDE CORE DRILL OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

CARPENTER <i>CARPENTERS -ZONE 2 (Eastern Massachusetts)</i>	03/01/2024	\$47.12	\$9.83	\$19.97	\$0.00	\$76.92
	09/01/2024	\$48.37	\$9.83	\$19.97	\$0.00	\$78.17
	03/01/2025	\$49.62	\$9.83	\$19.97	\$0.00	\$79.42
	09/01/2025	\$50.87	\$9.83	\$19.97	\$0.00	\$80.67
	03/01/2026	\$52.12	\$9.83	\$19.97	\$0.00	\$81.92
	09/01/2026	\$53.37	\$9.83	\$19.97	\$0.00	\$83.17
	03/01/2027	\$54.62	\$9.83	\$19.97	\$0.00	\$84.42

**Apprentice - CARPENTER - Zone 2 Eastern MA**

**Effective Date - 03/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$21.20	\$9.83	\$1.73	\$0.00	\$32.76
2	45	\$21.20	\$9.83	\$1.73	\$0.00	\$32.76
3	55	\$25.92	\$9.83	\$3.40	\$0.00	\$39.15
4	55	\$25.92	\$9.83	\$3.40	\$0.00	\$39.15
5	70	\$32.98	\$9.83	\$16.51	\$0.00	\$59.32
6	70	\$32.98	\$9.83	\$16.51	\$0.00	\$59.32
7	80	\$37.70	\$9.83	\$18.24	\$0.00	\$65.77
8	80	\$37.70	\$9.83	\$18.24	\$0.00	\$65.77

**Effective Date - 09/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$21.77	\$9.83	\$1.73	\$0.00	\$33.33
2	45	\$21.77	\$9.83	\$1.73	\$0.00	\$33.33
3	55	\$26.60	\$9.83	\$3.40	\$0.00	\$39.83
4	55	\$26.60	\$9.83	\$3.40	\$0.00	\$39.83
5	70	\$33.86	\$9.83	\$16.51	\$0.00	\$60.20
6	70	\$33.86	\$9.83	\$16.51	\$0.00	\$60.20
7	80	\$38.70	\$9.83	\$18.24	\$0.00	\$66.77
8	80	\$38.70	\$9.83	\$18.24	\$0.00	\$66.77

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CARPENTER WOOD FRAME	10/01/2023	\$25.55	\$7.02	\$4.80	\$0.00	\$37.37
<i>CARPENTERS-ZONE 3 (Wood Frame)</i>	10/01/2024	\$26.65	\$7.02	\$4.80	\$0.00	\$38.47
	10/01/2025	\$27.75	\$7.02	\$4.80	\$0.00	\$39.57
	10/01/2026	\$28.85	\$7.02	\$4.80	\$0.00	\$40.67

All Aspects of New Wood Frame Work

**Apprentice - CARPENTER (Wood Frame) - Zone 3**

**Effective Date - 10/01/2023**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$15.33	\$7.02	\$0.00	\$0.00	\$22.35
2	60	\$15.33	\$7.02	\$0.00	\$0.00	\$22.35
3	65	\$16.61	\$7.02	\$1.00	\$0.00	\$24.63
4	70	\$17.89	\$7.02	\$1.00	\$0.00	\$25.91
5	75	\$19.16	\$7.02	\$4.80	\$0.00	\$30.98
6	80	\$20.44	\$7.02	\$4.80	\$0.00	\$32.26
7	85	\$21.72	\$7.02	\$4.80	\$0.00	\$33.54
8	90	\$23.00	\$7.02	\$4.80	\$0.00	\$34.82

**Effective Date - 10/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$15.99	\$7.02	\$0.00	\$0.00	\$23.01
2	60	\$15.99	\$7.02	\$0.00	\$0.00	\$23.01
3	65	\$17.32	\$7.02	\$1.00	\$0.00	\$25.34
4	70	\$18.66	\$7.02	\$1.00	\$0.00	\$26.68
5	75	\$19.99	\$7.02	\$4.80	\$0.00	\$31.81
6	80	\$21.32	\$7.02	\$4.80	\$0.00	\$33.14
7	85	\$22.65	\$7.02	\$4.80	\$0.00	\$34.47
8	90	\$23.99	\$7.02	\$4.80	\$0.00	\$35.81

**Notes:**

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80  
 Step 1&2 \$18.52/ 3&4 \$21.07/ 5&6 \$28.70/ 7&8 \$31.26

**Apprentice to Journeyworker Ratio:1:5**

CEMENT MASONRY/PLASTERING	01/01/2024	\$49.33	\$13.00	\$23.57	\$1.30	\$87.20
<i>BRICKLAYERS LOCAL 3 (LOWELL)</i>						

<b>Classification</b>	<b>Effective Date</b>	<b>Base Wage</b>	<b>Health</b>	<b>Pension</b>	<b>Supplemental Unemployment</b>	<b>Total Rate</b>
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**Apprentice - CEMENT MASONRY/PLASTERING - Lowell**

**Effective Date - 01/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.67	\$13.00	\$15.93	\$0.00	\$53.60
2	60	\$29.60	\$13.00	\$18.57	\$1.30	\$62.47
3	65	\$32.06	\$13.00	\$19.57	\$1.30	\$65.93
4	70	\$34.53	\$13.00	\$20.57	\$1.30	\$69.40
5	75	\$37.00	\$13.00	\$21.57	\$1.30	\$72.87
6	80	\$39.46	\$13.00	\$22.57	\$1.30	\$76.33
7	90	\$44.40	\$13.00	\$23.57	\$1.30	\$82.27

**Notes:**  
Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.

**Apprentice to Journeyworker Ratio:1:3**

<b>CHAIN SAW OPERATOR</b> <i>LABORERS - ZONE 2</i>  For apprentice rates see "Apprentice- LABORER"	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
<b>CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES</b> <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$57.15	\$15.30	\$16.40	\$0.00	\$88.85
	12/01/2024	\$58.63	\$15.30	\$16.40	\$0.00	\$90.33
	06/01/2025	\$59.96	\$15.30	\$16.40	\$0.00	\$91.66
	12/01/2025	\$61.43	\$15.30	\$16.40	\$0.00	\$93.13
	06/01/2026	\$62.76	\$15.30	\$16.40	\$0.00	\$94.46
	12/01/2026	\$64.24	\$15.30	\$16.40	\$0.00	\$95.94
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
<b>COMPRESSOR OPERATOR</b> <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$36.17	\$15.30	\$16.40	\$0.00	\$67.87
	12/01/2024	\$37.12	\$15.30	\$16.40	\$0.00	\$68.82
	06/01/2025	\$37.97	\$15.30	\$16.40	\$0.00	\$69.67
	12/01/2025	\$38.92	\$15.30	\$16.40	\$0.00	\$70.62
	06/01/2026	\$39.78	\$15.30	\$16.40	\$0.00	\$71.48
	12/01/2026	\$40.73	\$15.30	\$16.40	\$0.00	\$72.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
<b>DELEADER (BRIDGE)</b> <i>PAINTERS LOCAL 35 - ZONE 2</i>	07/01/2024	\$57.26	\$9.95	\$23.95	\$0.00	\$91.16
	01/01/2025	\$58.46	\$9.95	\$23.95	\$0.00	\$92.36

<b>Classification</b>	<b>Effective Date</b>	<b>Base Wage</b>	<b>Health</b>	<b>Pension</b>	<b>Supplemental Unemployment</b>	<b>Total Rate</b>
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**Apprentice - PAINTER Local 35 - BRIDGES/TANKS**

**Effective Date - 07/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.63	\$9.95	\$0.00	\$0.00	\$38.58
2	55	\$31.49	\$9.95	\$6.66	\$0.00	\$48.10
3	60	\$34.36	\$9.95	\$7.26	\$0.00	\$51.57
4	65	\$37.22	\$9.95	\$7.87	\$0.00	\$55.04
5	70	\$40.08	\$9.95	\$20.32	\$0.00	\$70.35
6	75	\$42.95	\$9.95	\$20.93	\$0.00	\$73.83
7	80	\$45.81	\$9.95	\$21.53	\$0.00	\$77.29
8	90	\$51.53	\$9.95	\$22.74	\$0.00	\$84.22

**Effective Date - 01/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$29.23	\$9.95	\$0.00	\$0.00	\$39.18
2	55	\$32.15	\$9.95	\$6.66	\$0.00	\$48.76
3	60	\$35.08	\$9.95	\$7.26	\$0.00	\$52.29
4	65	\$38.00	\$9.95	\$7.87	\$0.00	\$55.82
5	70	\$40.92	\$9.95	\$20.32	\$0.00	\$71.19
6	75	\$43.85	\$9.95	\$20.93	\$0.00	\$74.73
7	80	\$46.77	\$9.95	\$21.53	\$0.00	\$78.25
8	90	\$52.61	\$9.95	\$22.74	\$0.00	\$85.30

**Notes:**  
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

DEMO: ADZEMAN LABORERS - ZONE 2	12/01/2023	\$44.48	\$9.65	\$18.07	\$0.00	\$72.20
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For apprentice rates see "Apprentice- LABORER"

DEMO: BACKHOE/LOADER/HAMMER OPERATOR LABORERS - ZONE 2	12/01/2023	\$45.48	\$9.65	\$18.07	\$0.00	\$73.20
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For apprentice rates see "Apprentice- LABORER"

DEMO: BURNERS LABORERS - ZONE 2	12/01/2023	\$45.23	\$9.65	\$18.07	\$0.00	\$72.95
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For apprentice rates see "Apprentice- LABORER"

DEMO: CONCRETE CUTTER/SAWYER LABORERS - ZONE 2	12/01/2023	\$45.48	\$9.65	\$18.07	\$0.00	\$73.20
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For apprentice rates see "Apprentice- LABORER"

DEMO: JACKHAMMER OPERATOR LABORERS - ZONE 2	12/01/2023	\$45.23	\$9.65	\$18.07	\$0.00	\$72.95
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For apprentice rates see "Apprentice- LABORER"

DEMO: WRECKING LABORER LABORERS - ZONE 2	12/01/2023	\$44.48	\$9.65	\$18.07	\$0.00	\$72.20
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For apprentice rates see "Apprentice- LABORER"

Proposal No. 609035- 126590

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DIRECTIONAL DRILL MACHINE OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$68.70	\$9.40	\$23.12	\$0.00	\$101.22
	For apprentice rates see "Apprentice- PILE DRIVER"					
DIVER TENDER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
	For apprentice rates see "Apprentice- PILE DRIVER"					
DIVER TENDER (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$73.60	\$9.40	\$23.12	\$0.00	\$106.12
	For apprentice rates see "Apprentice- PILE DRIVER"					
DIVER/SLURRY (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$103.05	\$9.40	\$23.12	\$0.00	\$135.57
	For apprentice rates see "Apprentice- PILE DRIVER"					
DRAWBRIDGE OPERATOR (Construction) <i>DRAWBRIDGE - SEIU LOCAL 888</i>	07/01/2020	\$26.77	\$6.67	\$3.93	\$0.16	\$37.53
ELECTRICIAN <i>ELECTRICIANS LOCAL 103</i>	03/01/2024	\$61.86	\$13.00	\$22.21	\$0.00	\$97.07
	09/01/2024	\$63.78	\$13.00	\$22.26	\$0.00	\$99.04
	03/01/2025	\$64.98	\$13.00	\$22.30	\$0.00	\$100.28
	09/01/2025	\$66.89	\$13.00	\$22.36	\$0.00	\$102.25
	03/01/2026	\$68.09	\$13.00	\$22.39	\$0.00	\$103.48
	09/01/2026	\$70.00	\$13.00	\$22.45	\$0.00	\$105.45
	03/01/2027	\$71.19	\$13.00	\$22.49	\$0.00	\$106.68
	09/01/2027	\$73.11	\$13.00	\$22.54	\$0.00	\$108.65
	03/01/2028	\$74.31	\$13.00	\$22.58	\$0.00	\$109.89

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - ELECTRICIAN - Local 103**

**Effective Date - 03/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$24.74	\$13.00	\$0.74	\$0.00	\$38.48
2	40	\$24.74	\$13.00	\$0.74	\$0.00	\$38.48
3	45	\$27.84	\$13.00	\$16.67	\$0.00	\$57.51
4	45	\$27.84	\$13.00	\$16.67	\$0.00	\$57.51
5	50	\$30.93	\$13.00	\$17.17	\$0.00	\$61.10
6	55	\$34.02	\$13.00	\$17.67	\$0.00	\$64.69
7	60	\$37.12	\$13.00	\$18.17	\$0.00	\$68.29
8	65	\$40.21	\$13.00	\$18.68	\$0.00	\$71.89
9	70	\$43.30	\$13.00	\$19.18	\$0.00	\$75.48
10	75	\$46.40	\$13.00	\$19.69	\$0.00	\$79.09

**Effective Date - 09/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$25.51	\$13.00	\$0.77	\$0.00	\$39.28
2	40	\$25.51	\$13.00	\$0.77	\$0.00	\$39.28
3	45	\$28.70	\$13.00	\$16.69	\$0.00	\$58.39
4	45	\$28.70	\$13.00	\$16.69	\$0.00	\$58.39
5	50	\$31.89	\$13.00	\$17.20	\$0.00	\$62.09
6	55	\$35.08	\$13.00	\$17.70	\$0.00	\$65.78
7	60	\$38.27	\$13.00	\$18.21	\$0.00	\$69.48
8	65	\$41.46	\$13.00	\$18.71	\$0.00	\$73.17
9	70	\$44.65	\$13.00	\$19.22	\$0.00	\$76.87
10	75	\$47.84	\$13.00	\$19.74	\$0.00	\$80.58

**Notes :**  
 App Prior 1/1/03; 30/35/40/45/50/55/65/70/75/80

**Apprentice to Journeyworker Ratio:2:3\*\*\***

ELEVATOR CONSTRUCTOR	01/01/2022	\$65.62	\$16.03	\$20.21	\$0.00	\$101.86
ELEVATOR CONSTRUCTORS LOCAL 4						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
<b>Apprentice - ELEVATOR CONSTRUCTOR - Local 4</b>						
<b>Effective Date - 01/01/2022</b>						
Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.81	\$16.03	\$0.00	\$0.00	\$48.84
2	55	\$36.09	\$16.03	\$20.21	\$0.00	\$72.33
3	65	\$42.65	\$16.03	\$20.21	\$0.00	\$78.89
4	70	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
5	80	\$52.50	\$16.03	\$20.21	\$0.00	\$88.74

**Notes:**  
Steps 1-2 are 6 mos.; Steps 3-5 are 1 year

**Apprentice to Journeyworker Ratio:1:1**

ELEVATOR CONSTRUCTOR HELPER <i>ELEVATOR CONSTRUCTORS LOCAL 4</i>	01/01/2022	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"						
FENCE & GUARD RAIL ERECTOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$38.78	\$9.65	\$17.80	\$0.00	\$66.23
	12/01/2024	\$40.11	\$9.65	\$17.80	\$0.00	\$67.56
	06/01/2025	\$41.50	\$9.65	\$17.80	\$0.00	\$68.95
	12/01/2025	\$42.88	\$9.65	\$17.80	\$0.00	\$70.33
	06/01/2026	\$44.32	\$9.65	\$17.80	\$0.00	\$71.77
	12/01/2026	\$45.76	\$9.65	\$17.80	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2024	\$50.79	\$15.00	\$16.40	\$0.00	\$82.19
	11/01/2024	\$52.08	\$15.00	\$16.40	\$0.00	\$83.48
	05/01/2025	\$53.52	\$15.00	\$16.40	\$0.00	\$84.92
	11/01/2025	\$54.81	\$15.00	\$16.40	\$0.00	\$86.21
	05/01/2026	\$56.25	\$15.00	\$16.40	\$0.00	\$87.65
	11/01/2026	\$57.54	\$15.00	\$16.40	\$0.00	\$88.94
	05/01/2027	\$58.97	\$15.00	\$16.40	\$0.00	\$90.37
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2024	\$52.37	\$15.00	\$16.40	\$0.00	\$83.77
	11/01/2024	\$53.67	\$15.00	\$16.40	\$0.00	\$85.07
	05/01/2025	\$55.12	\$15.00	\$16.40	\$0.00	\$86.52
	11/01/2025	\$56.42	\$15.00	\$16.40	\$0.00	\$87.82
	05/01/2026	\$57.87	\$15.00	\$16.40	\$0.00	\$89.27
	11/01/2026	\$59.17	\$15.00	\$16.40	\$0.00	\$90.57
	05/01/2027	\$60.62	\$15.00	\$16.40	\$0.00	\$92.02
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						



Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2024	\$24.91	\$15.00	\$16.40	\$0.00	\$56.31
	11/01/2024	\$25.67	\$15.00	\$16.40	\$0.00	\$57.07
	05/01/2025	\$26.52	\$15.00	\$16.40	\$0.00	\$57.92
	11/01/2025	\$27.28	\$15.00	\$16.40	\$0.00	\$58.68
	05/01/2026	\$28.13	\$15.00	\$16.40	\$0.00	\$59.53
	11/01/2026	\$28.89	\$15.00	\$16.40	\$0.00	\$60.29
	05/01/2027	\$29.74	\$15.00	\$16.40	\$0.00	\$61.14
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIRE ALARM INSTALLER <i>ELECTRICIANS LOCAL 103</i>	03/01/2024	\$61.86	\$13.00	\$22.21	\$0.00	\$97.07
	09/01/2024	\$63.78	\$13.00	\$22.26	\$0.00	\$99.04
	03/01/2025	\$64.98	\$13.00	\$22.30	\$0.00	\$100.28
	09/01/2025	\$66.89	\$13.00	\$22.36	\$0.00	\$102.25
	03/01/2026	\$68.09	\$13.00	\$22.39	\$0.00	\$103.48
	09/01/2026	\$70.00	\$13.00	\$22.45	\$0.00	\$105.45
	03/01/2027	\$71.19	\$13.00	\$22.49	\$0.00	\$106.68
	09/01/2027	\$73.11	\$13.00	\$22.54	\$0.00	\$108.65
	03/01/2028	\$74.31	\$13.00	\$22.58	\$0.00	\$109.89
For apprentice rates see "Apprentice- ELECTRICIAN"						
FIRE ALARM REPAIR / MAINTENANCE <i>LOCAL 103</i> / COMMISSIONING <i>ELECTRICIANS</i>	03/01/2024	\$49.49	\$13.00	\$20.19	\$0.00	\$82.68
	09/01/2024	\$51.02	\$13.00	\$20.24	\$0.00	\$84.26
	03/01/2025	\$51.98	\$13.00	\$20.27	\$0.00	\$85.25
	09/01/2025	\$53.51	\$13.00	\$20.32	\$0.00	\$86.83
	03/01/2026	\$54.47	\$13.00	\$20.34	\$0.00	\$87.81
	09/01/2026	\$56.00	\$13.00	\$20.39	\$0.00	\$89.39
	03/01/2027	\$56.95	\$13.00	\$20.42	\$0.00	\$90.37
	09/01/2027	\$58.49	\$13.00	\$20.46	\$0.00	\$91.95
03/01/2028	\$59.45	\$13.00	\$20.49	\$0.00	\$92.94	
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"						
FIREMAN (ASST. ENGINEER) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$45.23	\$15.30	\$16.40	\$0.00	\$76.93
	12/01/2024	\$46.41	\$15.30	\$16.40	\$0.00	\$78.11
	06/01/2025	\$47.47	\$15.30	\$16.40	\$0.00	\$79.17
	12/01/2025	\$48.64	\$15.30	\$16.40	\$0.00	\$80.34
	06/01/2026	\$49.70	\$15.30	\$16.40	\$0.00	\$81.40
	12/01/2026	\$50.88	\$15.30	\$16.40	\$0.00	\$82.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FLAGGER & SIGNALER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$27.01	\$9.65	\$17.80	\$0.00	\$54.46
	12/01/2024	\$27.01	\$9.65	\$17.80	\$0.00	\$54.46
	06/01/2025	\$28.09	\$9.65	\$17.80	\$0.00	\$55.54
	12/01/2025	\$28.09	\$9.65	\$17.80	\$0.00	\$55.54
	06/01/2026	\$29.21	\$9.65	\$17.80	\$0.00	\$56.66
	12/01/2026	\$29.21	\$9.65	\$17.80	\$0.00	\$56.66
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FLOORCOVERER <i>FLOORCOVERERS LOCAL 2168 ZONE I</i>	03/01/2024	\$54.73	\$8.83	\$20.27	\$0.00	\$83.83
	09/01/2024	\$56.23	\$8.83	\$20.27	\$0.00	\$85.33
	03/01/2025	\$57.73	\$8.83	\$20.27	\$0.00	\$86.83
	09/01/2025	\$59.23	\$8.83	\$20.27	\$0.00	\$88.33
	03/01/2026	\$60.73	\$8.83	\$20.27	\$0.00	\$89.83
	09/01/2026	\$62.23	\$8.83	\$20.27	\$0.00	\$91.33
	03/01/2027	\$63.73	\$8.83	\$20.27	\$0.00	\$92.83

**Apprentice - FLOORCOVERER - Local 2168 Zone I**

**Effective Date - 03/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$24.63	\$8.83	\$1.76	\$0.00	\$35.22
2	45	\$24.63	\$8.83	\$1.76	\$0.00	\$35.22
3	55	\$30.10	\$8.83	\$3.52	\$0.00	\$42.45
4	55	\$30.10	\$8.83	\$3.52	\$0.00	\$42.45
5	70	\$38.31	\$8.83	\$16.75	\$0.00	\$63.89
6	70	\$38.31	\$8.83	\$16.75	\$0.00	\$63.89
7	80	\$43.78	\$8.83	\$18.51	\$0.00	\$71.12
8	80	\$43.78	\$8.83	\$18.51	\$0.00	\$71.12

**Effective Date - 09/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$25.30	\$8.83	\$1.76	\$0.00	\$35.89
2	45	\$25.30	\$8.83	\$1.76	\$0.00	\$35.89
3	55	\$30.93	\$8.83	\$3.52	\$0.00	\$43.28
4	55	\$30.93	\$8.83	\$3.52	\$0.00	\$43.28
5	70	\$39.36	\$8.83	\$16.75	\$0.00	\$64.94
6	70	\$39.36	\$8.83	\$16.75	\$0.00	\$64.94
7	80	\$44.98	\$8.83	\$18.51	\$0.00	\$72.32
8	80	\$44.98	\$8.83	\$18.51	\$0.00	\$72.32

**Notes:** Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

FORK LIFT/CHERRY PICKER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$56.03	\$15.30	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.48	\$15.30	\$16.40	\$0.00	\$89.18
	06/01/2025	\$58.78	\$15.30	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.23	\$15.30	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.53	\$15.30	\$16.40	\$0.00	\$93.23
	12/01/2026	\$62.98	\$15.30	\$16.40	\$0.00	\$94.68

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
GENERATOR/LIGHTING PLANT/HEATERS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$36.17	\$15.30	\$16.40	\$0.00	\$67.87
	12/01/2024	\$37.12	\$15.30	\$16.40	\$0.00	\$68.82
	06/01/2025	\$37.97	\$15.30	\$16.40	\$0.00	\$69.67
	12/01/2025	\$38.92	\$15.30	\$16.40	\$0.00	\$70.62
	06/01/2026	\$39.78	\$15.30	\$16.40	\$0.00	\$71.48
	12/01/2026	\$40.73	\$15.30	\$16.40	\$0.00	\$72.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) <i>GLAZIERS LOCAL 35 (ZONE 2)</i>	07/01/2024	\$46.76	\$9.95	\$23.95	\$0.00	\$80.66
	01/01/2025	\$47.96	\$9.95	\$23.95	\$0.00	\$81.86

**Apprentice - GLAZIER - Local 35 Zone 2**

**Effective Date - 07/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.38	\$9.95	\$0.00	\$0.00	\$33.33
2	55	\$25.72	\$9.95	\$6.66	\$0.00	\$42.33
3	60	\$28.06	\$9.95	\$7.26	\$0.00	\$45.27
4	65	\$30.39	\$9.95	\$7.87	\$0.00	\$48.21
5	70	\$32.73	\$9.95	\$20.32	\$0.00	\$63.00
6	75	\$35.07	\$9.95	\$20.93	\$0.00	\$65.95
7	80	\$37.41	\$9.95	\$21.53	\$0.00	\$68.89
8	90	\$42.08	\$9.95	\$22.74	\$0.00	\$74.77

**Effective Date - 01/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.98	\$9.95	\$0.00	\$0.00	\$33.93
2	55	\$26.38	\$9.95	\$6.66	\$0.00	\$42.99
3	60	\$28.78	\$9.95	\$7.26	\$0.00	\$45.99
4	65	\$31.17	\$9.95	\$7.87	\$0.00	\$48.99
5	70	\$33.57	\$9.95	\$20.32	\$0.00	\$63.84
6	75	\$35.97	\$9.95	\$20.93	\$0.00	\$66.85
7	80	\$38.37	\$9.95	\$21.53	\$0.00	\$69.85
8	90	\$43.16	\$9.95	\$22.74	\$0.00	\$75.85

**Notes:**

Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

HOISTING ENGINEER/CRANES/GRADALLS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$56.03	\$15.30	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.48	\$15.30	\$16.40	\$0.00	\$89.18
	06/01/2025	\$58.78	\$15.30	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.23	\$15.30	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.53	\$15.30	\$16.40	\$0.00	\$93.23
	12/01/2026	\$62.98	\$15.30	\$16.40	\$0.00	\$94.68

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - OPERATING ENGINEERS - Local 4**

**Effective Date - 06/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$30.82	\$15.30	\$0.00	\$0.00	\$46.12
2	60	\$33.62	\$15.30	\$16.40	\$0.00	\$65.32
3	65	\$36.42	\$15.30	\$16.40	\$0.00	\$68.12
4	70	\$39.22	\$15.30	\$16.40	\$0.00	\$70.92
5	75	\$42.02	\$15.30	\$16.40	\$0.00	\$73.72
6	80	\$44.82	\$15.30	\$16.40	\$0.00	\$76.52
7	85	\$47.63	\$15.30	\$16.40	\$0.00	\$79.33
8	90	\$50.43	\$15.30	\$16.40	\$0.00	\$82.13

**Effective Date - 12/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$31.61	\$0.00	\$0.00	\$0.00	\$31.61
2	60	\$34.49	\$15.30	\$16.40	\$0.00	\$66.19
3	65	\$37.36	\$15.30	\$16.40	\$0.00	\$69.06
4	70	\$40.24	\$15.30	\$16.40	\$0.00	\$71.94
5	75	\$43.11	\$15.30	\$16.40	\$0.00	\$74.81
6	80	\$45.98	\$15.30	\$16.40	\$0.00	\$77.68
7	85	\$48.86	\$15.30	\$16.40	\$0.00	\$80.56
8	90	\$51.73	\$15.30	\$16.40	\$0.00	\$83.43

**Notes:**

**Apprentice to Journeyworker Ratio:1:6**

HVAC (DUCTWORK)	02/01/2024	\$57.22	\$14.59	\$27.50	\$2.98	\$102.29
SHEETMETAL WORKERS LOCAL 17 - A	08/01/2024	\$58.97	\$14.59	\$27.50	\$2.98	\$104.04
	02/01/2025	\$60.72	\$14.59	\$27.50	\$2.98	\$105.79
	08/01/2025	\$62.57	\$14.59	\$27.50	\$2.98	\$107.64
	02/01/2026	\$64.52	\$14.59	\$27.50	\$2.98	\$109.59

For apprentice rates see "Apprentice- SHEET METAL WORKER"

HVAC (ELECTRICAL CONTROLS)	03/01/2024	\$61.86	\$13.00	\$22.21	\$0.00	\$97.07
ELECTRICIANS LOCAL 103	09/01/2024	\$63.78	\$13.00	\$22.26	\$0.00	\$99.04
	03/01/2025	\$64.98	\$13.00	\$22.30	\$0.00	\$100.28
	09/01/2025	\$66.89	\$13.00	\$22.36	\$0.00	\$102.25
	03/01/2026	\$68.09	\$13.00	\$22.39	\$0.00	\$103.48
	09/01/2026	\$70.00	\$13.00	\$22.45	\$0.00	\$105.45
	03/01/2027	\$71.19	\$13.00	\$22.49	\$0.00	\$106.68
	09/01/2027	\$73.11	\$13.00	\$22.54	\$0.00	\$108.65
	03/01/2028	\$74.31	\$13.00	\$22.58	\$0.00	\$109.89

For apprentice rates see "Apprentice- ELECTRICIAN"

Proposal No. 609035- 126590

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
HVAC (TESTING AND BALANCING - AIR) <i>SHEETMETAL WORKERS LOCAL 17 - A</i>	02/01/2024	\$57.22	\$14.59	\$27.50	\$2.98	\$102.29
	08/01/2024	\$58.97	\$14.59	\$27.50	\$2.98	\$104.04
	02/01/2025	\$60.72	\$14.59	\$27.50	\$2.98	\$105.79
	08/01/2025	\$62.57	\$14.59	\$27.50	\$2.98	\$107.64
	02/01/2026	\$64.52	\$14.59	\$27.50	\$2.98	\$109.59
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (TESTING AND BALANCING -WATER) <i>PIPEFITTERS LOCAL 537</i>	03/01/2024	\$65.28	\$12.70	\$21.80	\$0.00	\$99.78
	09/01/2024	\$67.08	\$12.70	\$21.80	\$0.00	\$101.58
	03/01/2025	\$68.88	\$12.70	\$21.80	\$0.00	\$103.38
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HVAC MECHANIC <i>PIPEFITTERS LOCAL 537</i>	03/01/2024	\$65.28	\$12.70	\$21.80	\$0.00	\$99.78
	09/01/2024	\$67.08	\$12.70	\$21.80	\$0.00	\$101.58
	03/01/2025	\$68.88	\$12.70	\$21.80	\$0.00	\$103.38
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HYDRAULIC DRILLS <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						
HYDRAULIC DRILLS (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$39.28	\$9.65	\$17.80	\$0.00	\$66.73
	12/01/2024	\$40.61	\$9.65	\$17.80	\$0.00	\$68.06
	06/01/2025	\$42.00	\$9.65	\$17.80	\$0.00	\$69.45
	12/01/2025	\$43.38	\$9.65	\$17.80	\$0.00	\$70.83
	06/01/2026	\$44.82	\$9.65	\$17.80	\$0.00	\$72.27
	12/01/2026	\$46.26	\$9.65	\$17.80	\$0.00	\$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
INSULATOR (PIPES & TANKS) <i>HEAT &amp; FROST INSULATORS LOCAL 6 (BOSTON)</i>	09/01/2023	\$53.50	\$14.75	\$19.61	\$0.00	\$87.86
	09/01/2024	\$56.92	\$14.75	\$19.61	\$0.00	\$91.28
	09/01/2025	\$60.34	\$14.75	\$19.61	\$0.00	\$94.70
	09/01/2026	\$63.76	\$14.75	\$19.61	\$0.00	\$98.12

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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**Apprentice - ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Boston**

**Effective Date - 09/01/2023**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.75	\$14.75	\$14.32	\$0.00	\$55.82
2	60	\$32.10	\$14.75	\$15.37	\$0.00	\$62.22
3	70	\$37.45	\$14.75	\$16.43	\$0.00	\$68.63
4	80	\$42.80	\$14.75	\$17.49	\$0.00	\$75.04

**Effective Date - 09/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.46	\$14.75	\$14.32	\$0.00	\$57.53
2	60	\$34.15	\$14.75	\$15.37	\$0.00	\$64.27
3	70	\$39.84	\$14.75	\$16.43	\$0.00	\$71.02
4	80	\$45.54	\$14.75	\$17.49	\$0.00	\$77.78

**Notes:**

Steps are 1 year

**Apprentice to Journeyworker Ratio:1:4**

IRONWORKER/WELDER IRONWORKERS LOCAL 7 (LAWRENCE AREA)	03/16/2024	\$49.56	\$8.35	\$26.70	\$0.00	\$84.61
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**Apprentice - IRONWORKER - Local 7 Lawrence**

**Effective Date - 03/16/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$29.74	\$8.35	\$26.70	\$0.00	\$64.79
2	70	\$34.69	\$8.35	\$26.70	\$0.00	\$69.74
3	75	\$37.17	\$8.35	\$26.70	\$0.00	\$72.22
4	80	\$39.65	\$8.35	\$26.70	\$0.00	\$74.70
5	85	\$42.13	\$8.35	\$26.70	\$0.00	\$77.18
6	90	\$44.60	\$8.35	\$26.70	\$0.00	\$79.65

**Notes:**

**Apprentice to Journeyworker Ratio:1:4**

JACKHAMMER & PAVING BREAKER OPERATOR LABORERS - ZONE 2	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

LABORER LABORERS - ZONE 2	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
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**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - LABORER - Zone 2**

**Effective Date - 12/01/2023**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$22.72	\$9.65	\$16.89	\$0.00	\$49.26
2	70	\$26.50	\$9.65	\$16.89	\$0.00	\$53.04
3	80	\$30.29	\$9.65	\$16.89	\$0.00	\$56.83
4	90	\$34.07	\$9.65	\$16.89	\$0.00	\$60.61

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

LABORER (HEAVY & HIGHWAY)	06/01/2024	\$38.53	\$9.65	\$17.80	\$0.00	\$65.98
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2024	\$39.86	\$9.65	\$17.80	\$0.00	\$67.31
	06/01/2025	\$41.25	\$9.65	\$17.80	\$0.00	\$68.70
	12/01/2025	\$42.63	\$9.65	\$17.80	\$0.00	\$70.08
	06/01/2026	\$44.07	\$9.65	\$17.80	\$0.00	\$71.52
	12/01/2026	\$45.51	\$9.65	\$17.80	\$0.00	\$72.96

**Apprentice - LABORER (Heavy & Highway) - Zone 2**

**Effective Date - 06/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$23.12	\$9.65	\$17.80	\$0.00	\$50.57
2	70	\$26.97	\$9.65	\$17.80	\$0.00	\$54.42
3	80	\$30.82	\$9.65	\$17.80	\$0.00	\$58.27
4	90	\$34.68	\$9.65	\$17.80	\$0.00	\$62.13

**Effective Date - 12/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$23.92	\$9.65	\$17.80	\$0.00	\$51.37
2	70	\$27.90	\$9.65	\$17.80	\$0.00	\$55.35
3	80	\$31.89	\$9.65	\$17.80	\$0.00	\$59.34
4	90	\$35.87	\$9.65	\$17.80	\$0.00	\$63.32

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

LABORER: CARPENTER TENDER	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
LABORERS - ZONE 2						

For apprentice rates see "Apprentice- LABORER"

LABORER: CEMENT FINISHER TENDER	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65
LABORERS - ZONE 2						

For apprentice rates see "Apprentice- LABORER"

LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER	12/01/2023	\$37.95	\$9.65	\$17.20	\$0.00	\$64.80
LABORERS - ZONE 2						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$38.78	\$9.65	\$17.80	\$0.00	\$66.23
	12/01/2024	\$40.11	\$9.65	\$17.80	\$0.00	\$67.56
	06/01/2025	\$41.50	\$9.65	\$17.80	\$0.00	\$68.95
	12/01/2025	\$42.88	\$9.65	\$17.80	\$0.00	\$70.33
	06/01/2026	\$44.32	\$9.65	\$17.80	\$0.00	\$71.77
	12/01/2026	\$45.76	\$9.65	\$17.80	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
LABORER: MULTI-TRADE TENDER <i>LABORERS - ZONE 2</i>	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
For apprentice rates see "Apprentice- LABORER"						
LABORER: TREE REMOVER <i>LABORERS - ZONE 2</i>	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
This classification applies to the removal of standing trees, and the trimming and removal of branches and limbs when related to public works construction or site clearance incidental to construction . For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$38.78	\$9.65	\$17.80	\$0.00	\$66.23
	12/01/2024	\$40.11	\$9.65	\$17.80	\$0.00	\$67.56
	06/01/2025	\$41.50	\$9.65	\$17.80	\$0.00	\$68.95
	12/01/2025	\$42.88	\$9.65	\$17.80	\$0.00	\$70.33
	06/01/2026	\$44.32	\$9.65	\$17.80	\$0.00	\$71.77
	12/01/2026	\$45.76	\$9.65	\$17.80	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
MARBLE & TILE FINISHERS <i>BRICKLAYERS LOCAL 3 - MARBLE &amp; TILE</i>	02/01/2024	\$47.89	\$11.49	\$21.37	\$0.00	\$80.75
	08/01/2024	\$49.57	\$11.49	\$21.37	\$0.00	\$82.43
	02/01/2025	\$50.61	\$11.49	\$21.37	\$0.00	\$83.47
	08/01/2025	\$52.33	\$11.49	\$21.37	\$0.00	\$85.19
	02/01/2026	\$53.41	\$11.49	\$21.37	\$0.00	\$86.27
	08/01/2026	\$55.17	\$11.49	\$21.37	\$0.00	\$88.03
	02/01/2027	\$56.29	\$11.49	\$21.37	\$0.00	\$89.15



**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - MARBLE & TILE FINISHER - Local 3 Marble & Tile**

**Effective Date - 02/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.95	\$11.49	\$21.37	\$0.00	\$56.81
2	60	\$28.73	\$11.49	\$21.37	\$0.00	\$61.59
3	70	\$33.52	\$11.49	\$21.37	\$0.00	\$66.38
4	80	\$38.31	\$11.49	\$21.37	\$0.00	\$71.17
5	90	\$43.10	\$11.49	\$21.37	\$0.00	\$75.96

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.79	\$11.49	\$21.37	\$0.00	\$57.65
2	60	\$29.74	\$11.49	\$21.37	\$0.00	\$62.60
3	70	\$34.70	\$11.49	\$21.37	\$0.00	\$67.56
4	80	\$39.66	\$11.49	\$21.37	\$0.00	\$72.52
5	90	\$44.61	\$11.49	\$21.37	\$0.00	\$77.47

**Notes:**

**Apprentice to Journeyworker Ratio:1:3**

MARBLE MASONS, TILELAYERS & TERRAZZO MECH	02/01/2024	\$62.42	\$11.49	\$23.56	\$0.00	\$97.47
BRICKLAYERS LOCAL 3 - MARBLE & TILE	08/01/2024	\$64.52	\$11.49	\$23.56	\$0.00	\$99.57
	02/01/2025	\$65.82	\$11.49	\$23.56	\$0.00	\$100.87
	08/01/2025	\$67.97	\$11.49	\$23.56	\$0.00	\$103.02
	02/01/2026	\$69.32	\$11.49	\$23.56	\$0.00	\$104.37
	08/01/2026	\$71.52	\$11.49	\$23.56	\$0.00	\$106.57
	02/01/2027	\$72.92	\$11.49	\$23.56	\$0.00	\$107.97

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - MARBLE-TILE-TERRAZZO MECHANIC - Local 3 Marble & Tile**

**Effective Date - 02/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.21	\$11.49	\$23.56	\$0.00	\$66.26
2	60	\$37.45	\$11.49	\$23.56	\$0.00	\$72.50
3	70	\$43.69	\$11.49	\$23.56	\$0.00	\$78.74
4	80	\$49.94	\$11.49	\$23.56	\$0.00	\$84.99
5	90	\$56.18	\$11.49	\$23.56	\$0.00	\$91.23

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.26	\$11.49	\$23.56	\$0.00	\$67.31
2	60	\$38.71	\$11.49	\$23.56	\$0.00	\$73.76
3	70	\$45.16	\$11.49	\$23.56	\$0.00	\$80.21
4	80	\$51.62	\$11.49	\$23.56	\$0.00	\$86.67
5	90	\$58.07	\$11.49	\$23.56	\$0.00	\$93.12

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

MECH. SWEEPER OPERATOR (ON CONST. SITES) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MECHANICS MAINTENANCE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MILLWRIGHT (Zone 2) <i>MILLWRIGHTS LOCAL 1121 - Zone 2</i>	01/01/2024	\$42.76	\$10.08	\$21.47	\$0.00	\$74.31
	01/06/2025	\$45.09	\$10.08	\$21.47	\$0.00	\$76.64
	01/05/2026	\$47.42	\$10.08	\$21.47	\$0.00	\$78.97

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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**Apprentice - MILLWRIGHT - Local 1121 Zone 2**

**Effective Date - 01/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$23.52	\$10.08	\$5.50	\$0.00	\$39.10
2	65	\$27.79	\$10.08	\$6.50	\$0.00	\$44.37
3	75	\$32.07	\$10.08	\$18.97	\$0.00	\$61.12
4	85	\$36.35	\$10.08	\$19.97	\$0.00	\$66.40

**Effective Date - 01/06/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$24.80	\$10.08	\$5.50	\$0.00	\$40.38
2	65	\$29.31	\$10.08	\$6.50	\$0.00	\$45.89
3	75	\$33.82	\$10.08	\$18.97	\$0.00	\$62.87
4	85	\$38.33	\$10.08	\$19.97	\$0.00	\$68.38

**Notes:** Step 1&2 Appr. indentured after 1/6/2020 receive no pension, but do receive annuity. (Step 1 \$5.72, Step 2 \$6.66)  
Steps are 2,000 hours

**Apprentice to Journeyworker Ratio:1:4**

MORTAR MIXER LABORERS - ZONE 2	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

OILER (OTHER THAN TRUCK CRANES,GRADALLS) OPERATING ENGINEERS LOCAL 4	06/01/2024	\$24.71	\$15.30	\$16.40	\$0.00	\$56.41
	12/01/2024	\$25.37	\$15.30	\$16.40	\$0.00	\$57.07
	06/01/2025	\$25.97	\$15.30	\$16.40	\$0.00	\$57.67
	12/01/2025	\$26.63	\$15.30	\$16.40	\$0.00	\$58.33
	06/01/2026	\$27.22	\$15.30	\$16.40	\$0.00	\$58.92
	12/01/2026	\$27.89	\$15.30	\$16.40	\$0.00	\$59.59

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

OILER (TRUCK CRANES, GRADALLS) OPERATING ENGINEERS LOCAL 4	06/01/2024	\$30.28	\$15.30	\$16.40	\$0.00	\$61.98
	12/01/2024	\$31.08	\$15.30	\$16.40	\$0.00	\$62.78
	06/01/2025	\$31.80	\$15.30	\$16.40	\$0.00	\$63.50
	12/01/2025	\$32.60	\$15.30	\$16.40	\$0.00	\$64.30
	06/01/2026	\$33.32	\$15.30	\$16.40	\$0.00	\$65.02
	12/01/2026	\$34.12	\$15.30	\$16.40	\$0.00	\$65.82

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

OTHER POWER DRIVEN EQUIPMENT - CLASS II OPERATING ENGINEERS LOCAL 4	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

PAINTER (BRIDGES/TANKS) PAINTERS LOCAL 35 - ZONE 2	07/01/2024	\$57.26	\$9.95	\$23.95	\$0.00	\$91.16
	01/01/2025	\$58.46	\$9.95	\$23.95	\$0.00	\$92.36

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - PAINTER Local 35 - BRIDGES/TANKS**

**Effective Date - 07/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.63	\$9.95	\$0.00	\$0.00	\$38.58
2	55	\$31.49	\$9.95	\$6.66	\$0.00	\$48.10
3	60	\$34.36	\$9.95	\$7.26	\$0.00	\$51.57
4	65	\$37.22	\$9.95	\$7.87	\$0.00	\$55.04
5	70	\$40.08	\$9.95	\$20.32	\$0.00	\$70.35
6	75	\$42.95	\$9.95	\$20.93	\$0.00	\$73.83
7	80	\$45.81	\$9.95	\$21.53	\$0.00	\$77.29
8	90	\$51.53	\$9.95	\$22.74	\$0.00	\$84.22

**Effective Date - 01/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$29.23	\$9.95	\$0.00	\$0.00	\$39.18
2	55	\$32.15	\$9.95	\$6.66	\$0.00	\$48.76
3	60	\$35.08	\$9.95	\$7.26	\$0.00	\$52.29
4	65	\$38.00	\$9.95	\$7.87	\$0.00	\$55.82
5	70	\$40.92	\$9.95	\$20.32	\$0.00	\$71.19
6	75	\$43.85	\$9.95	\$20.93	\$0.00	\$74.73
7	80	\$46.77	\$9.95	\$21.53	\$0.00	\$78.25
8	90	\$52.61	\$9.95	\$22.74	\$0.00	\$85.30

**Notes:**

Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

PAINTER (SPRAY OR SANDBLAST, NEW) *	07/01/2024	\$48.16	\$9.95	\$23.95	\$0.00	\$82.06
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. PAINTERS LOCAL 35 - ZONE 2	01/01/2025	\$49.36	\$9.95	\$23.95	\$0.00	\$83.26

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - New**

**Effective Date - 07/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.08	\$9.95	\$0.00	\$0.00	\$34.03
2	55	\$26.49	\$9.95	\$6.66	\$0.00	\$43.10
3	60	\$28.90	\$9.95	\$7.26	\$0.00	\$46.11
4	65	\$31.30	\$9.95	\$7.87	\$0.00	\$49.12
5	70	\$33.71	\$9.95	\$20.32	\$0.00	\$63.98
6	75	\$36.12	\$9.95	\$20.93	\$0.00	\$67.00
7	80	\$38.53	\$9.95	\$21.53	\$0.00	\$70.01
8	90	\$43.34	\$9.95	\$22.74	\$0.00	\$76.03

**Effective Date - 01/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.68	\$9.95	\$0.00	\$0.00	\$34.63
2	55	\$27.15	\$9.95	\$6.66	\$0.00	\$43.76
3	60	\$29.62	\$9.95	\$7.26	\$0.00	\$46.83
4	65	\$32.08	\$9.95	\$7.87	\$0.00	\$49.90
5	70	\$34.55	\$9.95	\$20.32	\$0.00	\$64.82
6	75	\$37.02	\$9.95	\$20.93	\$0.00	\$67.90
7	80	\$39.49	\$9.95	\$21.53	\$0.00	\$70.97
8	90	\$44.42	\$9.95	\$22.74	\$0.00	\$77.11

**Notes:**

Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

PAINTER (SPRAY OR SANDBLAST, REPAINT)	07/01/2024	\$46.22	\$9.95	\$23.95	\$0.00	\$80.12
PAINTERS LOCAL 35 - ZONE 2	01/01/2025	\$47.42	\$9.95	\$23.95	\$0.00	\$81.32

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint**

**Effective Date - 07/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.11	\$9.95	\$0.00	\$0.00	\$33.06
2	55	\$25.42	\$9.95	\$6.66	\$0.00	\$42.03
3	60	\$27.73	\$9.95	\$7.26	\$0.00	\$44.94
4	65	\$30.04	\$9.95	\$7.87	\$0.00	\$47.86
5	70	\$32.35	\$9.95	\$20.32	\$0.00	\$62.62
6	75	\$34.67	\$9.95	\$20.93	\$0.00	\$65.55
7	80	\$36.98	\$9.95	\$21.53	\$0.00	\$68.46
8	90	\$41.60	\$9.95	\$22.74	\$0.00	\$74.29

**Effective Date - 01/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.71	\$9.95	\$0.00	\$0.00	\$33.66
2	55	\$26.08	\$9.95	\$6.66	\$0.00	\$42.69
3	60	\$28.45	\$9.95	\$7.26	\$0.00	\$45.66
4	65	\$30.82	\$9.95	\$7.87	\$0.00	\$48.64
5	70	\$33.19	\$9.95	\$20.32	\$0.00	\$63.46
6	75	\$35.57	\$9.95	\$20.93	\$0.00	\$66.45
7	80	\$37.94	\$9.95	\$21.53	\$0.00	\$69.42
8	90	\$42.68	\$9.95	\$22.74	\$0.00	\$75.37

**Notes:**  
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

PAINTER / TAPER (BRUSH, NEW) *	07/01/2024	\$46.76	\$9.95	\$23.95	\$0.00	\$80.66
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. PAINTERS LOCAL 35 - ZONE 2	01/01/2025	\$47.96	\$9.95	\$23.95	\$0.00	\$81.86

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - PAINTER - Local 35 Zone 2 - BRUSH NEW**

**Effective Date - 07/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.38	\$9.95	\$0.00	\$0.00	\$33.33
2	55	\$25.72	\$9.95	\$6.66	\$0.00	\$42.33
3	60	\$28.06	\$9.95	\$7.26	\$0.00	\$45.27
4	65	\$30.39	\$9.95	\$7.87	\$0.00	\$48.21
5	70	\$32.73	\$9.95	\$20.32	\$0.00	\$63.00
6	75	\$35.07	\$9.95	\$20.93	\$0.00	\$65.95
7	80	\$37.41	\$9.95	\$21.53	\$0.00	\$68.89
8	90	\$42.08	\$9.95	\$22.74	\$0.00	\$74.77

**Effective Date - 01/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.98	\$9.95	\$0.00	\$0.00	\$33.93
2	55	\$26.38	\$9.95	\$6.66	\$0.00	\$42.99
3	60	\$28.78	\$9.95	\$7.26	\$0.00	\$45.99
4	65	\$31.17	\$9.95	\$7.87	\$0.00	\$48.99
5	70	\$33.57	\$9.95	\$20.32	\$0.00	\$63.84
6	75	\$35.97	\$9.95	\$20.93	\$0.00	\$66.85
7	80	\$38.37	\$9.95	\$21.53	\$0.00	\$69.85
8	90	\$43.16	\$9.95	\$22.74	\$0.00	\$75.85

**Notes:**  
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

PAINTER / TAPER (BRUSH, REPAINT)	07/01/2024	\$44.82	\$9.95	\$23.95	\$0.00	\$78.72
PAINTERS LOCAL 35 - ZONE 2	01/01/2025	\$46.02	\$9.95	\$23.95	\$0.00	\$79.92

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - PAINTER Local 35 Zone 2 - BRUSH REPAINT**

**Effective Date - 07/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.41	\$9.95	\$0.00	\$0.00	\$32.36
2	55	\$24.65	\$9.95	\$6.66	\$0.00	\$41.26
3	60	\$26.89	\$9.95	\$7.26	\$0.00	\$44.10
4	65	\$29.13	\$9.95	\$7.87	\$0.00	\$46.95
5	70	\$31.37	\$9.95	\$20.32	\$0.00	\$61.64
6	75	\$33.62	\$9.95	\$20.93	\$0.00	\$64.50
7	80	\$35.86	\$9.95	\$21.53	\$0.00	\$67.34
8	90	\$40.34	\$9.95	\$22.74	\$0.00	\$73.03

**Effective Date - 01/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.01	\$9.95	\$0.00	\$0.00	\$32.96
2	55	\$25.31	\$9.95	\$6.66	\$0.00	\$41.92
3	60	\$27.61	\$9.95	\$7.26	\$0.00	\$44.82
4	65	\$29.91	\$9.95	\$7.87	\$0.00	\$47.73
5	70	\$32.21	\$9.95	\$20.32	\$0.00	\$62.48
6	75	\$34.52	\$9.95	\$20.93	\$0.00	\$65.40
7	80	\$36.82	\$9.95	\$21.53	\$0.00	\$68.30
8	90	\$41.42	\$9.95	\$22.74	\$0.00	\$74.11

**Notes:**  
Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

PAINTER TRAFFIC MARKINGS (HEAVY/HIGHWAY)	06/01/2024	\$38.53	\$9.65	\$17.80	\$0.00	\$65.98
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2024	\$39.86	\$9.65	\$17.80	\$0.00	\$67.31
	06/01/2025	\$41.25	\$9.65	\$17.80	\$0.00	\$68.70
	12/01/2025	\$42.63	\$9.65	\$17.80	\$0.00	\$70.08
	06/01/2026	\$44.07	\$9.65	\$17.80	\$0.00	\$71.52
	12/01/2026	\$45.51	\$9.65	\$17.80	\$0.00	\$72.96

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)

PANEL & PICKUP TRUCKS DRIVER	06/01/2024	\$39.78	\$15.07	\$18.67	\$0.00	\$73.52
TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	12/01/2024	\$39.78	\$15.07	\$20.17	\$0.00	\$75.02
	01/01/2025	\$39.78	\$15.57	\$20.17	\$0.00	\$75.52
	06/01/2025	\$40.78	\$15.57	\$20.17	\$0.00	\$76.52
	12/01/2025	\$40.78	\$15.57	\$21.78	\$0.00	\$78.13
	01/01/2026	\$40.78	\$16.17	\$21.78	\$0.00	\$78.73
	06/01/2026	\$41.78	\$16.17	\$21.78	\$0.00	\$79.73
	12/01/2026	\$41.78	\$16.17	\$23.52	\$0.00	\$81.47
	01/01/2027	\$41.78	\$16.77	\$23.52	\$0.00	\$82.07



Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i> For apprentice rates see "Apprentice- PILE DRIVER"	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
PILE DRIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59

**Apprentice - PILE DRIVER - Local 56 Zone 1**

**Effective Date - 08/01/2020**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.54	\$9.40	\$23.12	\$0.00	\$57.06
2	60	\$29.44	\$9.40	\$23.12	\$0.00	\$61.96
3	70	\$34.35	\$9.40	\$23.12	\$0.00	\$66.87
4	75	\$36.80	\$9.40	\$23.12	\$0.00	\$69.32
5	80	\$39.26	\$9.40	\$23.12	\$0.00	\$71.78
6	80	\$39.26	\$9.40	\$23.12	\$0.00	\$71.78
7	90	\$44.16	\$9.40	\$23.12	\$0.00	\$76.68
8	90	\$44.16	\$9.40	\$23.12	\$0.00	\$76.68

**Notes:**  
 % Indentured After 10/1/17; 45/45/55/55/70/70/80/80  
 Step 1&2 \$34.01/ 3&4 \$41.46/ 5&6 \$62.80/ 7&8 \$69.25

**Apprentice to Journeyworker Ratio:1:5**

PIPEFITTER & STEAMFITTER <i>PIPEFITTERS LOCAL 537</i>	03/01/2024	\$65.28	\$12.70	\$21.80	\$0.00	\$99.78
	09/01/2024	\$67.08	\$12.70	\$21.80	\$0.00	\$101.58
	03/01/2025	\$68.88	\$12.70	\$21.80	\$0.00	\$103.38

<b>Classification</b>	<b>Effective Date</b>	<b>Base Wage</b>	<b>Health</b>	<b>Pension</b>	<b>Supplemental Unemployment</b>	<b>Total Rate</b>
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**Apprentice - PIPEFITTER - Local 537**

**Effective Date - 03/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$26.11	\$12.70	\$9.05	\$0.00	\$47.86
2	45	\$29.38	\$12.70	\$21.80	\$0.00	\$63.88
3	60	\$39.17	\$12.70	\$21.80	\$0.00	\$73.67
4	70	\$45.70	\$12.70	\$21.80	\$0.00	\$80.20
5	80	\$52.22	\$12.70	\$21.80	\$0.00	\$86.72

**Effective Date - 09/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$26.83	\$12.70	\$9.05	\$0.00	\$48.58
2	45	\$30.19	\$12.70	\$21.80	\$0.00	\$64.69
3	60	\$40.25	\$12.70	\$21.80	\$0.00	\$74.75
4	70	\$46.96	\$12.70	\$21.80	\$0.00	\$81.46
5	80	\$53.66	\$12.70	\$21.80	\$0.00	\$88.16

**Notes:**

\*\* 1:3; 3:15; 1:10 thereafter / Steps are 1 yr.  
 Refrig/AC Mechanic \*\*1:1;1:2;2:4;3:6;4:8;5:10;6:12;7:14;8:17;9:20;10:23(Max)

**Apprentice to Journeyworker Ratio:\*\***

PIPELAYER LABORERS - ZONE 2	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

PIPELAYER (HEAVY & HIGHWAY) LABORERS - ZONE 2 (HEAVY & HIGHWAY)	06/01/2024	\$38.78	\$9.65	\$17.80	\$0.00	\$66.23
	12/01/2024	\$40.11	\$9.65	\$17.80	\$0.00	\$67.56
	06/01/2025	\$41.50	\$9.65	\$17.80	\$0.00	\$68.95
	12/01/2025	\$42.88	\$9.65	\$17.80	\$0.00	\$70.33
	06/01/2026	\$44.32	\$9.65	\$17.80	\$0.00	\$71.77
	12/01/2026	\$45.76	\$9.65	\$17.80	\$0.00	\$73.21

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

PLUMBERS & GASFITTERS PLUMBERS & GASFITTERS LOCAL 12	03/03/2024	\$67.74	\$14.32	\$19.11	\$0.00	\$101.17
	09/01/2024	\$69.54	\$14.32	\$19.11	\$0.00	\$102.97
	03/02/2025	\$71.34	\$14.32	\$19.11	\$0.00	\$104.77

<b>Classification</b>	<b>Effective Date</b>	<b>Base Wage</b>	<b>Health</b>	<b>Pension</b>	<b>Supplemental Unemployment</b>	<b>Total Rate</b>
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**Apprentice - PLUMBER/GASFITTER - Local 12**

**Effective Date - 03/03/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$23.71	\$14.32	\$6.88	\$0.00	\$44.91
2	40	\$27.10	\$14.32	\$7.82	\$0.00	\$49.24
3	55	\$37.26	\$14.32	\$10.65	\$0.00	\$62.23
4	65	\$44.03	\$14.32	\$12.53	\$0.00	\$70.88
5	75	\$50.81	\$14.32	\$14.41	\$0.00	\$79.54

**Effective Date - 09/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$24.34	\$14.32	\$6.88	\$0.00	\$45.54
2	40	\$27.82	\$14.32	\$7.82	\$0.00	\$49.96
3	55	\$38.25	\$14.32	\$10.65	\$0.00	\$63.22
4	65	\$45.20	\$14.32	\$12.53	\$0.00	\$72.05
5	75	\$52.16	\$14.32	\$14.41	\$0.00	\$80.89

**Notes:**  
 \*\* 1:2; 2:6; 3:10; 4:14; 5:19/Steps are 1 yr  
 Step4 with lic\$69.00, Step5 with lic\$76.87

**Apprentice to Journeyworker Ratio:\*\***

PNEUMATIC CONTROLS (TEMP.) <i>PIPEFITTERS LOCAL 537</i>	03/01/2024	\$65.28	\$12.70	\$21.80	\$0.00	\$99.78
	09/01/2024	\$67.08	\$12.70	\$21.80	\$0.00	\$101.58
	03/01/2025	\$68.88	\$12.70	\$21.80	\$0.00	\$103.38

For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"

PNEUMATIC DRILL/TOOL OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

PNEUMATIC DRILL/TOOL OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$38.78	\$9.65	\$17.80	\$0.00	\$66.23
	12/01/2024	\$40.11	\$9.65	\$17.80	\$0.00	\$67.56
	06/01/2025	\$41.50	\$9.65	\$17.80	\$0.00	\$68.95
	12/01/2025	\$42.88	\$9.65	\$17.80	\$0.00	\$70.33
	06/01/2026	\$44.32	\$9.65	\$17.80	\$0.00	\$71.77
	12/01/2026	\$45.76	\$9.65	\$17.80	\$0.00	\$73.21

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

POWDERMAN & BLASTER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.86	\$9.65	\$17.14	\$0.00	\$65.65
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For apprentice rates see "Apprentice- LABORER"

POWDERMAN & BLASTER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$39.53	\$9.40	\$17.55	\$0.00	\$66.48
	12/01/2024	\$40.86	\$9.40	\$17.55	\$0.00	\$67.81
	06/01/2025	\$42.25	\$9.40	\$17.55	\$0.00	\$69.20
	12/01/2025	\$43.63	\$9.40	\$17.55	\$0.00	\$70.58
	06/01/2026	\$45.07	\$9.40	\$17.55	\$0.00	\$72.02
	12/01/2026	\$46.51	\$9.40	\$17.55	\$0.00	\$73.46

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

Proposal No. 609035- 126590

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
POWER SHOVEL/DERRICK/TRENCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$56.03	\$15.30	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.48	\$15.30	\$16.40	\$0.00	\$89.18
	06/01/2025	\$58.78	\$15.30	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.23	\$15.30	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.53	\$15.30	\$16.40	\$0.00	\$93.23
	12/01/2026	\$62.98	\$15.30	\$16.40	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (CONCRETE) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (DEWATERING, OTHER) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$36.17	\$15.30	\$16.40	\$0.00	\$67.87
	12/01/2024	\$37.12	\$15.30	\$16.40	\$0.00	\$68.82
	06/01/2025	\$37.97	\$15.30	\$16.40	\$0.00	\$69.67
	12/01/2025	\$38.92	\$15.30	\$16.40	\$0.00	\$70.62
	06/01/2026	\$39.78	\$15.30	\$16.40	\$0.00	\$71.48
	12/01/2026	\$40.73	\$15.30	\$16.40	\$0.00	\$72.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
READY-MIX CONCRETE DRIVER <i>TEAMSTERS 170 - J.G. MacLellan (Lowell)</i>	05/01/2024	\$30.00	\$11.17	\$6.55	\$0.00	\$47.72
	01/01/2025	\$30.00	\$11.57	\$6.55	\$0.00	\$48.12
	05/01/2025	\$30.50	\$11.57	\$6.65	\$0.00	\$48.72
	01/01/2026	\$30.50	\$11.97	\$6.65	\$0.00	\$49.12
RECLAIMERS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
RIDE-ON MOTORIZED BUGGY OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
ROLLER/SPREADER/MULCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg) <i>ROOFERS LOCAL 33</i>	02/01/2024	\$50.03	\$12.78	\$21.45	\$0.00	\$84.26
	08/01/2024	\$51.53	\$12.78	\$21.45	\$0.00	\$85.76
	02/01/2025	\$52.78	\$12.78	\$21.45	\$0.00	\$87.01
	08/01/2025	\$54.28	\$12.78	\$21.45	\$0.00	\$88.51
	02/01/2026	\$55.53	\$12.78	\$21.45	\$0.00	\$89.76

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - ROOFER - Local 33**

**Effective Date - 02/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.02	\$12.78	\$6.21	\$0.00	\$44.01
2	60	\$30.02	\$12.78	\$21.45	\$0.00	\$64.25
3	65	\$32.52	\$12.78	\$21.45	\$0.00	\$66.75
4	75	\$37.52	\$12.78	\$21.45	\$0.00	\$71.75
5	85	\$42.53	\$12.78	\$21.45	\$0.00	\$76.76

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.77	\$12.78	\$6.21	\$0.00	\$44.76
2	60	\$30.92	\$12.78	\$21.45	\$0.00	\$65.15
3	65	\$33.49	\$12.78	\$21.45	\$0.00	\$67.72
4	75	\$38.65	\$12.78	\$21.45	\$0.00	\$72.88
5	85	\$43.80	\$12.78	\$21.45	\$0.00	\$78.03

**Notes:** \*\* 1:5, 2:6-10, the 1:10; Reroofing: 1:4, then 1:1  
 Step 1 is 2000 hrs.; Steps 2-5 are 1000 hrs.  
 (Hot Pitch Mechanics' receive \$1.00 hr. above ROOFER)

**Apprentice to Journeyworker Ratio:\*\***

ROOFER SLATE / TILE / PRECAST CONCRETE	02/01/2024	\$50.28	\$12.78	\$21.45	\$0.00	\$84.51
ROOFERS LOCAL 33	08/01/2024	\$51.78	\$12.78	\$21.45	\$0.00	\$86.01
	02/01/2025	\$53.03	\$12.78	\$21.45	\$0.00	\$87.26
	08/01/2025	\$54.53	\$12.78	\$21.45	\$0.00	\$88.76
	02/01/2026	\$55.78	\$12.78	\$21.45	\$0.00	\$90.01

For apprentice rates see "Apprentice- ROOFER"

SHEETMETAL WORKER	02/01/2024	\$57.22	\$14.59	\$27.50	\$2.98	\$102.29
SHEETMETAL WORKERS LOCAL 17 - A	08/01/2024	\$58.97	\$14.59	\$27.50	\$2.98	\$104.04
	02/01/2025	\$60.72	\$14.59	\$27.50	\$2.98	\$105.79
	08/01/2025	\$62.57	\$14.59	\$27.50	\$2.98	\$107.64
	02/01/2026	\$64.52	\$14.59	\$27.50	\$2.98	\$109.59

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - SHEET METAL WORKER - Local 17-A**

**Effective Date - 02/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$24.03	\$14.59	\$6.13	\$0.00	\$44.75
2	42	\$24.03	\$14.59	\$6.13	\$0.00	\$44.75
3	47	\$26.89	\$14.59	\$12.11	\$1.61	\$55.20
4	47	\$26.89	\$14.59	\$12.11	\$1.61	\$55.20
5	52	\$29.75	\$14.59	\$13.09	\$1.72	\$59.15
6	52	\$29.75	\$14.59	\$13.34	\$1.73	\$59.41
7	60	\$34.33	\$14.59	\$14.75	\$1.91	\$65.58
8	65	\$37.19	\$14.59	\$15.73	\$2.03	\$69.54
9	75	\$42.92	\$14.59	\$17.69	\$2.26	\$77.46
10	85	\$48.64	\$14.59	\$19.15	\$2.47	\$84.85

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$24.77	\$14.59	\$6.13	\$0.00	\$45.49
2	42	\$24.77	\$14.59	\$6.13	\$0.00	\$45.49
3	47	\$27.72	\$14.59	\$12.11	\$1.63	\$56.05
4	47	\$27.72	\$14.59	\$12.11	\$1.63	\$56.05
5	52	\$30.66	\$14.59	\$13.09	\$1.75	\$60.09
6	52	\$30.66	\$14.59	\$13.34	\$1.76	\$60.35
7	60	\$35.38	\$14.59	\$14.75	\$1.94	\$66.66
8	65	\$38.33	\$14.59	\$15.73	\$2.06	\$70.71
9	75	\$44.23	\$14.59	\$17.69	\$2.30	\$78.81
10	85	\$50.12	\$14.59	\$19.15	\$2.52	\$86.38

**Notes:**  
Steps are 6 mos.

**Apprentice to Journeyworker Ratio:1:4**

SPECIALIZED EARTH MOVING EQUIP < 35 TONS	06/01/2024	\$40.24	\$15.07	\$18.67	\$0.00	\$73.98
TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	12/01/2024	\$40.24	\$15.07	\$20.17	\$0.00	\$75.48
	01/01/2025	\$40.24	\$15.57	\$20.17	\$0.00	\$75.98
	06/01/2025	\$41.24	\$15.57	\$20.17	\$0.00	\$76.98
	12/01/2025	\$41.24	\$15.57	\$21.78	\$0.00	\$78.59
	01/01/2026	\$41.24	\$16.17	\$21.78	\$0.00	\$79.19
	06/01/2026	\$42.24	\$16.17	\$21.78	\$0.00	\$80.19
	12/01/2026	\$42.24	\$16.17	\$23.52	\$0.00	\$81.93
	01/01/2027	\$42.24	\$16.77	\$23.52	\$0.00	\$82.53

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
SPECIALIZED EARTH MOVING EQUIP > 35 TONS <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2024	\$40.53	\$15.07	\$18.67	\$0.00	\$74.27
	12/01/2024	\$40.53	\$15.07	\$20.17	\$0.00	\$75.77
	01/01/2025	\$40.53	\$15.57	\$20.17	\$0.00	\$76.27
	06/01/2025	\$41.53	\$15.57	\$20.17	\$0.00	\$77.27
	12/01/2025	\$41.53	\$15.57	\$21.78	\$0.00	\$78.88
	01/01/2026	\$41.53	\$16.17	\$21.78	\$0.00	\$79.48
	06/01/2026	\$42.53	\$16.17	\$21.78	\$0.00	\$80.48
	12/01/2026	\$42.53	\$16.17	\$23.52	\$0.00	\$82.22
	01/01/2027	\$42.53	\$16.77	\$23.52	\$0.00	\$82.82
SPRINKLER FITTER <i>SPRINKLER FITTERS LOCAL 550 - (Section A) Zone 1</i>	03/01/2024	\$69.04	\$11.51	\$23.30	\$0.00	\$103.85
	10/01/2024	\$70.84	\$11.51	\$23.30	\$0.00	\$105.65
	03/01/2025	\$72.64	\$11.51	\$23.30	\$0.00	\$107.45

**Apprentice - SPRINKLER FITTER - Local 550 (Section A) Zone 1**

**Effective Date - 03/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$24.16	\$11.51	\$12.90	\$0.00	\$48.57
2	40	\$27.62	\$11.51	\$13.70	\$0.00	\$52.83
3	45	\$31.07	\$11.51	\$14.50	\$0.00	\$57.08
4	50	\$34.52	\$11.51	\$15.30	\$0.00	\$61.33
5	55	\$37.97	\$11.51	\$16.10	\$0.00	\$65.58
6	60	\$41.42	\$11.51	\$16.90	\$0.00	\$69.83
7	65	\$44.88	\$11.51	\$17.70	\$0.00	\$74.09
8	70	\$48.33	\$11.51	\$18.50	\$0.00	\$78.34
9	75	\$51.78	\$11.51	\$19.30	\$0.00	\$82.59
10	80	\$55.23	\$11.51	\$20.10	\$0.00	\$86.84

**Effective Date - 10/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$24.79	\$11.51	\$12.90	\$0.00	\$49.20
2	40	\$28.34	\$11.51	\$13.70	\$0.00	\$53.55
3	45	\$31.88	\$11.51	\$14.50	\$0.00	\$57.89
4	50	\$35.42	\$11.51	\$15.30	\$0.00	\$62.23
5	55	\$38.96	\$11.51	\$16.10	\$0.00	\$66.57
6	60	\$42.50	\$11.51	\$16.90	\$0.00	\$70.91
7	65	\$46.05	\$11.51	\$17.70	\$0.00	\$75.26
8	70	\$49.59	\$11.51	\$18.50	\$0.00	\$79.60
9	75	\$53.13	\$11.51	\$19.30	\$0.00	\$83.94
10	80	\$56.67	\$11.51	\$20.10	\$0.00	\$88.28

**Notes:** Apprentice entered prior 9/30/10:  
40/45/50/55/60/65/70/75/80/85  
Steps are 850 hours

**Apprentice to Journeyworker Ratio:1:3**

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
STEAM BOILER OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TELECOMMUNICATION TECHNICIAN <i>ELECTRICIANS LOCAL 103</i>	03/01/2024	\$49.49	\$13.00	\$20.19	\$0.00	\$82.68
	09/01/2024	\$51.02	\$13.00	\$20.24	\$0.00	\$84.26
	03/01/2025	\$51.98	\$13.00	\$20.27	\$0.00	\$85.25
	09/01/2025	\$53.51	\$13.00	\$20.32	\$0.00	\$86.83
	03/01/2026	\$54.47	\$13.00	\$20.34	\$0.00	\$87.81
	09/01/2026	\$56.00	\$13.00	\$20.39	\$0.00	\$89.39
	03/01/2027	\$56.95	\$13.00	\$20.42	\$0.00	\$90.37
	09/01/2027	\$58.49	\$13.00	\$20.46	\$0.00	\$91.95
03/01/2028	\$59.45	\$13.00	\$20.49	\$0.00	\$92.94	



**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - TELECOMMUNICATION TECHNICIAN - Local 103**

**Effective Date - 03/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$22.27	\$13.00	\$0.67	\$0.00	\$35.94
2	45	\$22.27	\$13.00	\$0.67	\$0.00	\$35.94
3	50	\$24.75	\$13.00	\$16.16	\$0.00	\$53.91
4	50	\$24.75	\$13.00	\$16.16	\$0.00	\$53.91
5	55	\$27.22	\$13.00	\$16.57	\$0.00	\$56.79
6	60	\$29.69	\$13.00	\$16.97	\$0.00	\$59.66
7	65	\$32.17	\$13.00	\$17.38	\$0.00	\$62.55
8	70	\$34.64	\$13.00	\$17.78	\$0.00	\$65.42
9	75	\$37.12	\$13.00	\$18.18	\$0.00	\$68.30
10	80	\$39.59	\$13.00	\$18.58	\$0.00	\$71.17

**Effective Date - 09/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$22.96	\$13.00	\$0.69	\$0.00	\$36.65
2	45	\$22.96	\$13.00	\$0.69	\$0.00	\$36.65
3	50	\$25.51	\$13.00	\$16.16	\$0.00	\$54.67
4	50	\$25.51	\$13.00	\$16.16	\$0.00	\$54.67
5	55	\$28.06	\$13.00	\$16.57	\$0.00	\$57.63
6	60	\$30.61	\$13.00	\$16.97	\$0.00	\$60.58
7	65	\$33.16	\$13.00	\$17.38	\$0.00	\$63.54
8	70	\$35.71	\$13.00	\$17.78	\$0.00	\$66.49
9	75	\$38.27	\$13.00	\$18.18	\$0.00	\$69.45
10	80	\$40.82	\$13.00	\$18.58	\$0.00	\$72.40

**Notes:**

**Apprentice to Journeyworker Ratio:1:1**

TERRAZZO FINISHERS	02/01/2024	\$61.34	\$11.49	\$23.59	\$0.00	\$96.42
BRICKLAYERS LOCAL 3 - MARBLE & TILE	08/01/2024	\$63.44	\$11.49	\$23.59	\$0.00	\$98.52
	02/01/2025	\$64.74	\$11.49	\$23.59	\$0.00	\$99.82
	08/01/2025	\$66.89	\$11.49	\$23.59	\$0.00	\$101.97
	02/01/2026	\$68.24	\$11.49	\$23.59	\$0.00	\$103.32
	08/01/2026	\$70.44	\$11.49	\$23.59	\$0.00	\$105.52
	02/01/2027	\$71.84	\$11.49	\$23.59	\$0.00	\$106.92

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - TERRAZZO FINISHER - Local 3 Marble & Tile**

**Effective Date - 02/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.67	\$11.49	\$23.59	\$0.00	\$65.75
2	60	\$36.80	\$11.49	\$23.59	\$0.00	\$71.88
3	70	\$42.94	\$11.49	\$23.59	\$0.00	\$78.02
4	80	\$49.07	\$11.49	\$23.59	\$0.00	\$84.15
5	90	\$55.21	\$11.49	\$23.59	\$0.00	\$90.29

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.72	\$11.49	\$23.59	\$0.00	\$66.80
2	60	\$38.06	\$11.49	\$23.59	\$0.00	\$73.14
3	70	\$44.41	\$11.49	\$23.59	\$0.00	\$79.49
4	80	\$50.75	\$11.49	\$23.59	\$0.00	\$85.83
5	90	\$57.10	\$11.49	\$23.59	\$0.00	\$92.18

**Notes:**

**Apprentice to Journeyworker Ratio:1:3**

<b>TEST BORING DRILLER</b> <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2024	\$49.81	\$9.65	\$18.22	\$0.00	\$77.68
	12/01/2024	\$51.28	\$9.65	\$18.22	\$0.00	\$79.15
	06/01/2025	\$52.78	\$9.65	\$18.22	\$0.00	\$80.65
	12/01/2025	\$54.28	\$9.65	\$18.22	\$0.00	\$82.15
	06/01/2026	\$55.83	\$9.65	\$18.22	\$0.00	\$83.70
	12/01/2026	\$57.33	\$9.65	\$18.22	\$0.00	\$85.20
For apprentice rates see "Apprentice- LABORER"						
<b>TEST BORING DRILLER HELPER</b> <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2024	\$45.60	\$9.65	\$18.22	\$0.00	\$73.47
	12/01/2024	\$47.07	\$9.65	\$18.22	\$0.00	\$74.94
	06/01/2025	\$48.57	\$9.65	\$18.22	\$0.00	\$76.44
	12/01/2025	\$50.07	\$9.65	\$18.22	\$0.00	\$77.94
	06/01/2026	\$51.62	\$9.65	\$18.22	\$0.00	\$79.49
	12/01/2026	\$53.12	\$9.65	\$18.22	\$0.00	\$80.99
For apprentice rates see "Apprentice- LABORER"						
<b>TEST BORING LABORER</b> <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2024	\$45.48	\$9.65	\$18.22	\$0.00	\$73.35
	12/01/2024	\$46.95	\$9.65	\$18.22	\$0.00	\$74.82
	06/01/2025	\$48.45	\$9.65	\$18.22	\$0.00	\$76.32
	12/01/2025	\$49.95	\$9.65	\$18.22	\$0.00	\$77.82
	06/01/2026	\$51.50	\$9.65	\$18.22	\$0.00	\$79.37
	12/01/2026	\$53.00	\$9.65	\$18.22	\$0.00	\$80.87
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TRACTORS/PORTABLE STEAM GENERATORS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.41	\$15.30	\$16.40	\$0.00	\$87.11
	12/01/2024	\$56.85	\$15.30	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.13	\$15.30	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.57	\$15.30	\$16.40	\$0.00	\$91.27
	06/01/2026	\$60.85	\$15.30	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.29	\$15.30	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TRAILERS FOR EARTH MOVING EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2024	\$40.82	\$15.07	\$18.67	\$0.00	\$74.56
	12/01/2024	\$40.82	\$15.07	\$20.17	\$0.00	\$76.06
	01/01/2025	\$40.82	\$15.57	\$20.17	\$0.00	\$76.56
	06/01/2025	\$41.82	\$15.57	\$20.17	\$0.00	\$77.56
	12/01/2025	\$41.82	\$15.57	\$21.78	\$0.00	\$79.17
	01/01/2026	\$41.82	\$16.17	\$21.78	\$0.00	\$79.77
	06/01/2026	\$42.82	\$16.17	\$21.78	\$0.00	\$80.77
	12/01/2026	\$42.82	\$16.17	\$23.52	\$0.00	\$82.51
01/01/2027	\$42.82	\$16.77	\$23.52	\$0.00	\$83.11	
TUNNEL WORK - COMPRESSED AIR <i>LABORERS (COMPRESSED AIR)</i>	06/01/2024	\$57.71	\$9.65	\$19.00	\$0.00	\$86.36
	12/01/2024	\$59.18	\$9.65	\$19.00	\$0.00	\$87.83
	06/01/2025	\$60.68	\$9.65	\$19.00	\$0.00	\$89.33
	12/01/2025	\$62.18	\$9.65	\$19.00	\$0.00	\$90.83
	06/01/2026	\$63.73	\$9.65	\$19.00	\$0.00	\$92.38
	12/01/2026	\$65.23	\$9.65	\$19.00	\$0.00	\$93.88
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) <i>LABORERS (COMPRESSED AIR)</i>	06/01/2024	\$59.71	\$9.65	\$19.00	\$0.00	\$88.36
	12/01/2024	\$61.18	\$9.65	\$19.00	\$0.00	\$89.83
	06/01/2025	\$62.68	\$9.65	\$19.00	\$0.00	\$91.33
	12/01/2025	\$64.18	\$9.65	\$19.00	\$0.00	\$92.83
	06/01/2026	\$65.73	\$9.65	\$19.00	\$0.00	\$94.38
	12/01/2026	\$67.23	\$9.65	\$19.00	\$0.00	\$95.88
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR <i>LABORERS (FREE AIR TUNNEL)</i>	06/01/2024	\$49.78	\$9.65	\$19.00	\$0.00	\$78.43
	12/01/2024	\$51.25	\$9.65	\$19.00	\$0.00	\$79.90
	06/01/2025	\$52.75	\$9.65	\$19.00	\$0.00	\$81.40
	12/01/2025	\$54.25	\$9.65	\$19.00	\$0.00	\$82.90
	06/01/2026	\$55.80	\$9.65	\$19.00	\$0.00	\$84.45
	12/01/2026	\$57.30	\$9.65	\$19.00	\$0.00	\$85.95
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR (HAZ. WASTE) <i>LABORERS (FREE AIR TUNNEL)</i>	06/01/2024	\$51.78	\$9.65	\$19.00	\$0.00	\$80.43
	12/01/2024	\$53.25	\$9.65	\$19.00	\$0.00	\$81.90
	06/01/2025	\$54.75	\$9.65	\$19.00	\$0.00	\$83.40
	12/01/2025	\$56.25	\$9.65	\$19.00	\$0.00	\$84.90
	06/01/2026	\$57.80	\$9.65	\$19.00	\$0.00	\$86.45
	12/01/2026	\$59.30	\$9.65	\$19.00	\$0.00	\$87.95
For apprentice rates see "Apprentice- LABORER"						

Proposal No. 609035- 126590

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
VAC-HAUL <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2024	\$40.24	\$15.07	\$18.67	\$0.00	\$73.98
	12/01/2024	\$40.24	\$15.07	\$20.17	\$0.00	\$75.48
	01/01/2025	\$40.24	\$15.57	\$20.17	\$0.00	\$75.98
	06/01/2025	\$41.24	\$15.57	\$20.17	\$0.00	\$76.98
	12/01/2025	\$41.24	\$15.57	\$21.78	\$0.00	\$78.59
	01/01/2026	\$41.24	\$16.17	\$21.78	\$0.00	\$79.19
	06/01/2026	\$42.24	\$16.17	\$21.78	\$0.00	\$80.19
	12/01/2026	\$42.24	\$16.17	\$23.52	\$0.00	\$81.93
	01/01/2027	\$42.24	\$16.77	\$23.52	\$0.00	\$82.53
WAGON DRILL OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
WAGON DRILL OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$38.78	\$9.65	\$17.80	\$0.00	\$66.23
	12/01/2024	\$40.11	\$9.65	\$17.80	\$0.00	\$67.56
	06/01/2025	\$41.50	\$9.65	\$17.80	\$0.00	\$68.95
	12/01/2025	\$42.88	\$9.65	\$17.80	\$0.00	\$70.33
	06/01/2026	\$44.32	\$9.65	\$17.80	\$0.00	\$71.77
	12/01/2026	\$45.76	\$9.65	\$17.80	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
WASTE WATER PUMP OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$56.03	\$15.30	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.48	\$15.30	\$16.40	\$0.00	\$89.18
	06/01/2025	\$58.78	\$15.30	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.23	\$15.30	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.53	\$15.30	\$16.40	\$0.00	\$93.23
	12/01/2026	\$62.98	\$15.30	\$16.40	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
WATER METER INSTALLER <i>PLUMBERS &amp; GASFITTERS LOCAL 12</i>	03/03/2024	\$67.74	\$14.32	\$19.11	\$0.00	\$101.17
	09/01/2024	\$69.54	\$14.32	\$19.11	\$0.00	\$102.97
	03/02/2025	\$71.34	\$14.32	\$19.11	\$0.00	\$104.77
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						

Additional Apprentice Information:

Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the pre-determined hourly wage rate established by the Commissioner under the provisions of the M.G.L. c. 149, ss. 26-27D. Apprentice ratios are established by the Division of Apprenticeship Training pursuant to M.G.L. c. 23, ss. 11E-11L.

All apprentices must be registered with the Division of Apprenticeship Training in accordance with M.G.L. c. 23, ss. 11E-11L.

All steps are six months (1000 hours.)

Ratios are expressed in allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified.

\*\* Multiple ratios are listed in the comment field.

\*\*\* APP to JM; 1:1, 2:2, 2:3, 3:4, 4:4, 4:5, 4:6, 5:7, 6:7, 6:8, 6:9, 7:10, 8:10, 8:11, 8:12, 9:13, 10:13, 10:14, etc.

\*\*\*\* APP to JM; 1:1, 1:2, 2:3, 2:4, 3:5, 4:6, 4:7, 5:8, 6:9, 6:10, 7:11, 8:12, 8:13, 9:14, 10:15, 10:16, etc.

## DOCUMENT 00870

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT  
SPECIFICATIONS  
(EXECUTIVE ORDER 11246)  
Revised April 9, 2019

1. As used in these specifications:
  - a. "Covered area" means the geographical area described in the solicitation from which this contract resulted:
  - b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority.
  - c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
  - d. "Minority" includes:
    - (i) Black (all persons having origins in any of the black African racial groups not of Hispanic origin);
    - (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
    - (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
    - (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$ 10,000 the provisions of the specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.
3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.
4. The Contractor shall implement the specific affirmative action standards provided in Paragraphs 7a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. The Contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.
5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.
7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
  - a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
  - b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
  - c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.
  - d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
  - e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
  - f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
  - g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
  - h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

- i. Direct its recruitment efforts both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
  - j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.
  - k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
  - l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
  - m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.
  - n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
  - o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
  - p. Conduct a review, at least annually, of all supervisor's adherence to and performance under the Contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work force participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.
  9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).
  10. The Contractor shall not use the goals and timetables of affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.
  - 11 The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.
13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.
14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as many be required by the Government and keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.
15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).



APPENDIX A

The following goals and timetables for female utilization shall be included in all Federal and federally assisted construction contracts and subcontracts in excess of \$ 10,000. The goals are applicable to the Contractor's aggregate on-site construction workforce whether or not part of that workforce is performing work on a Federal or federally-assisted construction contract or subcontract.

Area covered: Goal for Women apply nationwide

Goals and Timetables

Timetable

Goals (percent)

From Apr. 1, 1980 until further notice

6.9

APPENDIX B-80

Until further notice, the following goals for minority utilization in each construction craft and trade shall included in all Federal or federally assisted construction contracts and subcontracts in excess of \$ 10,000 to be performed in the respective geographical areas. The goals are applicable to each nonexempt contractor's total on- site construction workforce, regardless of whether or not part of that workforce is performing work on a Federal, federally assisted or nonfederally related project, contract or subcontract.

Construction contractors participating in an approved Hometown Plan (see 41 CFR 6-4.5) are required to comply with the goals of the Hometown Plan with regard to construction work they perform in the area covered by the Hometown Plan. With regard to all their other covered construction work, such contractors are required to comply with the applicable SMSA or EA goal contained in this Appendix B-80.

Economic Areas

<u>STATE:</u>	<u>Goals (percent)</u>
MASSACHUSETTS	
004 Boston MA:	
SMSA Counties:	
1123 Boston-Lowell-Brockton-Lawrence-Haverhill, MA-NH	4.0
MA Essex, MA Middlesex, MA Norfolk, MA Plymouth, MA Suffolk, NH Rockingham.	
5403 Fall River- New Bedford MA, Bristol	1.6
9243 Worcester-Fitchburg-Leominster, MA	1.6
6323 Springfield-Chicopee-Holyoke MA-CT MA Hampden, MA Hampshire	4.8
Non-SMSA Counties: MA Barnstable, MA Dukes, MA Nantucket	3.6
Non-SMSA Counties: MA Franklin	5.9

## APPENDIX C

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor”) agrees as follows:

1. **Compliance with Regulations:** The contractor (hereinafter includes consultants) will comply with the Acts and Regulations relative to Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, Federal Highway Administration (FHWA), as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. **Non-discrimination:** The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, national origin (including limited English proficiency), age, sex, disability, or low-income status in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.
3. **Solicitations for Subcontractors, including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor’s obligations under this contract and the Acts and the Regulations relative to nondiscrimination on the grounds of race, color, national origin (including limited English proficiency), age, sex, disability, or low-income status.
4. **Information and Reports:** The contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto, and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Massachusetts Department of Transportation (MassDOT) or FHWA to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information, the contractor will so certify to MassDOT or FHWA, as appropriate, and will set forth what efforts it has made to obtain the information.
5. **Sanctions for Noncompliance:** In the event of a contractor’s noncompliance with the Nondiscrimination provisions of this contract, MassDOT will impose such contract sanctions as it or FHWA may determine to be appropriate, including, but not limited to:
  - a. withholding payments to the contractor under the contract until the contractor complies; and/or
  - b. cancelling, terminating, or suspending a control, in whole or in part.
6. **Incorporation of Provisions:** The contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations, and directives issued pursuant thereto. The contractor will take action with respect to any subcontract or procurement as MassDOT or FHWA may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request MassDOT to enter into any litigation to protect the interests of MassDOT. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

## APPENDIX D

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor,” which includes consultants) agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

**PERTINENT NON-DISCRIMINATION AUTHORITIES:**

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d *et seq.*, 78 stat. 252) (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. § 4601) (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-Aid programs and projects)
- Federal-Aid Highway Act of 1973 (23 U.S.C. § 324 *et seq.*) (prohibits discrimination on the basis of sex)
- Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. § 794 *et seq.*), as amended (prohibits discrimination on the basis of disability) and 49 CFR Part 27
- The Age Discrimination Act of 1975, as amended (42 U.S.C. § 6101 *et seq.*) (prohibits discrimination on the basis of age)
- Airport and Airway Improvement Act of 1982 (49 U.S.C. § 471, Section 47123), as amended (prohibits discrimination based on race, creed, color, national origin, or sex)
- The Civil Rights Restoration Act of 1987 (PL 100-209) (broadened the scope, coverage, and applicability of Title VI of the Civil Rights Act of 1964, the Age Discrimination Act of 1975, and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of Federal-Aid recipients, sub-recipients, and contractors, whether such programs or activities are Federally funded or not)
- Titles II and III of the Americans with Disabilities Act (42 U.S.C. §§ 12131-12189), as implemented by Department of Transportation regulations at 49 CFR parts 37 and 38 (prohibits discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities)
- The Federal Aviation Administration’s Non-Discrimination Statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex)
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (ensures discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations)
- Executive Order 13166, Improving Access to Services for People with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100)
- Title IX of the Education Amendments Act of 1972, as amended (20 U.S.C. 1681 *et seq.*) (prohibits discrimination on the basis of sex in education programs or activities)

\*\*\* END OF DOCUMENT \*\*\*

DOCUMENT 00875  
TRAINEE SPECIAL PROVISIONS  
Revised October, 2016

THE REQUIRED NUMBER OF TRAINEES TO BE TRAINED UNDER THIS CONTRACT WILL BE **3**

The contractor shall provide on-the job training aimed at developing full journeyworkers in the type of trade of job classification involved.

In the event that a contractor subcontracts a portion of the contract work, the General Contractor shall determine how many, if any, of the trainees are to be trained by the subcontractor, provided, however, that the contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The contractor shall also insure that this training special provision is made applicable to such subcontract. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training.

The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journeyworkers in the various classifications within a reasonable area of recruitment. Prior to commencing construction, the contractor shall submit to the Massachusetts Department Of Transportation (MassDOT) for approval the number of trainees to be trained in each selected classification and training program to be used. Furthermore, the contractor shall specify the starting time for training in each of the classifications. The contractor will be credited for each trainee employed on the contract work who is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees as provided hereinafter.

Training and upgrading of minorities and women toward journeyworker status is a primary objective of the Training Special Provision. Accordingly, the contractor shall make every effort to enroll minority and women trainees (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees) to the extent that such persons are available within a reasonable area of recruitment. The contractor will be responsible for demonstrating the steps that have been taken in pursuance thereof, prior to a determination as to whether the contractor is in compliance with this Training Special Provision. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training.

No employee shall be trained under this Special Provision in any classification in which he or she has successfully completed a training course leading to journeyworker status or in which he or she has been employed as a journeyworker. The contractor should satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used the contractor's records should document the finding in each case.

The minimum length and type of training for each classification will be as established in the training program selected by the contractor and approved by the Massachusetts Department Of Transportation and the Federal Highway Administration. The Massachusetts Department Of Transportation and the Federal Highway Administration shall approve a program if it is reasonably calculated to meet the equal employment opportunity obligations of the contractor and to qualify the average trainee for journeyworker status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau and training programs approved but not necessarily sponsored by the U.S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training shall also be considered acceptable provided it is being administered in a manner consistent with the equal employment obligations of Federal-aid highway construction contracts. Approval or acceptance of a training program shall be obtained from the State prior to commencing work on the classification covered by the program. It is the intention of these provisions that training is to be provided in the construction crafts rather than clerk-typist or secretarial-type positions. Training is permissible in lower level management positions such as office engineers, estimators, timekeepers, etc. where the training is oriented toward construction applications. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and approved by the Federal Highway Administration division office. Some offsite training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training.

**Reimbursement**

Under these Training Special Provisions, reimbursement will be as follows:

The Contractor will only be reimbursed 80 cents for each hour of on the job training as specified in the approved Training Program.

The Contractor is advised and encouraged that it may train additional persons in excess of the number specified and will be reimbursed as stated above. Reimbursement will be made even though the contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the contractor from receiving other reimbursement.

If less than full training specified in the approved training programs is provided, payment to the contractor will be made at a rate of 80 cents for each hour of training completed under this contract. However, no payment shall be made to the contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyworker, is caused by the contractor and evidences a lack of good faith on the part of the contractor in meeting the requirements of this Training Special Provision.

**Payment**

Trainees will be paid:

1. Percentage (%) of the journeyworker's rate as provided in the existing programs approved by the Department of Labor or Transportation as of September 15, 1970.
2. For journeyworker programs submitted by the Contractor and approved by Massachusetts Department Of Transportation and the Federal Highway Administration at least 60 percent of the appropriate minimum journeyworker's rate specified in the contract for the first half of the training period, 75 percent for the third quarter if the training period, and 90 percent for the last quarter of the training period.
3. For skilled laborer programs, the minimum starting wage rate of unskilled laborer. At the conclusion of training, he or she will be paid the minimum wage rate of the Classification for programs submitted by the Contractor and approved by the Massachusetts Department Of Transportation and the Federal Highway Administration.
4. For the purposes of meeting the legal requirements of State Prevailing Wage Law, please be advised that no person may be paid the Apprentice wage rate as listed on a MA Prevailing Wage Rates schedule, unless that person and program is registered with the Department of Labor Standards/Division of Apprentice Standards (DLS/DAS). Any person or program not registered with DLS/DAS, regardless of whether or not they are registered with any other federal, state, local, or private entity must be paid the journeyworker's rate for the trade.

The contractor shall provide each trainee with a certification showing the type and length of training satisfactorily complete.

The contractor will provide for the maintenance of records and furnish periodic reports documenting his performance under this Training Special Provision.

Form FHWA-1409, Federal-aid Highway Construction Contracting Semi Annual Training Report, shall be submitted as per instructions on the Form.

\*\*\* END OF DOCUMENT \*\*\*

DOCUMENT 00880

Revised January 12, 2022



# **DEPARTMENT OF LABOR**

**Employment Standards Administration**

## **MINIMUM WAGES FOR FEDERAL AND FEDERALLY ASSISTED CONTRACTS**

"General Decision Number: MA20240021 06/21/2024

Superseded General Decision Number: MA20230021

State: Massachusetts

Construction Type: Highway

County: Middlesex County in Massachusetts.

HIGHWAY CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract.  . The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract.  . The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.



Modification Number	Publication Date
0	01/05/2024
1	01/19/2024
2	03/22/2024
3	05/31/2024
4	06/21/2024

ELEC0103-007 03/01/2024

	Rates	Fringes
ELECTRICIAN.....	\$ 61.86	36.14

\* ENGI0004-026 06/01/2024

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
Group 1.....	\$ 56.03	32.75
Group 2.....	\$ 55.41	32.75

FOOTNOTE FOR POWER EQUIPMENT OPERATORS:  
 A. PAID HOLIDAYS: New Year's Day, Washington's Birthday,  
 Labor Day, Memorial Day, Independence Day, Patriot's Day,  
 Columbus Day, Veteran's Day, Thanksgiving Day, Christmas Day

POWER EQUIPMENT OPERATORS CLASSIFICATIONS  
 Group 1: Backhoe/Excavator/Trackhoe; Bobcat/Skid Steer/Skid  
 Loader; Broom/Sweeper; Gradall; Loader; Paver (Asphalt,  
 Aggregate, and Concrete)  
 Group 2: Bulldozer; Grader/Blade; Milling Machine; Roller

IRON0007-031 03/16/2024

	Rates	Fringes
IRONWORKER (ORNAMENTAL, REINFORCING, AND STRUCTURAL).....	\$ 54.68	36.48

LABO0039-002 06/01/2018

	Rates	Fringes
LABORER		
Asphalt, Includes Raker, Shoveler, Spreader and Distributor.....	\$ 33.50	22.92
Landscape.....	\$ 33.25	22.92

PAIN0035-023 01/01/2024

	Rates	Fringes
PAINTER (Steel).....	\$ 56.06	35.60

SUMA2014-011 01/11/2017

	Rates	Fringes
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CARPENTER, Includes Form Work....	\$ 47.93	19.46
CEMENT MASON/CONCRETE FINISHER...	\$ 56.70	21.08
LABORER: Common or General.....	\$ 36.58	19.40
LABORER: Concrete Saw (Hand Held/Walk Behind).....	\$ 41.78	18.37
LABORER: Guardrail Installation.....	\$ 37.70	15.37
OPERATOR: Crane.....	\$ 57.61	0.00
OPERATOR: Forklift.....	\$ 64.67	0.00
OPERATOR: Mechanic.....	\$ 48.14	17.02
OPERATOR: Piledriver.....	\$ 44.46	16.94
OPERATOR: Post Driver (Guardrail/Fences).....	\$ 41.49	23.07
PAINTER: Spray (Linestriping)....	\$ 40.87	13.86
PILEDRIVERMAN.....	\$ 45.65	23.33
TRAFFIC CONTROL: Flagger.....	\$ 23.00	20.44
TRAFFIC CONTROL: Laborer-Cones/ Barricades/Barrels - Setter/Mover/Sweeper.....	\$ 44.49	12.41
TRUCK DRIVER: Concrete Truck....	\$ 33.69	15.79
TRUCK DRIVER: Dump Truck.....	\$ 38.92	9.73
TRUCK DRIVER: Flatbed Truck.....	\$ 48.53	0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic

violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

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The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

#### Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

#### Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

#### Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

#### State Adopted Rate Identifiers

Classifications listed under the "SA" identifier indicate that the prevailing wage rate set by a state (or local) government was adopted under 29 C.F.R. 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 01/03/2024 reflects the date on which the classifications and rates under the SA identifier took effect under state law in the state from which the rates were adopted.

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#### WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- \* an existing published wage determination
- \* a survey underlying a wage determination
- \* a Wage and Hour Division letter setting forth a position on a wage determination matter
- \* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations  
Wage and Hour Division

U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

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DOCUMENT A00801

**SPECIAL PROVISIONS****WESTFORD****Federal Aid Project No. STP/CMQ/TAP-0033(038)X  
Rehabilitation of Boston Road**

Labor participation goals for this Project shall be 15.3% for minorities and 6.9% for women for each job category. The goals are applicable to both Contractor's and Subcontractor's on-site construction workforce. Refer to Document 00820 for details.

**SCOPE OF WORK**

The work under this contract consists of the reconstruction of approximately 5,500 feet of Boston Road and approximately 250 feet of Crown Road, and minor improvements to approximately 250 feet of Main Street in the Town of Westford.

The proposed improvements include the construction of enhanced bicycle and pedestrian accommodations (e.g. continuous 5.5-foot sidewalk along the eastern side of Boston Road, ADA/AAB-compliant pedestrian curb ramps, and on-road bicycle lanes). The roadway cross section will be modified to provide two 11-foot vehicular travel lanes and two 5-foot bicycle lanes. Improvements also include modifications to the existing traffic signals at Boston Road and the I-495 Northbound and Southbound Off-Ramps, full depth pavement reclaim of Boston Road and Crown Road, a new stormwater drainage system on Boston Road with stormwater BMP's, replacement of the public water supply infrastructure on Boston Road, and installation of MUTCD compliant signs and pavement markings throughout project limits.

The work includes unclassified excavation, pavement reclamation, superpave asphalt pavement, guardrail, modified rockfill slope stabilization, stone wall rehabilitation, stormwater drainage system and public water system upgrades, granite curbing, landscaping, tree removal/trimming/protection, Massachusetts certified arborist services, and other incidental work.

All work under this Contract shall be done in conformance with the *2024 Standard Specifications for Highways and Bridges*, the *Supplemental Specifications* contained in this book, the *2017 Construction Standard Details*, the *Traffic Management Plans and Detail Drawings*, *MassDOT Work Zone Safety Temporary Traffic Control*, the *1990 Standard Drawings for Signs and Supports*; the *2015 Overhead Signal Structure and Foundation Standard Drawings*, the *2009 Manual on Uniform Traffic Control Devices (MUTCD) with Revisions 1, 2, and 3* and the *November 2022 Massachusetts Amendments to the MUTCD*; the *1968 Standard Drawings for Traffic Signals and Highway Lighting*; *The American Standard for Nursery Stock*; the Plans and these Special Provisions.

## **SUBSECTION 7.05 INSURANCE REQUIREMENTS**

### **B. Public Liability Insurance**

The insurance requirements set forth in this subsection are in addition to the requirements of the Standard Specifications and supersede all other requirements.

#### **Paragraphs 1 and 2**

The Massachusetts Department of Transportation and applicable railroads shall be named as additional insureds.

#### **Paragraph 4**

Asbestos Liability Insurance shall be obtained for this project. The Contractor and the Massachusetts Department of Transportation shall be named as additional insureds.

## **CONTRACTOR QUESTIONS AND ADDENDUM ACKNOWLEDGEMENTS**

Prospective bidders are required to submit all questions to the Construction Contracts Engineer by 3:00 P.M. on the Tuesday of the previous week before the scheduled bid opening date. Any questions received after this time will not be considered for review by the Department.

Contractors should email questions and addendum acknowledgements to the following email address [massdotSpecifications@dot.state.ma.us](mailto:massdotSpecifications@dot.state.ma.us) The MassDOT project file number and municipality is to be placed in the subject line.

## **WORK SCHEDULE**

No work involving the gas lines shall take place between November 15 through April based on National Grid Gas regulations.

The Town of Westford does not allow work within town layout between November 15 through April 15. However, work shall be allowed inside Town-owned property outside the layout, subject to any conditions in the Order of Conditions issued by the Westford Conservation Commission.

The Contractor and all subcontractors shall perform all work in accordance with Westford standard work hours for construction as follows: Monday through Friday (Excluding Holidays) 7:30 AM to 4:30 PM.

The Contractor and all subcontractors shall perform all work that impacts the I-495 ramp operation during off-peak hours (9:00 AM to 3:00 PM) only.

Work is allowed from 9:00 p.m. to 5:00 a.m. only with the approval of MassDOT District 3 and the Town of Westford.



**TEMPORARY DETOUR**

(Supplementing Subsection 7.09)

The Temporary Traffic Control Plans (TTCP) include plans to establish a temporary detour route, including applicable signs, installation of temporary traffic signals at two (2) intersection locations, and provisions for temporary traffic signal timing adjustments at five (5) additional intersection locations. The intent is that the detour shall be implemented only on an as-needed temporary basis, as determined by the Engineer after consultation with MassDOT Traffic Operations, MassDOT's Area Construction Engineer, and the Town of Westford Police Chief and Fire Chief. Also, once the temporary traffic signals are installed and activated to facilitate implementation of the temporary detour, they shall typically remain in active stop-and-go operation until the detour will no longer be employed on the project, unless otherwise required by the Engineer.

The decision to allow implementation of the detour and hours that it may be active shall be initially restricted to off-peak hours (9:00 AM to 3:00 PM) to facilitate construction of the water and drainage systems between Crown Road and I-495 ramps. As the project progresses, the detour hours of use shall be determined at the discretion of the Engineer and consultation with MassDOT Traffic Operations and the Town of Westford.

Traffic operations at intersections impacted by detoured traffic will be monitored during implementation of the detour; allowable days and/or times of implementation may need to be adjusted and ultimately, use of the detour shall be terminated if required by the Engineer. The Contractor shall have no basis for claim in the event that use of the detour is restricted or disallowed altogether by the Engineer for any reason including, but not limited to, as a result of unacceptable traffic operation or for safety considerations.

**SUBSECTION 8.02 SCHEDULE OF OPERATIONS**

Replace this subsection with the following:

An integrated cost and schedule controls program shall be implemented by the Contractor to track and document the progress of the Work from Notice to Proceed (NTP) through the Contractor Field Completion (CFC) Milestone. The Contractor's schedules will be used by the Engineer to monitor project progress, plan the level-of-effort required by the Department's work force and consultants and as a critical decision-making tool. Accordingly, the Contractor shall ensure that it complies fully with the requirements specified herein and that its schedules are both accurate and updated as required by the specification throughout the life of the project. Detailed requirements are provided in Division II, Section 722 Construction Scheduling.

## **HOLIDAY WORK RESTRICTIONS**

(Supplementing Subsection 7.09)

The District Highway Director (DHD) may authorize work to continue during these specified time periods if it is determined by the District that the work will not negatively impact the traveling public. DHD may allow work in those areas on a case by case basis and where work is behind barrier and will not impact traffic

Below are the holiday work restrictions:

### New Years Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day. No work on local roadways on the holiday without permission by the DHD and the local police chief.

### Martin Luther King's Birthday (Federal Holiday)

No work restrictions due to traffic concerns, however work on local roadways requires permission by the DHD and local police chief.

### President's Day (Federal Holiday)

No work restrictions due to traffic concerns, however work on local roadways requires permission by the DHD and local police chief.

### Evacuation Day (Suffolk County State Holiday)

No work restrictions due to traffic concerns.

### Patriot's Day (State Holiday)

Work restrictions will be in place for Districts 3 and 6 along the entire Boston Marathon route and any other locations that the DHD in those districts determine are warranted so as to not to impact the marathon. All other districts work restrictions will be as per DHD.

### Mother's Day

No work on Western Turnpike and Metropolitan Highway System from 5:00 AM on the Friday before, until the normal start of business on the following day.

### Memorial Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the Friday before, until the normal start of business on the following day.

## **HOLIDAY WORK RESTRICTIONS** (Continued)

### Bunker Hill Day (Suffolk County State Holiday)

No work restrictions due to traffic concerns.

### Juneteenth

No work restrictions due to traffic concerns, however work on local roadways requires permission by the DHD and local police chief.

### Independence Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day. No work on local roadways on the holiday without permission by the DHD and the local police chief.

### Labor Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the Friday before, until the normal start of business on the following day.

### Columbus Day (Federal Holiday)

No work on major arterials from 5:00 AM on the Friday before, until the normal start of business on the following day

### Veterans' Day (Federal Holiday)

No work restrictions due to traffic concerns.

### Thanksgiving Day (Federal Holiday)

No work on major arterials from 5:00 AM two days before until the normal start of business on the following Monday.

### Christmas Day (Federal Holiday)

No work on major arterial roadways from 5:00 AM on the day before until the normal start of business on the next subsequent business day.

## **EQUIVALENT SINGLE AXLE LOADS (ESALS)**

The estimated traffic level to be used for SUPERPAVE HMA mixture designs for this contract, expressed in Equivalent Single Axle Loads (ESALS) for the design travel lane over a 20-year period, is 4.63 Million 18-kip (80-kn) ESALS.

## **SUBSECTION 8.14 UTILITY COORDINATION, DOCUMENTATION, AND MONITORING RESPONSIBILITIES**

### **A. GENERAL**

In accordance with the provisions of Section 8.00 Prosecution and Progress, utility coordination is a critical aspect to this Contract. This section defines the responsibility of the Contractor and MassDOT, with regard to the initial utility relocation plan and changes that occur as the prosecution of the Work progresses. The Engineer, with assistance from the Contractor shall coordinate with Utility companies that are impacted by the Contractor's operations. To support this effort, the Contractor shall provide routine and accurate schedule updates, provide notification of delays, and provide documentation of the steps taken to resolve any conflicts for the temporary and/or permanent relocations of the impacted utilities. The Contractor shall provide copies to the Engineer of the Contractor communication with the Utility companies, including but not limited to:

- Providing advanced notice, for all utility-related meetings initiated by the Contractor.
- Providing meeting minutes for all utility-related meetings that the Contractor attends.
- Providing all test pit records.
- Request for Early Utility work requirements of this section (see below).
- Notification letters for any proposed changes to Utility start dates and/or sequencing.
- Written notification to the Engineer of all apparent utility delays within seven (7) Calendar Days after a recognized delay to actual work in the field – either caused by a Utility or the Contractor.
- Any communication, initiated by the Contractor, associated with additional Right-of-Way needs in support of utility work.
- Submission of completed Utility Completion Forms.

### **B. PROJECT UTILITY COORDINATION (PUC) FORM**

The utility schedule and sequence information provided in the Project Utility Coordination Form (if applicable) is the best available information at the time of the bid and has been considered in setting the contract duration. The Contractor shall use all of this information in developing the bid price and the Baseline Schedule Submission, inclusive of the individual utility durations sequencing requirements, and any work that has been noted as potentially concurrent utility installations.

### **C. INITIATION OF UTILITY WORK**

The Engineer will issue all initial notice-to-proceed dates to each Utility company based on either the:

- 1) Contractor's accepted Baseline Schedule
- 2) An approved Early Utility Request in the form of an Early Utility sub-net schedule (in accordance with the requirements of this Subsection)
- 3) An approved Proposal Schedule

#### **C.1 - BASELINE SCHEDULE – UTILITY BASIS**

The Contractor shall provide a Baseline Schedule submission in accordance with the requirements of Subsection 8.02 and inclusive of all of the information provided in the PUC Form that has been issued in the Contract documents. This is to include the utility durations, sequencing of work, allowable concurrent work, and all applicable considerations that have been depicted on the PUC Form.

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**SUBSECTION 8.14** (Continued)**C.2 – EARLY UTILITY REQUEST – (aka SUBNET SCHEDULE) PRIOR TO THE BASELINE**

All early utility work is defined as any anticipated/required utility relocations that need to occur prior to the Baseline Schedule acceptance. In all cases of proposed early utility relocation, the Contractor shall present all known information at the pre-construction conference in the form of a ‘sub-net’ schedule showing when each early utility activity needs to be issued a notice-to-proceed. The Contractor shall provide advance notification of this intent to request early utility work in writing at or prior to the Pre-Construction meeting. Prior to officially requesting approval for early utility work, the Contractor shall also coordinate with MassDOT and all utility companies (private, state or municipal) which may be impacted by the Contract. If this request is acceptable to the Utilities and to MassDOT, the Engineer will issue a notice-to-proceed to the affected Utilities, based on these accepted dates.

**C.3 – PROPOSAL SCHEDULE - CHANGES TO THE PUC FORM**

If the Contractor intends to submit a schedule (in accordance with MassDOT Standard Specifications, Division I, Subsection 8.02) that contains durations or sequencing that vary from those provided in the Project Utility Coordination (PUC) Form, the Contractor must submit this as an intended change, in the form of a Proposal Schedule and in accordance with MassDOT Standard Specifications, Division I, Subsection 8.02. These proposed changes are subject to the approval of the Engineer and the impacted utilities, in the form of this Proposal Schedule and a proposed revision to the PUC form. The Contractor shall not proceed with any changes of this type without written authorization from the Engineer, that references the approved Proposal Schedule and PUC form changes. The submission of the Baseline Schedule should not include any of these types of proposed utility changes and should not delay the submission of the Baseline Schedule. As a prerequisite to the Proposal Schedule submission, and in advance of the utility notification(s) period, the Contractor shall coordinate the proposed utility changes with the Engineer and the utility companies, to develop a mutually agreed upon schedule, prior to the start of construction.

**D. UTILITY DELAYS**

The Contractor shall notify the Engineer upon becoming aware that a Utility owner is not advancing the work in accordance with the approved utility schedule. Such notice shall be provided to the Engineer no later than seven (7) calendar days after the occurrence of the event that the Contractor believes to be a utility delay. After such notice, the Engineer and the Contractor shall continue to diligently seek the Utility Owner’s cooperation in performing their scope of Work.

In order to demonstrate that a critical path delay has been caused by a third-party Utility, the Contractor must demonstrate, through the requirements of the monthly Progress Schedule submissions and the supporting contract records associated with Subsection 8.02, 8.10 and 8.14, that the delays were beyond the control of the Contractor.

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**SUBSECTION 8.14** (Continued)

All documentation provided in this section is subject to the review and verification of the Engineer and, if required, the Utility Owner. In accordance with MassDOT Specifications, Division I, Subsection 8.10, a Time Extension will be granted for a delay caused by a Utility, only if the actual duration of the utility work is in excess of that shown on the Project Utility Coordination Form, and only if;

- 1) proper Notification of Delay was provided to MassDOT in accordance with the time requirements that are specified in this Section
- 2) the utility delay is a critical path impact to the Baseline Schedule (or most recently approved Progress Schedule)

**E. LOCATION OF UTILITIES**

The locations of existing utilities are shown on the Contract drawings as an approximation only. The Contractor shall perform a pre-construction utility survey, including any required test pits, to determine the location of all known utilities no later than thirty (30) calendar days before commencing physical site work in the affected area.

**F. POST UTILITY SURVEY – NOTIFICATION**

Following completion of a utility survey of existing locations, the Contractor will be responsible to notify the Engineer of any known conflicts associated with the actual location of utilities prior to the start of the work. The Engineer and the Contractor will coordinate with any utility whose assets are to be affected by the Work of this Contract. A partial list of utility contact information is provided in the Project Utility Coordination Form.

**G. MEETINGS AND COOPERATION WITH UTILITY OWNERS**

The Contractor shall notify the Engineer in advance of any meeting they initiate with a Utility Owner's representative to allow MassDOT to participate in the meeting if needed.

Prior to the Pre-Construction Meeting, the Contractor should meet with all Utility Owners who will be required to perform utility relocations within the first 6 months of the project, to update the affected utilities of the Project Utility Coordination Form and all other applicable Contract requirements that impact the Utilities. The Contractor shall copy the Engineer on any correspondence between the Utility Owner and the Contractor.

**H. FORCE ACCOUNT / UTILITY MONITORING REQUIREMENTS**

The Engineer will be responsible for recording daily Utility work force reports. The start, suspension, re-start, and completion dates of each of the Utilities, within each phase of the utility relocation work, will be monitored and agreed to by the Engineer and the Contractor as the work progresses.

**I. ACCESS AND INSPECTION**

The Contractor shall be responsible for allowing Utility owners access to their own utilities to perform the relocations and/or inspections. The Contractor shall schedule their work accordingly so as not to delay or prevent each utility from maintaining their relocation schedule.

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**COMPLIANCE WITH THE NATIONAL DEFENSE AUTHORIZATION ACT**  
(Supplementing Subsection 7.01)

On all projects, the “Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment” Regulation (2 CFR 200.216) prohibits the Contractor from using or furnishing the following telecommunications equipment or services:

- Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).
- For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).
- Telecommunications or video surveillance services provided by such entities or using such equipment.
- Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

This prohibition applies to all products manufactured by the aforementioned companies, including any individual components or parts.

By submitting a bid on a project, the Contractor certifies that all work will be in compliance with the terms of 2 CFR 200.216. The Contractor shall submit a COC indicating compliance with the above provisions for all telecommunications equipment or services included in the Contract.

Payment for the item in which the materials are incorporated may be withheld until these COCs are received. Any cost involved in furnishing the certificate(s) shall be borne by the Contractor.

**BIDDERS LIST**

Pursuant to the provisions of 49 CFR Part 26.11 all official bidders will be required to report the names, addresses and telephone numbers of all firms that submitted bids or quotes in connection with this project. Failure to comply with a written request for this information within 15 business days may result in a recommendation to the Prequalification Committee that prequalification status be suspended until the information is received.

The Department will survey all firms that have submitted bids or quotes during the previous year prior to setting the annual goal and shall request that each firm report its age and gross receipts for the year.

**BUILD AMERICA BUY AMERICA PREFERENCE**

On Federally-aid projects the Buy America (23.CFR § 635.410) and Build America, Buy America Act (Pub. L. No. 117-58, §§ 70901-52), requires the following,

- (1) all iron and steel used in the project are produced in the United States--this means all manufacturing processes, from the initial melting stage through the application of coatings, must occur in the United States. Foreign steel and iron can be used if the cost of the materials does not exceed 0.1% of the total Contract cost or \$2,500, whichever is greater. The action of applying a coating to a covered material (i.e., steel and iron) is deemed a manufacturing process subject to Buy America. Coating includes epoxy coating, galvanizing, painting and any other coating that protects or enhances the value of a material subject to requirements of Build America, Buy America. Steel used for temporary support of excavation, including H piles, soldier piles, and sheeting when the steel is required to be left in place is subject to requirements of Build America, Buy America. Temporary steel, shall remain in place when it falls within the influence zone of the soil supporting any structure or railroad tracks.
- (2) all manufactured products used in the project are produced in the United States—this means the manufactured product was manufactured in the United States; and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation; and
- (3) all construction materials are manufactured in the United States—this means that all manufacturing processes for the construction material occurred in the United States. “Construction materials” includes an article, material, or supply—other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives—that is or consists primarily of:
  - non-ferrous metals,
  - plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables),
  - glass (including optic glass),
  - lumber; or
  - drywall.

The Buy America preference only applies to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project. Nor does a Buy America preference apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project but are not an integral part of the structure or permanently affixed to the infrastructure project.

**NOTE:** The requirements for manufactured products indicated in paragraph (2) above are not in effect for this contract.



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## **MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION FILE NUMBER SIGN**

This project is subject to Massachusetts General Laws, Chapter 131, Section 40 as amended. Signs shall be in accordance with the latest MassDOT Construction Standards. All costs for the manufacture, erection, maintenance, moving, and removal of the signs shall be absorbed by the contractor with no additional compensation other than the contract unit prices.

For this project the Massachusetts Department of Environmental Protection File Number is 334-1823.

## **ENVIRONMENTAL PERMITTING**

An Order of Conditions has been obtained from the Westford Conservation Commission under the Wetlands Protection Act. If field conditions and/or Contractor-proposed erection, demolition, storage, or other procedures not originally allowed by existing environmental permits require work to occur in or otherwise impact water or wetland resource areas, the Contractor is advised that no associated work can occur until all required environmental permits have been either amended or obtained allowing such work. The Contractor must notify the District 3 Highway Director and Resident Engineer in writing at least 60 days prior to desired commencement of the proposed activity. All environmental submittals including, any contract with Local, State, or Federal environmental agencies, must be coordinated with the District 3 Environmental Engineer. The Contractor shall fully cooperate with requests for information and provide same in a timely manner. The Contractor is further advised that the Department will not entertain a delay claim due to the time required to modify or obtain the environmental permits.

## **ORCHARD HILL TRUST CONSERVATION RESTRICTION**

(Supplementing Subsections 6.03 and 7.13)

The Contractor's attention is directed to the applicable conditions of a Conservation Restriction and Trail Easement in place over the Orchard Hill Trust property located at approximate Station 41+60 to 47+50 Right (Middlesex North Registry of Deeds Book 8135, Page 259). Those conditions restrict certain activities on the property including, but not limited to, placing utility poles or lines, excavating, placing soil, storing materials, and cutting trees or other vegetation. Consistent with the requirements of the Standard Specifications, no work shall be allowed beyond the limits of the temporary easements or public utility easements that have been secured by the Town of Westford to facilitate construction along the roadway interface with the subject property. Work allowed within the aforementioned easements (guy wire removal and installation, clearing and grubbing, grading, placement of loam and seed) may be performed as detailed within the Order of Taking (Middlesex North Registry of Deeds Book 38331, Page 202); and said work shall include restoration of any disturbance made during construction in accordance with the contract documents.

## **NATIONAL REGISTER-LISTED WESTFORD CENTER HISTORIC DISTRICT**

The Contactor is hereby alerted that the northern portion of the project area is located within the National Register-listed Westford Center Historic District (Sta. 10+60 to Sta. 37+25); and therefore, special attention must be paid to historic resources within and adjacent to this segment of the project area.

The triangular National Register-listed Westford Town Common is located at the northernmost end of the project area on the east side of Boston Road, and the project work calls for some minor work/improvements along the west side of the Common. The Town Common, which was a Colonial-era training field, contains a number of historic monuments and mature trees, which must be protected. (The monuments/historic objects are located at Sta. 20+55L, Sta. 21+70L, Sta. 22+5L, and Sta. 22+95L.) Because of the historic nature of the Town Common, the Contractor shall not complete any work within the Town Common other than the construction activities specifically shown in the project plans and stated in the construction contract. The Contractor shall not allow staging areas, stock piling or vehicle parking on the Town Common.

The triangular traffic island to the southwest of the Town Common, from approximately Station 22+47R to Station 23+20R, is historically associated with the Town Common. There is a historic Civil War monument at Station 22+95R that shall not be removed, damaged or otherwise harmed by this project. A short, rounded, granite wall, which is setback from the roadway by approximately 7', forms a triangle around the monument, and it shall also not be removed, damaged or otherwise harmed. The Contractor shall not allow staging areas, stock piling or vehicle parking on this triangular traffic island.

Outside of the Town Common parcels, there are five historic objects adjacent to Boston Road within the Historic District. The Contractor must not remove or damage these historic objects and must follow the instructions for each object to 'remain' in place. The following historic objects are within the project area:

- Granite Post at Sta. 20+80R,
- Granite Slab/Step at Sta. 21+80R,
- Granite Post at Sta. 23+85L,
- Granite Post at Station 24+75R, and
- Metal Hitching Posts at Sta. 27+50L & Sta. 27+57L.

The Contractor shall not remove, damage, drill, or otherwise harm any historic resources within the Westford Center Historic District. Prior to construction, the Contractor and Engineer shall inspect and photograph the existing conditions of the historic objects and monuments identified in this Special Provision, and snow fencing shall be wrapped around each monument/historic object as well. The Contractor shall notify the Engineer if any of the historic objects or monuments are damaged during construction. The Contractor will be responsible for repairing any damage to match the existing condition prior to the commencement of this construction project. Any damage incurred to historic objects as well as costs associated with the repairs will be the sole responsibility of the Contractor. The Engineer shall notify MassDOT Cultural Resources Unit (CRU) staff if any damage is incurred to any historic objects(s) and prior to any repairs being undertaken. MassDOT CRU Contact: Mary Hafferty, 781-801-0057 or [mary.hafferty@state.ma.us](mailto:mary.hafferty@state.ma.us). CRU staff will evaluate the damage and coordinate any necessary consultation with the Westford Historical Commission and Massachusetts Historical Commission.

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## **NORTHERN LONG-EARED BAT PROTECTION**

The U.S. Fish and Wildlife Service (USFWS) has listed the northern long-eared bat (NLEB) as endangered under the Endangered Species Act (ESA) and the following requirements exist to protect the bat and its habitat. This project has been consulted with the USFWS through the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), and Federal Transit Administration (FTA) Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat revised February 5, 2018.

On July 10-15, 2022, Tetra Tech, on behalf of MassDOT Highway Division Environmental Services, conducted a northern long-eared bat summer presence/absence survey using acoustic detection methods, in accordance with the 2022 survey guidelines. The survey did not detect northern long-eared bat, and as stated within the survey guidelines, the survey is valid for five years. Due to the 5-year validity of the negative presence/absence survey, it is recommended that the contractor conduct all activities that could result in stressors to the bats such as tree removal/trimming, bridge and/or structure removal/maintenance, lighting, or use of percussive, by July 10-15, 2027. If additional stressor producing work is proposed by the Contractor past this date, additional review is required by the MassDOT Highway Division's Environmental Services Section, and additional review and restrictions may be required by the USFWS.

Due to the negative survey results, the project is eligible for a May Affect, Not Likely to Adversely Affect (NLAA) determination, without Avoidance and Minimizations Measures (AMMs), in accordance with the FHWA, FRA and FTA Range-wide Programmatic Consultation for Indiana Bat and Northern Long-eared Bat. On behalf of FHWA, the lead federal agency for Section 7 consultation, MassDOT submitted a Programmatic Consultation for Transportation Projects affecting NLEB or Indiana Bat to the USFWS through the Information for Planning and Consultation (IPaC) webpage and generated a NLAA documentation letter (see Document A00869). Therefore, the project has completed Section 7 consultation through the Endangered Species Act, and no AMMs apply to the project.

The Contractor shall ensure all personnel working in on the project site are aware of all environmental commitments related to NLEB, including all applicable AMMs. NLEB Bat information (<https://www.fws.gov/midwest/endangered/mammals/nleb/>) shall be made available to all personnel.

## **EMERALD ASH BORER ADVISORY**

To the extent possible, all trees and brush shall be disposed on site, typically chipped and spread in place. When trees or brush must be removed, such as in urban, or otherwise populated areas, Contractor shall identify proposed location for disposal, and provide written notification to the Engineer for approval. Disposal shall be in city or town of project, or at minimum, within county, of construction operations.

**NOTICE TO OWNERS OF UTILITIES**

(Supplementing Subsection 7.13)

Written notice shall be given by the Contractor to all public service corporations or municipal and State officials owning or having charge of publicly or privately owned utilities of its intention to commence operations affecting such utilities at least one week in advance of the commencement of such operations. The Contractor shall, at the same time, file a copy of such notice with the Engineer.

Before commencing work on service connections, the Contractor shall be responsible for contacting the Electric Company servicing the area to obtain construction requirements, standards, and to give notice of commencement of work in accordance with the respective utility company policy. The Contractor's attention is further directed to the requirements of work in the immediate vicinity of certain underground structures and poles herein included in these Special Provisions.

A list of public and private utilities can be found on the MassDOT website at:  
<http://www.mass.gov/info-details/utility-contacts-by-district-and-municipality>

Select District 3 on top of the webpage, select the Town of Westford and then locate the utility.

The Contractor shall inform the following officials in each area that he is assigned to work:

Superintendent, Department of Public Works or Town Engineer, Police and Fire Department, and Electric Department

Town officials are shown at website <http://www.mass.gov/portal/government/cities-and-towns.html>

Select "Westford" from alphabetized listed.  
Select the official Municipality Home Page.

The following are the names of owners and representatives of the principal utilities affected, but completeness of this list is not guaranteed by the Department:

National Grid (Electric)  
548 Haydenville Road  
Leeds, MA 01053

Sandra Annis  
413-582-7424  
sandra.annis@nationalgrid.com

National Grid (Gas)  
170 Date Drive  
Waltham, MA 02451

Melissa Owens  
781-907-2845  
Melissa.Owens@nationalgrid.com

Verizon (Telephone)  
385 Myles Standish Boulevard  
Taunton, MA 02780

Karen Mealey  
774-409-3160  
karen.m.mealey@verizon.com

MCI-Verizon Business  
PO Box 600  
Charlton, MA 01507

Stephen Parretti  
508-248-1305  
Stephen.paretti@verizon.com

**NOTICE TO OWNERS OF UTILITIES** (Continued)

Comcast Cable Corporation  
PO Box 6505  
Chelmsford, MA 01824

Wendy Brown  
978-848-5163  
Wendy\_brown@comcast.com

Westford Water Department  
60 Forge Village Road  
Westford, MA 01886

Mark Warren  
978-399-2457  
mwarren@westfordma.gov

Crown Castle  
80 Central Street  
Boxborough, MA 01719

Mark Bonanno  
508-616-7818  
Mark.bonanno@crowncastle.com

Waveguide Fiber  
10 N Southwood Drive  
Nashua, NH 03063

Phil Kumph  
603-598-0096  
pkumph@waveguidefiber.com

Lumen  
1025 Eldorado Blvd  
Broomfield, CO 80021

Renoy Thomas  
516-712-3041  
relocations@lumen.com

AT&T/Teleport Comm, c/o Siena Eng  
50 Mall Rad – Suite 203  
Burlington, MA 01803

Erica Hudson  
781-221-8400 x7041  
Erica.hudson@sienaengineeringgroup.com

Westford DPW  
28 North Street  
Westford, MA 01886

Kyle Fox  
978-399-2455  
kfox@westfordma.gov

Westford Town Engineer  
28 North Street  
Westford, MA 01886

Paul Starratt  
978-360-0498  
pstarratt@westfordma.gov

**NATIONAL GRID EMERGENCY TELEPHONE NUMBERS**

GAS:

Emergency: 1-800-233-5325  
New Service: 1- 877-696-4743  
Customer Support: 1-800-732-3400

ELECTRIC:

Outage/ Emergency: 1-800-465-1212  
New Service: 1-800-375-7405  
Customer Support: 1-800-322-3223

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## **VALUE ENGINEERING CHANGE PROPOSAL**

This Subsection defines the conditions and requirements which apply to Value Engineering Change Proposals (“VECPs”). The purpose of this provision is to encourage the Contractor to propose changes in certain project requirements that will maintain the project’s functional requirements at a savings in contract time, contract price, or both. The net savings obtained by using a VECP that meets the conditions and requirements set forth here will be shared by the Contractor and MassDOT.

VECP’s under this provision are to be initiated, developed and submitted to MassDOT by the Contractor. The VECP must show the contemplated changes to the Drawings, Specifications and other requirements in the Contract. When a VECP submitted pursuant to this section is fully accepted by MassDOT, the VECP will be implemented by the Contractor and paid using the current cost and resource loaded schedule. Contractor shall demonstrate that the VECP is equal to, or better than, the original design or material; that there is an interest in public safety within the VECP; that there is a life-cycle cost benefit; and/or that end users will benefit from the shortened schedule. VECPs shall be consistent with the MassHighway/MassDOT Standard Specifications for Highways and Bridges and other applicable reference documents and directives. Any proposed deviation from these documents will need to be clearly identified in the VECP Proposal Documents, and must be approved by MassDOT’s Chief Engineer before accepting this VECP.

- A. In order to be considered for MassDOT review each VECP shall:
1. Be clearly labeled pursuant to this Subsection;
  2. Yield a net savings at least two hundred and fifty thousand (250,000.00) Dollars and/or a net saving of contract completion duration of at least three (3) months;
  3. The proposed changes to contract items must:
    - a. maintain the specified items’ required functions (service life, reliability);
    - b. meet applicable safety regulations and codes;
    - c. material substitutions must be in accordance with DOT prequalified/preapproved products and must be tested in accordance with standard material specs/testing methods ( and considering all relevant environmental, load, and other relevant factors);
    - d. show economy of operation, ease of maintenance, ease of construction, and necessary standardized features and appearance; and
  4. Shall not require an extension of Contract Time or Contract Milestones, with the exception of cases when there are anticipated significant cost saving.

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**VALUE ENGINEERING CHANGE PROPOSAL** (Continued)

The thresholds above are considered to be a general guideline. MassDOT will consider VECPs outside of these thresholds if a significant benefit is demonstrated. Additionally, notwithstanding this VECP process, MassDOT will consider minor revisions in the form of a Contract Modification.

Further, any VECP submitted shall be in sufficient detail to clearly define the proposed change. The Contractor's failure to provide information of the type, detail and in a format to facilitate the MassDOT's review, may be grounds for rejection of the VECP. Additionally, the Contractor will not be entitled to any equitable adjustment or increased Time, due to any aspect of any of the proposed VECP including permitting, right of way, utility coordination or delayed responses by MassDOT. If, after the progression of the work associated with the executed Contract Modification for the VECP, any additional costs are realized by the Contractor or any of the sub-consultants, sub-contractors, or suppliers, the Contractor shall be obligated to pay for any and all costs.

- B. The following initial items shall be provided by the Contractor for MassDOT's review. *Items 1-6 need to be submitted prior to the start of MassDOT's review of the VECP and item 7 is an important consideration for the pricing of the VECP and the timeline of the proposed VECP schedule.*
1. ***VECP Description:*** A description of the difference between the existing and the proposed Contract requirements, and the comparative advantages and disadvantages of each;
  2. ***VECP Change Listing:*** A listing of the Contract requirements that will need to be changed, modified, or reviewed as well as the proposed Contract document changes in the Instructions to Bidders, Contract, Standard Specifications, General Requirements and Special Provisions required by the VECP.
  3. ***Construction Schedule Update:*** Any changes in the Contract Time(s) or Contract Milestone(s), that will result from acceptance of the VECP, shall be accompanied by a contemporaneous schedule analysis (*i.e., the Contractor's baseline schedule submission, all past/required monthly schedule updates, a detailed assessment of all past delays, and a resource loaded Critical Path Method schedule as specified in Section 8.0 / Subsection 8.02 of this Contract*) of the projected Work that remains including the proposed VECP related schedule changes (*inclusive of the timeline to review accept the VECP and the timeline for implementing the design changes*) in the remaining work. This shall be submitted in the form of a Proposal Schedule until the VECP has been formally accepted. Note: All of this information is to be updated, recertified, and formally accepted by MassDOT before final acceptance of this this VECP is issued.

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**VALUE ENGINEERING CHANGE PROPOSAL** (Continued)

4. ***Date for MassDOT's Acceptance:*** A statement that clearly justifies the date by which the VECP must be accepted to obtain the maximum price reduction, noting any effect upon the Contract Time(s) and/or Contract Milestone(s). This statement must include a narrative that demonstrates the most recent construction schedule has been utilized to justify that proposed acceptance date (*e.g. "in order to start to fabricate critical materials, authorization must be provided to work on the shop drawings by no later than [date]"*). The Contractor should allow for at least sixty (60) to ninety (90) days for acceptance by MassDOT once all of the VECP documentation has been provided. Acceptance shall mean that MassDOT has received a finalized and executed contract modification. However, this is a proposed Contract change.

The Contractor is fully obligated to progress the Work of the original Contract and MassDOT is not liable for any delays or costs that may occur in the review phase of any VECP proposal.

5. ***Cost and Savings Estimates:*** A detailed estimate of the anticipated net savings, calculated as follows:
- a. ***Original Scope:*** Isolate the cost of performing the original contract construction activities, in accordance with the original Contract Documents, as originally bid by the Contractor, that are anticipated to be superseded by the VECP. *This cost is to include any original contract scope that is anticipated to be altered or eliminated by the VECP such as, shop drawing preparation, inspection work, testing, maintenance of traffic, or any other original contract costs, that have yet to have been performed at the time of this VECP submission.*
  - b. ***New VECP Scope:*** Calculate the cost of performing the comparable construction activities associated with the VECP.
  - c. ***Contractor's Engineer & Inspection:*** Calculate the cost of engineering, inspection, and design work by the Contractor's Engineer/Designer. This should be a realistic estimate of the costs of any required engineering, design and review work by the Contractor's Engineer.
  - d. ***MassDOT's Costs:*** MassDOT's estimate of costs to perform engineering/design reviews, cost estimate reviews, schedule reviews, and any other administrative costs to review and recommend implementation of the proposed VECP. (*including all anticipated increased costs to MassDOT on other Contracts and all anticipated follow-on increased costs to MassDOT, if any*) as provided by MassDOT. MassDOT's estimated costs must be included the VECP calculation and will be provided by MassDOT in support of the VECP evaluation process.
  - e. ***Other Costs:*** Estimated costs associated with any revisions to other project related costs, such as Environmental Permits or Right of Way acquisitions, including other agency or municipality costs, as provided by MassDOT.



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**VALUE ENGINEERING CHANGE PROPOSAL** (Continued)Net Savings:

**The net savings to be split between MassDOT and the Contractor shall be calculated using the items above as follows:  $a - (b+c+d+e) = \text{net savings}$**

6. *The Contractor shall also provide:*

- a. A proposed Change Order, which explains and justifies any required Equitable Adjustment in the Contract Price.
- b. The Contractor's actual costs expended for developing the VECP as of the date of the VECP submission;

7. ***Design Changes and Drawings:*** The costs that are outlined above should be inclusive of the following design and engineering responsibilities.

- a. Design changes shall be prepared and stamped by the Contractor's professional designer and/or engineer. In addition, in the development of the VECP; the Contractor is responsible for anticipating and managing all aspects associated with any VECP design work that must be performed by a licensed Engineer.
- b. The Contractor's engineer must analyze and stamp all components of any aspect of the project that has been redesigned, changed, or altered as a result of this VECP.
- c. The Contractor's engineer shall provide all calculations and supporting design/engineering documentation that was utilized to develop the changes and stamped drawings. These will be used by MassDOT's Designer-of-Record to review the VECP changes. The Contractor is limited to selecting only those engineer's that have been pre-qualified by MassDOT's A&E Board.
- d. MassDOT's Designer-of-Record will review and respond to all completed design submissions related to this VECP within thirty (30) calendar days, unless determined to be a non-critical path item.
- e. MassDOT will be responsible for estimating and managing MassDOT's Designer-of-Record during the VECP review and implementation. Should any significant conflicts arise, between the Contractor's Engineer and MassDOT's Designer-of-Record, the DOT and the Contractor will work expeditiously to resolve the conflict. Should this type of conflict continue for greater than five (5) days, the Contractor is to bear all financial and time related impacts of such delay and must seek to resolve the design conflict, in an acceptable manner to MassDOT. The resolution of this conflict will be funded at the Contractor's expense – exclusive of the net saving that was agreed to at the execution of the contract modification for this VECP.
- f. The Contractor's Engineer may also be required to inspect the construction work. The Contractor is to include such anticipated inspection costs in the initial VECP.

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**VALUE ENGINEERING CHANGE PROPOSAL** (Continued)

- g. MassDOT's Designer of Record will remain the Designer-of-Record for the entire Project. Any costs incurred in the use of MassDOT's Designer-of-Record by MassDOT or Contractor associated with the review of a VECP are to be included in the calculated net savings.
- C. Approval of the VECP shall not occur until a Contract Modification, incorporating the VECP, is issued by MassDOT and properly executed by the Contractor. MassDOT may accept or reject part or all of any VECP at any time prior to an executed Contract Modification for the applicable VECP. The decision of MassDOT, concerning acceptance or rejection of any VECP, shall be final and shall not be subject to dispute resolution.

It is expected that several weeks may go by before the final VECP documentation has been executed with a Contract Modification. Therefore, MassDOT intends to make certain that the initial cost estimate information has not changed before entering into a Contract Modification. As the VECP evaluation process is finalized, and prior to the signed Contract Modification for the VECP, the Contractor and MassDOT must re-certify the current status of the originally proposed cost and/or schedule savings.

Until a contract modification is issued and schedule and cost/savings re-certification is complete and accepted by MassDOT, the Contractor shall remain obligated to perform the Work in accordance with the terms and conditions of the original Contract Documents.

Upon completion of the work associated with the VECP, MassDOT may require verification that the VECP savings has been achieved.

- D. VECPs will be processed (distributed, reviewed, commented upon, accepted or rejected) expeditiously (pursuant to M.G.L. c. 30, § 39R); however, as this is an elective modification to the contract, MassDOT shall not be liable for any delay or cost in the review and acceptance of the VECP. During the review of the VECP, the Contractor remains obligated to progress the original Contract scope, and schedule, as planned; until a Contract Modification, accepting the Contractor re-certified VECP, has been executed by MassDOT.

The Contractor has the right to withdraw part, or all of any VECP, prior to acceptance by MassDOT. Such withdrawal shall be made in writing to the Engineer. The Contractor shall state the period of time, from the date of the initial VECP submittal, that the VECP shall remain valid and feasible. Revision of this validity and feasibility period shall be allowed only by mutual agreement of the Contractor and the Engineer in writing.

If the Contractor desires to withdraw the proposal prior to the expiration of this period for non-technical reason, MassDOT reserves the right to recover all actual costs that have been incurred to MassDOT.

If the Contractor withdraws the VEC Proposal, MassDOT reserves the right to proceed with the VECP or any portion of the VECP as a normal change and the Contractor waives any right it may have had to share in net savings thereunder.

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**VALUE ENGINEERING CHANGE PROPOSAL** (Continued)

For purposes of this provision, expiration of the time established by the Contractor for approval shall be considered as withdrawal by the Contractor if MassDOT requests an extension of that time and the Contractor does not provide a written extension.

- E. With regard to unknown conditions or sub-surface work, in general, the expectation is that the Contractor and MassDOT will strive to gain enough knowledge about the risks in order to provide a forward-priced Change Proposal. Therefore, any costs to fully evaluate the proposal, such as additional borings and/or test pits, must be considered in the cost evaluation of whether the VECP is worth pursuing. However, if it is impractical to gather conclusive exploratory information, before the VECP is executed, MassDOT may consider provisions in the VECP that clearly identifies the risk sharing (cost and time) related specifically to the unknown/sub-surface conditions. If these VECP provisions are acceptable to MassDOT they are to include supplemental language to provide a determination of the final savings/cost, and time impacts, no later than 45 days after the sub-surface work is completed. All other aspects of the VECP, unrelated to these Provisions, will be binding upon execution of the VECP.

**CONTAMINATED SOIL**

Soil to be removed from the project area shall not be assumed to be uncontaminated and must be evaluated prior to off-site management for potential contamination with hazardous materials. Quantities for soil disposal are based on the project design, existing knowledge of soil contamination in the project area, the presence of known risk factors for soil contamination in the project area, and the designer's best professional judgement.

**SOIL STOCKPILING DIRECTIVE P-22-001**

Any stockpiling of soil must be performed in compliance with Policy Directive P-22-001, Off-Site Stockpiling of Soil from MassDOT Construction Projects. The directive limits the allowable location for off-site stockpiling of soil generated during MassDOT projects and includes various requirements that must be satisfied by the Contractor prior to off-site stockpiling.

**NOTIFICATION OF FUNDING SOURCES FOR WORK TO BE PAID BY OTHERS**

This contract contains work that shall be paid by the *City and/ or Town of Westford or by another entity (public/ or private)\**. The said *City and/ or Town or entity* shall be responsible for construction costs associated with a Non-Participating Agreement with MassDOT.

This contract has an agreement with the *City and/ or Town of Westford*; whereas when the construction costs for the contract scope exceed the total participating contract bid price by more than ten percent (10%), the *City/Town* shall be responsible for the amount over 110% of the total participating contract bid price.

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## SECTION 722 CONSTRUCTION SCHEDULING

### DESCRIPTION

#### 722.20 General

The Contractor's approach to prosecution of the Work shall be disclosed to the Department by submission of a Critical Path Method (CPM) schedule and a cost/resource loaded Construction Schedule when required in this Subsection. These requirements are in addition to, and not in limitation of, requirements imposed in other sections.

The requirements for scheduling submissions are established based on the Project Value at the time of the bid and are designated as Type A, B, C or D. The definitions of these Schedule Requirement Types are summarized below. Complete descriptions of all detailed requirements are established elsewhere in this specification.

**Type A** – for all Site-Specific Contracts with a Project Value over \$20 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Resource-Loading
- Resources Graphic Reporting
- Cash Flow Projections from the CPM
- Cash Flow Charts
- Cost-loaded CPM
- Contractor-furnished CPM software, computer and training

**Type B** – for all Site-Specific Contracts with a Project Value between \$10 Million and \$20 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Cost-loaded CPM
- Resource-Loading
- Monthly Projected Spending Report (PSR)
- Contractor-furnished CPM software, computer and training

**SECTION 722 (Continued)**

**Type C** – for all Site-Specific Contracts with a Project Value between \$3 Million and \$10 Million

- Schedule Planning Session
- Baseline CPM Schedule
- Monthly Update CPM Schedule
- Short-term Construction Schedule
- Contract Schedule Update Meeting
- Monthly Projected Spending Report (PSR)
- Contractor-furnished CPM software, computer and training

**Type D** - for all contracts with a Project Value less than \$3 Million; various locations contracts of any dollar amount; contracts with durations less than one-hundred and eighty (180) Calendar Days; and other contracts as determined by the Engineer.

- Bar chart schedule updated monthly or at the request of the Engineer (See Section 722.62.B - Bar Charts.)
- Monthly Projected Spending Report (PSR) (See Section 722.62.F - Projected Spending Reports.)

**MATERIALS, EQUIPMENT, PERSONNEL****722.40 General****A. Software Requirements (Types A, B and C)**

The Contractor shall use Primavera P6 computer scheduling software.

In addition to the requirements of Section 740 – Engineer’s Field Office and Equipment, the Contractor shall provide to the Department one (1) copy of the scheduling software, one (1) software license and one (1) computer capable of running the scheduling software for the duration of the Contract. This computer and software shall be installed in the Engineer’s Field Office within twenty-eight (28) Calendar Days after Notice to Proceed. The computer and software shall be maintained and serviced as recommended by the computer manufacturer and/or as required by the Engineer during the duration of the Contract at no additional cost to the Department. The Contractor shall provide professional training in the basic use of the software for up to eight (8) Department employees. The trainer shall be approved by the Engineer. This training shall be provided within twenty-eight (28) Calendar Days after Notice to Proceed.

**B. Scheduler Requirements**

For all schedule types, if the Contractor plans to use outside scheduling services, the scheduler shall be approved as a subcontractor by the Engineer.

For Type A, B and C Schedules the name of the Contractor’s Project Scheduler together with his/her qualifications shall be submitted to the Department for approval by the Engineer within seven (7) Calendar Days after NTP. The Project Scheduler shall have a minimum of five [5] years of project CPM scheduling experience, three [3] years of which shall be on projects of similar scope and value as the project for which the Project Scheduler is being proposed. References shall be provided from past projects that can attest to the capabilities of the Project Scheduler.

**SECTION 722 (Continued)****CONSTRUCTION METHODS****722.60 General****A. Schedule Planning Session**

(Types A, B and C)

The Contractor shall conduct a schedule planning session within seven (7) Calendar Days after the Contractor receives the NTP and prior to submission of the Baseline Schedule. This session will be attended by the Department and its consultants. During this session, the Contractor shall present its planned approach to the project including, but not limited to:

1. the Work to be performed by the Contractor and its subcontractors;
2. the planned construction sequence and phasing; planned crew sizes;
3. summary of equipment types, sizes, and numbers to be used for each work activity;
4. all early work related to third party utilities;
5. identification of the most critical submittals and projected submission timelines;
6. estimated durations of major work activities;
7. the anticipated Critical Path of the project and a summary of the activities on that Critical Path;
8. a summary of the most difficult schedule challenges the Contractor is anticipating and how it plans to manage and control those challenges;
9. a summary of the anticipated quarterly cash flow over the life of the project.

This will be an interactive session and the Contractor shall answer all questions that the Department and its consultants may have. The Contractor shall provide a minimum of five (5) copies of a written summary of the information presented and discussed during the session to the Engineer. The Contractor's Baseline Schedule and accompanying Schedule Narrative shall incorporate the information discussed at this Schedule Planning Session.

**B. Schedule Reviews by the Department (All Types)****1. Baseline Schedule Reviews**

The Engineer will respond to the Baseline Schedule Submission within thirty (30) Calendar Days of receipt providing comments, questions and/or disposition that either accepts the schedule or requires revision and resubmittal. Baseline Schedules shall be resubmitted within fifteen (15) Calendar Days after receipt of the Engineer's comments.

**2. Contract Progress Schedule / Monthly Update Reviews**

The Engineer will respond to each submittal within twenty one (21) Calendar Days. Schedules shall be resubmitted by the Contractor within five (5) Calendar Days after receipt of the Engineer's comments.

Failure to submit schedules as and when required could result in the withholding of full or partial pay estimate payments by the Engineer.

**SECTION 722 (Continued)****722.61 Schedule Content and Preparation Requirements**  
(Types A, B and C unless otherwise noted)

Each Contract Progress Schedule shall fully conform to these requirements.

**A. LOGIC**

The schedules shall divide the Work into activities with appropriate logic ties to show:

1. conformance with the requirements of this Section and Division I, Subsection 8.02 - Schedule of Operations
2. the Contractor's overall approach to the planning, scheduling and execution of the Work
3. conformance with any additional sequences of Work required by the Contract Documents, including, but not limited to, Subsection 8.03 - Prosecution of Work and Subsection 8.06 – Limitations of Operations.

**B. ACTIVITIES**

The schedules shall clearly define the progression of the Work from NTP to Contractor Field Completion (CFC) by using separate activities for each of the following items:

1. NTP
2. Each component of the Work defined by specific activities
3. Detailed activities to satisfy permit requirements
4. Procurement of fabricated materials and equipment with long lead times, including time for review and approval of submittals required before purchasing
5. The preparation and submission of shop drawings, procedures and other required submittals, with a planned duration that is to be demonstrated to the Engineer as reasonable
6. The review and return of shop drawings, procedures and other required submittals, approved or with comments, the duration of which shall be thirty (30) Calendar Days, unless otherwise specified or as approved by the Engineer
7. Interfaces with adjacent work, utility companies, other public agencies, sensitive abutters, and/or any other third party work affecting the Contract
8. The Critical Path, clearly defined and organized
9. Float shall be clearly identified
10. Access Restraints – restrictions on access to areas of the Work that are defined by the Department in the bid package, in Subsection 8.06 – Limitations of Operations or elsewhere in the Contract
11. Milestones listed in Subsection 8.03 - Prosecution of Work or elsewhere in the Contract Documents
12. Subcontractor approvals at fifteen (15) Calendar Days from submittal to response
13. Full Beneficial Use (FBU) Contract Milestone per the requirements of Subsection 8.03 - Prosecution of Work
14. Contractor's request for validation of FBU (ready to open to traffic)
15. The Department's confirmation of completed work to allow for FBU

**SECTION 722 (Continued)**

16. Substantial Completion Contract Milestone per the requirements of Subsections 7.15 - Claims Against Contractors for Payment of Labor, Materials and Other Purposes and 8.03 - Prosecution of Work
17. Contractor's request for validation of Substantial Completion
18. Punchlist Completion Period of at least thirty (30) Calendar Days per the requirements of Subsections 5.11 - Final Acceptance, 7.15 - Claims Against Contractors for Payment of Labor, Materials and Other Purposes and 8.03 - Prosecution of Work
19. Contractor confirmation that all punchlist work and documentation has been completed
20. Physical Completion of the Work Contract Milestone per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
21. Documentation Completion per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
22. Contractor Field Completion Contract Milestone per the requirements of Subsections 5.11 - Final Acceptance and 8.03 - Prosecution of Work
23. Utility work to be performed in accordance with the Project Utility Coordination (PUC) Form as provided in Section 8.14 - Utilities Coordination, Documentation and Monitoring Responsibilities
24. Traffic work zone set-up and removal, night work and phasing
25. Early Utility Relocation (by others) that has been identified in the Contract
26. Right-of-Way (ROW) takings that have been identified in the Contract
27. Material Certifications
28. Work Breakdown Structure in accordance with the MassDOT-Highway Division Contractor Construction Schedule Toolkit located on the MassDOT-Highway Division website at:  
<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>
29. For Type A and B Contracts only: All items to be paid, including all Unit Price and Lump Sum pay items, shall be identified by activity. This shall include all non-construction activities such as engineering work; purchase of permanent materials and equipment, purchase of structural steel stock, equipment procurement, equipment delivery to the site or storage location and the representative amount of overhead/indirect costs that was included in the Contractor's Bid Prices.

**C. EARLY AND LATE DATES**

Early Dates shall be based on proceeding with the Work or a designated part of the Work exactly on the date when the corresponding Contract Time commences. Late Dates shall be based on completing the Work or a designated part of the Work exactly on the corresponding Contract Time, even if the Contractor anticipates early completion.



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**SECTION 722 (Continued)****D. DURATIONS**

Activity durations shall be in Work Days. Planned Original Durations shall be established with consideration to resources and production rates that correspond to the Contractor's Bid Price. Within all of the Department-required schedules, the Contractor shall plan the Work using durations for all physical construction activities of no less than one (1) Work Day and no greater than fourteen (14) Work Days, unless approved by the Engineer as part of the Baseline Schedule Review.

Should there be an activity with a duration that is determined by the Engineer to be unreasonable, the Contractor will be asked to provide a basis of the duration using bid documents, historic production rates for similar work, or other form of validation that is acceptable to the Engineer. Should the Contractor and the Engineer be unable to agree on reasonable activity durations, the Engineer will, at a minimum, note the disagreement in the Baseline Schedule Review along with a duration the Engineer considers reasonable and the basis for that duration. A schedule that contains a substantial number of activities with durations that are deemed unreasonable by the Engineer will not be accepted.

**E. MATERIALS ON HAND (for Types A and B only)**

The Contractor shall identify in the Baseline Schedule all items of permanent materials (Materials On Hand) for which the Contractor intends to request payment prior to the incorporation of such items into the Work.

**F. ACTIVITY DESCRIPTIONS**

The Contractor shall use activity descriptions in all schedules that clearly describe the work to be performed using a combination of words, structure numbers, station numbers, bid item numbers, work breakdown structure (WBS) and/or elevations in a concise and compact label as specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>

**G. ACTIVITY IDENTIFICATION NUMBERS**

The Contractor shall use the activity identification numbering system specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located online at the address above.

**H. ACTIVITY CODES**

The Contractor shall use the activity codes specified in the MassDOT-Highway Division Contractor Construction Schedule Toolkit located online at the address above.

**I. CALENDARS**

Different calendars may be created and assigned to all activities or to individual activities. Calendars define the available hours of work in each Calendar Day, holidays and general or project-specific non-Work Days such as Fish Migration Periods, time of year (TOY) restrictions and/or area roadway restrictions.

**SECTION 722 (Continued)**

Examples of special calendars include, but are not limited to:

- Winter Shutdown Period, specific work is required by separate special provision to be performed during the winter. See Special Provision 8.03 (if applicable)
- Peak traffic hours on heavily traveled roadways. This shall be from 6:30 am to 9:30 am and from 3:30 pm to 7:00 pm, unless specified differently elsewhere in the Contract.
- Special requirements by sensitive abutters, railroads, utilities and/or other state agencies as defined in the Contract.
- Cape Cod and the Islands Summer Roadway Work Restrictions: A general restriction against highway and bridge construction is enforced between Memorial Day and Labor Day, unless otherwise directed by the Engineer. Refer to the Project Special Provisions for specific restrictions.
- Cape Ann Summer Roadway Work Restrictions: While there are no general restrictions for Cape Ann as there are for Cape Cod and the Islands, project-specific restrictions may be enforced. Refer to the Project Special Provisions for specific restrictions.
- Turtle and/or Fish Migration Periods and/or other in-water work restrictions: Refer to the Project Special Provisions for specific restrictions.
- Working over Waterways Restricted Periods: Refer to the Project Special Provisions for specific restrictions.
- Night-time paving and striping operations, traffic and temperature restrictions: Refer to the Project Special Provisions for specific restrictions.
- Utility Restrictions shall be as specified within the Contract.

**J. FLOAT**

For the calculation of float in the CPM schedule, the setting for *Retained Logic* is required for all schedule submissions, starting with the Baseline Schedule Submission. Should the Contractor have a reason to propose that an alternative calculation setting such as *Progress Override* be used, the Contractor shall obtain the Engineer's approval prior to modifying to this setting.

**K. COST AND RESOURCE LOADING (Types A and B only)**

For all Type A and B Schedules, the Contractor shall provide a cost and resource-loaded schedule with an accurate allocation of the costs and resources necessary to complete the Work. The costs and resources shall be assigned to all schedule activities in order to enable the Contractor to efficiently execute the Contract requirements and the Engineer to validate the original plan, monitor progress, provide cash flow projections and analyze delays.

1. Each schedule activity shall have an assigned cost that accurately represents the value of the Work. Each schedule activity shall have its resources assigned to it by craft and the anticipated hours to accomplish the work. Each schedule activity's equipment resources shall be assigned to it by equipment type and hours operated. Front-loading or other unbalancing of the cost distribution will not be permitted.
2. The sum of the cost of all schedule activities shall be equal to the Contractor's Bid Price.
3. Indicating the labor hours per individual, per day, by craft and equipment hours/day will be acceptable.

**SECTION 722 (Continued)**

4. The Engineer reserves the right to use the cost-loading as a means to resolve changes, disputes, time entitlement evaluations, increases or decreases in the scope of Work, unit price renegotiations and/or claims.
5. For all Type A and B Schedules, all subnets, fragnets, Proposal Schedules, and Recovery Schedules shall be cost and resource- loaded to help to quickly validate and monitor the duration of the Work to be performed.
6. For Type A Schedules, cost-loading of the schedule will also be used for cash flow projection purposes.
7. The cost-loading of each activity shall indicate the portion of the cost for that activity that is applicable to a specific bid item (cost account.) The total cost for each cost account must equal the bid item price.
8. For Type A Schedules, each month, the Contractor will be paid using the Cost-loaded CPM activities for Lump Sum payment items. This requirement supersedes any requirements elsewhere in this Contract regarding partial payments of schedule-of-values for all Lump Sum items.

**L. NOT TO BE USED IN THE CONTRACTOR'S CPM SCHEDULE**

1. Milestones or constraint dates not specified in the Contract
2. Scheduled work not required for the accomplishment of a Contract Milestone
3. Use of activity durations, logic ties and/or sequences deemed unreasonable by the Engineer
4. Delayed starts of follow-on trades
5. Float suppression techniques

**722.62 Submittal Requirements**

All schedules shall be prepared and submitted in accordance with the requirements listed below.

Each monthly Contract Progress Schedule submittal shall be uniquely identified.

Except as stated elsewhere in this subsection, schedule submittals shall include each of the documents listed below, prepared in two formats, for distribution as follows:

- a. four (4) compact discs (CD); one (1) each for the Office of Project Controls and Performance Oversight (O-PC&PO), the Boston Construction Section Office, the District Construction Office and the Resident Engineer's Office. Additional copies shall be required if the work is performed in more than one district.
- b. two (2) hard copies plotted in color on 24" X 36" paper; one (1) copy each for the District Construction Office and the Resident Engineer's Office. No copies for the O-PC&PO and the Boston Construction Section Office. Additional copies shall be required if the work is performed in more than one district.

**SECTION 722 (Continued)****A. Narratives**

A written narrative shall be submitted with every schedule submittal. The narrative shall:

1. itemize and describe the flow of work for all activities on the Critical Path in a format that includes any changes made to the schedule since the previous Contract Progress Schedule / Monthly Update or the Baseline Schedule, whichever is most recent;
2. provide a description of any specification requirements that are not being followed. Identify those that are improvements and those that are not considered to be meeting the requirements;
3. provide all references to any Notice of Delay that has been issued, within the time period of the Contract Progress Schedule Update, by letter to the Engineer. Note that any Notice of Delay that is not issued by letter will not be recognized by the Engineer. See Subsection 722.64.A - Notice of Delay;
4. provide a description of each third-party utility's planned vs. actual progress and note any that are trending late or are late per the durations and commitments as provided in the PUC Form; provide a description of the five (5) most important responses needed from the Department and the need date for the responses in order to maintain the current Schedule of Record;
5. provide a description of all critical issues that are not within the control of the Contractor or the Department (third party) and any impact they had or may have on the Critical Path;
6. provide a description of any possible considerations to improve the probability of completing the project early or on-time;
7. compare Early and Late Dates for activities on the Critical Path and describe reasons for changes in the top three (3) most critical paths ;
8. describe the Contractor's plan, approach, methodologies and resources to be employed for completing the various operations and elements of the Work for the top three (3) most critical paths. For update schedules, describe and propose changes to those plans and verify that a Proposal Schedule is not required;
9. describe, in general, the need for shifts that are not 5 days/week, 8 hours/day, the holidays that are inserted into each calendar and a tabulation of each calendar that has been used in the schedule;
10. describe any out-of-sequence logic and provide an explanation of why each out-of-sequence activity does not require a correction, if one has not been provided, and an adequate demonstration that these changes represent the basis of how these activities will be built, including considerations for resources, dependencies and previously-approved production rates;
11. identify any possible duration increases resulting from actual or anticipated unit price item quantity overruns as compared to the baseline duration, with a corresponding suggestion to mitigate any possible delays to the Critical Path. If the delay is anticipated to impact the Critical Path, refer to Subsections 4.06 - Increased or Decreased Contract Quantities and 8.10 - Determination and Extension of Contract Time for Completion and submit a letter to the Engineer notifying of a potential delay;
12. include a schedule log consisting of the name of the schedule, the data date and the date submitted.

**SECTION 722 (Continued)****B. Bar Charts (Types A, B, C and D)**

One (1) time-scaled bar chart containing all activities shall be prepared and submitted using a scale that yields readable plots and that meets the requirements of Subsection 722.61 - Schedule Content and Preparation Requirements. Activities shall be linked by logic ties and shown on their Early Dates. Critical Paths shall be highlighted and Total Float shall be shown for all activities.

A second time-scaled bar chart shall also be prepared containing only the Critical Path or, if the Critical Path is not the longest path, the Longest Path using a scale that yields readable plots and that meets the requirements of Subsection 722.61 - Schedule Content and Preparation Requirements. Activities shall be linked by logic ties and shown on their Early Dates. Total Float shall be shown for all activities.

Bar Charts shall be printed in color and submitted on 11" X 17" paper or, if approved by the Engineer, as a .pdf file.

**C. Detailed Activity Schedule Comparisons**

A Detailed Activity Schedule Comparison (DASC) is a simple reporting tool in the format of a graphical report that will provide Resident Engineers with immediate, timely and up-to-date information. The DASC consists of an updated bar chart that overlays the current time period's bar chart onto the previous time period's bar chart for an easily-read comparison of progress during the present and previous reporting periods. The DASC shall be prepared and submitted in accordance with the instructions contained in the Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit>

The reports described in Subsections D, E and F below shall be submitted with all of the schedules listed in Subsection 722.20 - General:

**D. Activity Cost Report and Monthly Cash Flow Projections (Type A only)**

With each Contractor Quantity Estimate (CQE), the Contractor shall submit an Activity Cost Report and Cash Flow Projection that includes all activities grouped by Contract Bid Item.

The Activity Cost Report shall be generated from the Schedule of Record and shall be the basis of the Monthly Cash Flow Projection. Within each contract Bid Item, activities shall be sequenced by ascending activity identification number and shall show:

1. activity ID and description,
2. forecast start and finish dates for each activity and,
3. when submitted as a revised schedule, actual start and finish dates for each completed activity.

For Unit Price pay items, in addition to the above, estimates to complete and any variance to the estimated Contract quantity shall be shown.

**E. Resource Graphs (Type A only)**

Monthly and cumulative resource graphs for the remaining Contract period using the Early Dates and Late Dates in the Contract Progress Schedule shall be included as part of each schedule submittal.

**SECTION 722 (Continued)****F. Projected Spending Reports (Types B, C and D)**

A Projected Spending Report (PSR) shall be prepared and submitted in accordance with the instructions listed at the end of this section. The PSR shall indicate the monthly spending (cash flow) projection for each month from NTP to Contractor Field Completion (CFC). Each month's actual spending shall be calculated using all CQEs paid during that month. If the difference between the Contractor's monthly projections vs. the actual spending is greater than 10%, the Contractor's monthly spending projection shall be revised and resubmitted within fifteen (15) Calendar Days.

The Projected Spending Report (PSR) shall be depicted in a tabular format and printed in color on 11 x 17-sized paper or larger as approved by the Engineer. For additional instructions and a template for preparing the Projected Spending Report (PSR), refer to the Contractor's Construction Schedule Toolkit located on the MassDOT-Highway Division website at:

<https://www.mass.gov/info-details/massdot-highway-contractors-schedule-toolkit> or consult with the District Construction Scheduler.

**722.63. Progress Schedule Requirements****A. Baseline Schedule**

The Baseline Schedule shall be due thirty (30) Calendar Days after Notice to Proceed (NTP.) The Baseline Schedule shall only reflect the Work awarded to the Contractor and shall not include any additional work involving Extra Work Orders or any other type of alleged delay. The Baseline Schedule shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements. Once the Baseline Schedule has been accepted by the Engineer, with or without comments, it shall represent the as-planned schedule for the Work and become the Contract Progress Schedule of Record until such time as the schedule is updated or revised under Subsections 722.63.C - Contract Progress Schedules / Monthly Updates, 722.64.C - Recovery Schedules and 722.64.D - Proposal Schedules.

The Cost and Resource-Loading information (Types A and B only) shall be provided by the Contractor within forty-five (45) Calendar Days after NTP.

The Engineer's review comments on the Baseline Schedule and the Contractor's responses to them will be maintained for the duration of the Contract and will be used by the Engineer to monitor the Contractor's work progress by comparing it to the Contract Progress Schedule / Monthly Update.

**B. Interim Progress-Only Schedule Submissions**

The first monthly update of the Contract Progress Schedule/Monthly Update is due within seventy (70) Calendar Days after Notice to Proceed (NTP.) The Baseline Schedule review period ends at sixty (60) Calendar Days after NTP, see Subsection 722.60.B - Schedule Reviews by the Department. If the Baseline Schedule has not been accepted within sixty (60) Calendar Days after NTP, an Interim Progress-Only Schedule shall be due within seventy (70) Calendar Days after NTP. The purpose of the Interim Progress-Only Schedule is to document the actual progress of all activities, including non-construction activities, from NTP until the Baseline Schedule is accepted.

**SECTION 722 (Continued)****C. Contract Progress Schedules / Monthly Updates (Types A, B, C and D)**

The first Contract Progress Schedule shall be submitted by the Contractor no later than seventy (70) Calendar Days after NTP. The data date for this first Progress Schedule shall be sixty (60) Calendar Days after NTP. Subsequent Progress Schedules shall be submitted monthly.

Each Contract Progress Schedule shall reflect progress up to the data date. Updated progress shall be limited to as-built sequencing and as-built dates for completed and in-progress activities. As-built data shall include actual start dates, remaining Work Days and actual finish dates for each activity, but shall not change any activity descriptions, the Original Durations, or the Original Resources (as planned at the time of bid), without the acceptance of the Engineer. If any activities have been completed out-of-sequence, the Contractor shall propose new logic ties for affected in-progress and future activities that accurately reflect the previously-approved sequencing. Alternatively, the Contractor may submit to the Engineer for approval an explanation of why an out-of-sequence activity does not require a correction and an adequate demonstration that the changes accurately represent how the activities will be built, including considerations for resources, dependencies and previously approved production rates. Once approved by the Engineer, the Contractor may incorporate the changes in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

No revisions to logic ties; sequence, description or duration of future activities; or planned resource costs shall be made without prior approval by the Engineer.

Any proposed logic changes for in-progress or future activities shall be submitted to the Engineer for approval before being incorporated into a Contract Progress Schedule. The logic changes must be submitted using a Proposal Schedule or a schedule fragment submission. Once approved by the Engineer, the Contractor may incorporate the logic in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

For any proposed changes to the original sequence, description or duration of future activities, the Contractor shall submit to the Engineer for approval an explanation of how the proposed description or duration change reflects how the activity will be progressed, including considerations for resources and previously approved production rates. Any description or duration change that does not accurately reflect how the activity will be progressed will not be approved by the Engineer. Once approved by the Engineer, the Contractor may incorporate the changes in the next Contract Progress Schedule/Monthly Update with the affected activities clearly identified and explained in the Schedule Narrative.

Except as otherwise designated by a Contract Modification, no Contract Progress Schedule that extends performance beyond the Contract Time and/or beyond any Contract Milestone shall be approved by the Engineer. The Contractor shall submit a Recovery Schedule if any Contract Progress Schedule/Monthly Update indicates a failure to meet the Contract Dates.

**D. Short-Term Construction Schedule**

The Contractor shall provide a Short-Term Construction Schedule that details daily work activities, including any multiple shift work that the Contractor intends to conduct, in a bar chart format. The daily activities shall directly correspond to the Contract Progress Schedule activities, with a matching reference to the activity identification number in the Contract Progress Schedule, and may be at a greater level of detail.

**SECTION 722 (Continued)**

The Short-Term Construction Schedule shall be submitted every two weeks. It shall display all work for a thirty-five (35) Calendar Day period consisting of completed work for the two (2) week period prior and all planned work for the following three (3) week period. The initial submission shall be provided no later than thirty (30) Calendar Days after NTP or as required by the Engineer.

The Contractor shall be prepared to discuss the Short-Term Construction Schedule, in detail, with the Engineer in order to coordinate field inspection staff requirements, the schedule of work affecting abutters and any corresponding work with affected utilities. Short-Term Construction Schedules shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements.

Failure to submit Short-Term Construction Schedules every two (2) weeks may result in withholding of full or partial payments by the Engineer.

**722.64 Impacted Schedule Requirements****A. Notice of Delay**

The Contractor shall notify the Engineer in writing, with copies to the District and State Construction Engineers, within three (3) Calendar Days of the start of any delays to the Critical Path that are caused by actions or inactions that were not within the control of the Contractor. Delay notifications that are not provided in a letter to the Engineer, such as a delay notification in the schedule narrative, will not be recognized as contractual notice in the determination of any Time Extension related to the impacts to the work associated with this specific alleged delay. Should such delay continue for more than one (1) week, the Contractor shall note it in the Schedule Narrative until the delay is no longer impacting the Critical Path for the completion of the Contract Milestones. The Engineer will evaluate the alleged delay and its impact and will respond to the Contractor within ten (10) Calendar Days after receipt of a notice of delay.

**B. Time Entitlement Analysis**

A Time Entitlement Analysis (TEA) shall consist of a descriptive narrative, prepared in accordance with Subsection 722.62.A - Narratives, and an as-built CPM schedule, which may be in the form of a schedule fragnet ( that has been developed from the project's Contract Progress Schedule of Record, and illustrates the impact of a delay to the Critical Path, Contract Milestones and/or Contract Completion Date as required in Subsection 8.10 - Determination and Extension of Contract Time for Completion. TEAs shall also be used to determine the schedule impact of proposed Extra Work Orders (EWO) as also required in Subsection 8.10.

TEAs shall be prepared and submitted in accordance with the requirements of Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements and shall be based on the Contract Progress Schedule of Record applicable at the start of the delay or impact from an EWO. A TEA fragnet must start with a specific new activity describing the work contained in either a Notice of Delay previously submitted to the Department per Subsection 722.64.A - Notice of Delay or an EWO.



**SECTION 722 (Continued)**

TEAs shall be submitted:

1. as part of any Extra Work Order that may impact Contract Time,
2. with a request for a Time Extension,
3. within fourteen (14) Calendar Days after a request for a TEA by the Engineer for any other reason.

A TEA shall be submitted to the Engineer before any Time Extension is granted to the Contractor. Time Extensions will not be granted unless the TEA accurately reflects an evaluation of all past delays and the actual events that occurred that impacted the Critical Path. The TEA must also demonstrate a plan for the efficient completion of all of the remaining work through an optimized CPM Schedule. The analysis shall include all delays, including Contractor-caused delays, and shall be subdivided into timeframes and causes of delays.

TEAs shall incorporate any proposed activities, logic ties, resource considerations, and activity costs required to most efficiently demonstrate the schedule impacts in addition to detailing all impacts to existing activities, logic ties, the Critical Path, Contract Milestones and the Contract Completion Date. In addition, TEAs shall accurately reflect any changes made to activities, logic ties, restraints and activity costs, necessitated by an Extra Work Order or other schedule impact, for the completion of the remaining work. The Contractor shall provide TEAs that demonstrate that all delays have been mitigated to the fullest extent possible without requiring an Equitable Adjustment to the original bid basis.

All TEAs shall clearly indicate any overtime hours, additional shifts and the resource that are proposed to be incorporated in the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts. The Engineer shall have the right to require that overtime hours and/or additional shifts be used to minimize the duration of Time Extensions if it is determined to be in the best interest of the Department to do so.

When accepted, the changes included in a TEA shall be incorporated into the next Contract Progress Schedule per the requirements of Subsection 722.63.C - Contract Progress Schedules / Monthly Updates.

During the review of any TEA, all Contract Progress Schedules shall continue to be submitted as required.

The Engineer may request that the Contractor prepare a Proposal Schedule or a Recovery Schedule to further mitigate any delays that are shown in the accepted TEA/Contract Progress Schedule.

**C. Recovery Schedules**

The Contractor shall promptly report to the Engineer all schedule delays during the prosecution of the Work. Except as otherwise designated by a Contract Modification, no Contract Progress Schedule that extends performance beyond the Contract Time and/or beyond any Contract Milestone shall be approved by the Engineer. The Contractor shall submit a Recovery Schedule within fourteen (14) Calendar Days of a Contract Progress Schedule submission that shows failure to meet the Contract Dates. This requirement is critical to the Department's ability to make informed decisions regarding Contract Time and costs.

**SECTION 722 (Continued)**

During the prosecution of the Work, should the Contractor's progress on a critical operation clearly not meet anticipated production, without cause by fault of the Department, or should a critical activity or series of activities not be staffed in accordance with the Contractor's approved Baseline Schedule resource planning, the Contractor shall be obligated to recover such delay. Recovery Schedules shall be prepared and submitted in accordance with Subsections 722.61 - Schedule Content and Preparation Requirements and 722.62 - Submittal Requirements within fourteen (14) Calendar Days of any of the cases listed above.

Recovery Schedules shall clearly indicate any proposed overtime hours, additional shifts, and the resources that are proposed to be incorporated in to the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts and shall have the right to require that overtime hours and/or additional shifts be used to minimize the duration of Time Extensions, without additional compensation for any Contractor delays, if it is determined to be in the best interest of the Department to do so.

During the review of any Recovery Schedule, all Contract Progress Schedules shall continue to be required every month.

The Engineer may request that the Contractor prepare a Recovery Schedule to further mitigate any delays that are shown in an accepted TEA/Contract Progress Schedule.

Changes represented in accepted Recovery Schedules shall be incorporated into the next Contract Progress Schedule.

**D. Proposal Schedules**

A Proposal Schedule is an alternative schedule used to evaluate proposed changes to the Contract scope or significant alternatives to previously approved approaches to complete the Work, which may include changes to activity durations, logic and sequence. For Types A and B Schedules, the Proposal Schedule shall be cost and resource-loaded.

A Proposal Schedule may be requested by the Department at any time or may be offered by the Contractor. The Engineer may request that the Contractor prepare a Proposal Schedule to further mitigate any delays that are shown in an accepted TEA/Contract Progress Schedule.

The Contractor shall submit the Proposal Schedule within thirty (30) Calendar Days of a request from the Department.

The Proposal Schedule shall not be considered a Schedule of Record until the logic, durations, narrative and basis of the Proposal Schedule have been accepted by the Engineer. If the Proposal Schedule took the form of a fragnet, it must be incorporated into the Contract Progress Schedule of Record showing the current progress of all other activities and the impacts/results of the changes made by the Proposal Schedule before the Proposal Schedule is accepted by the Department.

Proposal Schedules shall clearly indicate any proposed overtime hours, additional shifts, and the resources that are proposed to be incorporated in the schedule. The Engineer shall have final discretion over the use of overtime hours and additional shifts.

Changes represented in accepted Proposal Schedules shall be incorporated into the next Contract Progress Schedule. During the review of any Proposal Schedule, all Contract Progress Schedules shall continue to be required every month.

**SECTION 722 (Continued)**

**E. Disputes (Types A, B, C and D)**

All schedules shall be submitted, reviewed, dispositioned and accepted in the timely manner specified herein so as to provide the greatest possible benefit to the execution of this Contract.

Any dispute concerning the acceptance of a schedule or any other question of fact arising under this subsection shall be determined by the Engineer. Pending resolution of any dispute, the last schedule accepted by the Engineer will remain the Contract Schedule of Record.

**COMPENSATION**

**722.80 Method of Measurement and Basis of Payment (Types A, B, C and D)**

The Special Provisions will specify the fixed-price amount to be paid to the Contractor for the Project Schedule requirements contained herein. Each bidder shall include this lump-sum, fixed-price bid item amount in his/her bid. Failure to do so may be grounds for the rejection of the bid.

All required schedule-related work, including, but not limited to computers, computer software, the planning and coordination with utilities, training, schedule preparation and schedule submittals will be paid for under the fixed price amount.

This fixed price amount is for payment purposes only and is separate from what the Department considers to be the Contractor's General Condition costs. If the Contractor deems it necessary to include additional costs to provide all of the requirements of this section, these additional costs shall be included in the Contractor's overall bid price.

Twenty percent (20%) of this pay item will be paid upon the Engineer's acceptance of the Contractor's Baseline Schedule, prepared and submitted in accordance with Subsection 722.63.A.

The remaining eighty percent (80%) of this pay item will be paid in equal monthly installments distributed across the Contract Duration from Notice to Proceed (NTP) to Contractor Field Completion (CFC), less the 2 months required for the submittal and review of the Baseline Schedule in accordance with the following formula:

$$\text{Monthly Payment} = \frac{\text{Remaining Fixed Price amount (80\% of Item 100.)}}{\text{Contract Duration in whole months} - 2 \text{ months}}$$

The timely and accurate submission of the Baseline Schedule is critical to the Contract and the Department's ability to make informed decisions. Only payments under Item 740 - Engineer's Field Office and Item 748 – Mobilization will be made until the Baseline Schedule is accepted by the Engineer.

**SECTION 722 (Continued)**

No payment for any other pay item will be processed beyond seventy-five (75) Calendar Days from Notice to Proceed (NTP) until the Baseline Schedule is accepted by the Engineer. Until the Engineer's acceptance of the Baseline Schedule, the combined total of all payments made to the Contractor will be limited to an amount no greater than the total price for Item 748 - Mobilization or 3% of the contract price, whichever is less.

All Contract Progress Schedule Updates submitted later than ten (10) Calendar Days after the CQE (Contract Quantity Estimate) completion date, or greater than forty (40) Calendar Days from the Data Date of the previous submission, will be deemed to be no longer useful and will not qualify for payment. Late submittal of missed Contract Progress Monthly Updates will not result in recovery of the previously forfeited portion of the Schedule of Operations Fixed Price Payment Item.

Failure to submit schedules as and when required may result in the forfeiture of that portion of the Schedule of Operations Fixed Price Payment and/or the withholding of the full or partial CQE payments by the Engineer.

Failure to submit schedules that are acceptable to the Engineer may result in the forfeiture of that portion of the Schedule of Operations Fixed Price Payment and/or the withholding of the full or partial CQE payments by the Engineer.

The Schedule of Operations pay item will be adjusted to pay for only the actual quantity of schedules that have been submitted in accordance with this section.

The Contractor's failure or refusal to comply with the requirements of this Section shall be reasonable evidence that the Contractor is not prosecuting the Work with due diligence and may result in the withholding of full or partial payments by the Engineer.

Should there be a Time Extension granted to the Contractor, the Engineer may provide an Equitable Adjustment for additional Contract Progress Schedule Updates at intervals directed by the Engineer. Item 100. will be the basis for this Equitable Adjustment.

**722.82 Payment Items**

100. SCHEDULE OF OPERATIONS - FIXED PRICE \$ \_\_\_\_\_ LUMP SUM

**ITEM 102.3****HERBICIDE TREATMENT OF INVASIVE PLANTS****HOOR**

This work must be performed by persons who meet the qualifications below and are approved by the MassDOT Landscape Design Section.

Work under this item consists of herbicide treatment of invasive plants currently existing within the project limits and as directed. An Invasive Plant Management Strategy (IPMS) shall be submitted to the Engineer for review and approval and the IPMS shall be implemented on-site. The IPMS shall be measured and paid for under Item 102.33 Invasive Plant Management Strategy.

Work under this item shall be coordinated with work and schedule for Selective Clearing, Clearing and Grubbing, Mowing, Tree Removal, Planting, and Wetland Mitigation items.

Payment is per hour on-site and shall be compensation for a minimum crew of 2 licensed applicators, 2 back-pack sprayers and mist-blowers, a properly equipped spray truck with spray hoses, and a tank with sufficient capacity for a full day of work. If there is only one applicator, hourly payment shall be adjusted to 50 percent of the unit price. This item is not intended for manual removal of plants.

Management of plants determined to have been introduced to the site via imported loam, compost, mulch, plants, equipment, or other construction activities will be the Contractor's responsibility and at the Contractor's expense.

Herbicide shall be applied during daytime hours only.

Measures to prevent the introduction of invasive plant species to the site and to address introduction due to construction-related activities shall be covered under the Standard Specifications, Division I - Subsections 7.01(D) Plant Pest Control and 7.13 Protection and Restoration of Property as amended in these Special Provisions.

Plant species targeted for management under this item shall be as determined in the field per the site walk and as specified in the IPMS.

The definition of invasive plant species shall be as described by Massachusetts Invasive Plant Advisory Group (MIPAG): "non-native species that have spread into native or minimally managed plant systems in Massachusetts, causing economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems."

Control of invasive plants shall begin immediately with the initiation of construction activities and prior to any clearing or site disturbance. Treatment areas shall include stockpile locations and may, upon approval of the Engineer, extend outside the project limit. Treatment shall be done each consecutive year for the duration of the contract unless specified otherwise in the IPMS or unless directed otherwise by the MassDOT invasive species contact. Work shall be done during the growing season from May – October unless otherwise specified in the IPMS.

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**ITEM 102.3** (Continued)

Areas identified for vegetation control measures shall be as shown on the plans and as determined in the field by the Engineer and a MassDOT Landscape Architect. Contact at MassDOT Landscape Design Section is: [stephanie.smoot@dot.state.ma.us](mailto:stephanie.smoot@dot.state.ma.us).

**QUALIFICATIONS**

The applicators shall submit and meet the qualifications outlined below. A list of contractors specializing in invasive management and approved by MassDOT Landscape Design Section is available on the following website: <https://www.mass.gov/lists/landscape-design-and-roadside-maintenance> under Invasive Plant Management.

**Requirements**

1. Company must provide proof of qualifications by providing the following:
  - a. Narrative describing company, its expertise and experience with invasive plant control.
  - b. Demonstrate experience with herbicide treatment as part of restorations and in sensitive areas.
  - c. Describe company's technical qualifications and past performance.
2. Company must meet licensing requirements:
  - a. All crew applicators must have a Massachusetts Commercial Applicator License (CORE).
  - b. At least one or more applicator must have a ROW certification, if required for work.
  - c. Company must provide name(s) of applicator(s) and Applicator License/Certification number for all contractor crew leaders working on the project.
  - d. Company must provide documentation of any warnings, penalties or fines received in the last three (3) years.
3. Company must provide proof of experience with invasive plant control and include following:
  - a. At least five (5) references from prior invasive plant control work completed in last five (5) years. Provide contact information including address, phone number and email.
  - b. Provide a summary of each of these projects including nature of the problem, specific invasive vegetation treated, dates and period of treatment, methodologies used, and summary of success or not in terms of meeting performance objectives. Include summary of equipment used.
  - c. Photo documentation of these projects.
  - d. GPS coordinates of project locations, if available.
4. Crew leader must have expertise with invasive plant control and provide the following:
  - a. Have held Core license for at least five (5) years.
  - b. Resume listing five (5) or more years of experience applying pesticides with the company or with another company specializing in vegetation management.

**ITEM 102.3** (Continued)

**SUBMITTALS**

No work shall begin without approval of the submittals.

Submittals include the following items:

**Invasive Plant Management Strategy (IPMS)**

At least thirty (30) days prior to proposed treatment the IPMS shall be submitted for approval by the Engineer and MassDOT Landscape Architect. All chemicals, methods and work done under this item shall be consistent with the IPMS. The IPMS shall be as described under Item 102.33.

**Herbicide Use Report**

Within two (2) weeks after each application, the Contractor shall provide to the Engineer a completed and signed MassDOT Herbicide Use Report.

**Photo Documentation**

Digital photos with date and time of herbicide application work may be required and shall be submitted upon request.

**MATERIALS**

All proposed herbicides shall be as approved in the IPMS. Herbicides shall be labeled for the method of treatment and shall meet all federal, state and local regulation requirements. Application rates will depend on herbicide proposed and shall be per the manufacturer's label for specific application.

**METHODS**

All methods used shall be as approved in the IPMS which shall be determined during the Initial Site Walk as described under Item 102.33 Invasive Plant Management Strategy.

The Contractor shall be responsible for marking delineated areas and plants to be preserved, removed, or otherwise treated. Fencing or other materials needed for marking and delineating protected areas shall be incidental to this item.

The Contractor shall notify the Engineer a minimum of 3 days prior to date of expected herbicide application. Applicators shall notify the Engineer upon arriving on-site and upon leaving the site.

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**ITEM 102.3** (Continued)**Herbicide Applications**

All herbicide application shall conform to Massachusetts Pesticide Laws and Regulations per the Massachusetts Department of Agricultural Resources (MDAR) Pesticide Bureau.

Mixing, applying and/or disposing of herbicides shall always be in accordance with instructions on their labels and all applicable federal, state, and local regulations. Mixing shall not occur within sensitive areas, wetlands, or buffer zones.

Contractor shall not spray 2 hours prior to precipitation, during rain, or during windy conditions. The Contractor shall be responsible for monitoring weather conditions and adjusting the work schedule as appropriate for the herbicide and application method to be used.

Targeted vegetation shall be identified and marked prior to treatment. Plants treated by foliar spray, injection or glove application or other methods that leave standing vegetation, as opposed to cut-stump application, shall remain clearly marked for identification through the contract period.

Desirable vegetation shall be protected from both spray and other physical damage.

Contractor is responsible for any damage to vegetation not designated for removal or treatment. Vegetation damaged shall be restored. Cost of replacement plants and/or restoration shall be borne by the Contractor.

Contractor shall ensure that the public does not enter a work area while herbicide application or spraying is underway.

**Disposal Of Invasive Plant Material**

All material to be cleared shall become the property of the Contractor. The satisfactory disposal of all cleared plant material (seeds, roots, woody vegetation, associated soils, etc.) shall be the Contractor's responsibility.

The Contractor shall take measures to prevent viable plant material from leading to further infestations (seeds, roots, woody material, etc.) while stockpiled, in transit, or at final disposal locations. All precautions shall be taken to avoid contamination of natural landscapes with invasive plants or invasive plant material.

Chipping, shredding, or on-site burning of plant material must be approved by the Engineer and included in the IMPS.

For plant material taken to an incinerating facility per the IPMS, a receipt from that facility shall be submitted to the Engineer as proof of disposal.



**ITEM 102.3** (Continued)

Where feasible, it is preferable to dispose of plants on-site or to bury them on-site with on-going monitoring for re-sprouting. Disposal locations and methods must be approved and included in the IPMS. Site work such as grading and seeding to stabilize and restore disposal area shall be incidental to this item.

The Contractor shall be responsible for treating or otherwise managing areas of re-growth due to improper disposal. Treatment shall be at the Contractor's expense.

**Follow-Up Treatment**

Plants and areas shall be re-treated as necessary and as appropriate to the time of year. Treatment shall be for the duration of the contract and per the IPMS.

**MEASURE OF SUCCESS**

The expectation is a minimum of 85-95 percent control achieved after the first treatment, depending on plants targeted and extent of population, and based on the expectations laid out in the IPMS. The expectation for the contract duration is 95-100% eradication by the end of the treatment period, unless otherwise specified in the IPMS.

**METHOD OF MEASUREMENT**

Item 102.3 will be measured for payment by the Hour of crew time spent on the project doing actual herbicide application work. A crew shall be defined as a minimum of two licensed applicators each equipped with (at minimum) back-pack sprayer and mist blower. The crew shall also have a properly equipped spray truck with hoses and a tank with sufficient capacity for a full day of work.

**BASIS OF PAYMENT**

Item 102.3 will be paid at the contract unit price per Hour, which price shall include all labor, materials, equipment, tools, and all incidentals required to complete the work.

Payment will be based upon time spent on the project doing actual work and shall not include travel time to and from the Contractor's place of business and shall also not include time for investigative field trips.

If there is only one applicator, hourly payment shall be adjusted to 50 percent of the unit price.

The Invasive Plant Management Strategy will be paid for under Item 102.33.

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**ITEM 102.33**      **INVASIVE PLANT MANAGEMENT STRATEGY**      **HOUR**

This item consists of providing an Invasive Plant Management Strategy (IPMS) for the control of invasive plants currently existing on the project site and/or as directed and shall be coordinated with Item 102.3 Herbicide Treatment of Invasive Plants. The IPMS shall be submitted for review and approval and the IPMS shall be implemented on-site.

Herbicide treatment for invasive plants shall be as described under Item 102.3 Herbicide Treatment of Invasive Plants and shall be compensated per that Item.

Work under this item shall be coordinated with work and schedule for Selective Clearing, Clearing and Grubbing, Mowing, Tree Removal, Planting, and Wetland Mitigation as relevant to the project.

Individual attending the site walk and determining the Invasive Plant Management Strategy must demonstrate expertise with vegetation management and invasive plant control and submit qualifications as described below.

**SUBMITTALS****Task Summary**

For measurement of payment, the contractor shall submit the total sum and a breakdown of hours for the tasks performed. At a minimum, the tasks shall include the Initial Site Walk, the IPMS Written Report, and if necessary to accommodate project or site changes, a Follow-up Site Inspection and accompanying IPMS Amendment.

Interim Site Monitoring Reports and/or a Final Report shall be submitted if requested by the MassDOT Landscape Design contact. The MassDOT Landscape Design contact shall be notified to attend the final walk through when a Final Report has been requested.

**Qualifications**

Individual shall be from the same company as that providing services for Item 102.3 Herbicide Treatment of Invasive Plants or shall meet the following requirements:

- Submit copy of current Core license.
- Submit a resume listing five (5) or more years of experience managing invasive plants with a company specializing in vegetation management. References shall be submitted if requested.

**Invasive Plant Management Strategy (IPMS)**

At least thirty (30) days prior to construction activities and/or any proposed treatment, submit a written IPMS proposal for approval by the Engineer and MassDOT Landscape Architect. All chemicals and methods proposed shall be consistent with applicable Massachusetts Wetlands Protection Act Order of Conditions.

**ITEM 102.33** (Continued)

The IPMS shall be completed in coordination with the Roadway Contractor and the Engineer and shall include the following as appropriate to the project:

- I. Project Information**
  - a. Company writing IPMS and performing herbicide application.
  - b. Date of site walk
  - c. Attendees at site walk
  - d. Expected end date of contract and expected last treatment (month/season)
- II. Brief Description of Conditions**
  - a. Provide a free-hand sketch on construction plans or aerial image showing species, location, and as relevant, show or note extent of population as relevant to Strategy (i.e., population extends off ROW preventing eradication, small population and eradication deemed feasible within contract schedule, etc.).
- III. Coordination with Roadway Contractor regarding other work**
  - a. Tree Work: Note coordination to be implemented with tree removal, clearing, and clearing and grubbing as applicable to the project.
  - b. Wetland Mitigation - Include management proposed for wetland mitigation areas in the IPMS, if and as required.
  - c. Planting: If there will be planting in areas proposed for treatment, propose treatment and schedule to avoid herbicide damage to plants.
  - d. Mowing: If coordination is required with state mowers, note need in IPMS.
- IV. Soil Management**
  - a. Provide specifics on how soil with invasive plant roots (in particular) or seeds will be handled (i.e., separate stockpiles, plant material will be buried on-site, re-used on-site, disposed off site and if so, where?).
  - b. Show stockpile locations on plan and include treatment schedule.
  - c. Note measures that will be implemented to avoid spread through equipment, including how and where equipment will be cleaned.
- V. Invasive Plant Treatment & Management**
  - a. Proposed chemical and methods of treatment for each species or area.
  - b. Time of treatment based on target plant species.
  - c. Submit product label including application methods and rates (entire MSDS information need not be submitted if available online).
  - d. Proposed performance metrics or measure of treatment success if different from that specified under Item 102.3.
  - e. Method for disposing invasive plant material. This includes material that may result in spread (i.e., seeds, roots) and material that has been treated and/or is not viable (foliage, dead wood, etc.). Methods may include grinding in place, stockpiling and treating, and incinerating offsite.
  - f. Expected follow-up treatment for duration of contract.
- VI. Monitoring Schedule** if requested by MassDOT.

Note: The IPMS is critical for identifying pre-construction conditions as well as strategies for minimizing import or spread of invasive plants. Failure to provide an approved IPMS may jeopardize this item, in which case, the contractor will be responsible for management of invasive plants found on-site at no cost to the contract.

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**ITEM 102.33** (Continued)**Photo Documentation**

Digital photos with date and time verification shall be provided with the IPMS and with any follow-up monitoring or reporting.

**IPMS Follow-up Amendments**

The IPMS may be amended to address additional concerns or adjust to conditions. The amended IPMS shall be submitted to the Engineer and MassDOT Landscape Architect for approval at least fourteen (14) days prior to any proposed treatment.

**Interim Site Monitoring Inspection Reports**

If required by the MassDOT Landscape Architect and Engineer, Interim Site Monitoring and an accompanying report shall be conducted.

**Final Report**

A final inspection and report documenting the status of the invasive control may be required for regulatory purposes or for instances where control will be continued by others. The report shall include photo documentation of pre-construction (existing) and post-treatment conditions, notations on a plan or aerial image of area treated, summary of treatment performed, and control achieved.

**INITIAL SITE WALK**

Prior to any work the Contractor shall walk the site with the Engineer and the MassDOT Landscape Architect to determine the IPMS. During the site walk the Contractor shall identify limits of work and, as necessary, mark locations of areas designated for treatment and individual plants targeted for treatment or removal. The Contractor shall be responsible for marking delineated areas and plants to be preserved, removed, or otherwise treated. Fencing or other materials needed for marking and delineating protected areas shall be incidental to this item.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 102.33 will be paid at the contract unit price per Hour, which price shall include all labor, materials, equipment, tools, and all incidentals required to complete the work. The basis for measurement shall be per the completion of tasks as approved under the Task Summary submittal.

Payment shall not include travel time to and from the Contractor's place of business.

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**ITEM 102.511    TREE PROTECTION – ARMORING AND PRUNING                    EACH**

The work under this item shall conform to the relevant provisions of Section 771 of the Standard Specifications and the following:

The work shall include furnishing and installation of temporary tree trunk protection and limb pruning to prevent injury to the tree from construction equipment and activities. Trunk armoring is for instances where construction activity (the use of heavy equipment) comes close enough to potentially damage the tree trunk or limbs. It shall be used where shown on the plans and as required by the Engineer.

Associated Item: All references to Arborist herein shall refer to the Arborist under Item 102.55. Arborist shall meet the requirements as specified under Item 102.55 and shall be compensated under that item.

Related Documents: Arborist Report prepared by Professional Environmental Services, LLC, Lynn, MA dated May 24, 2021. (See Document A00804)

Trees to be trunk armored and/or limb pruned shall be those identified in Section A00802, Detail Sheets, and/or as determined by the Engineer per the recommendations of the Arborist.

#### References

If requested, the Contractor shall provide to the Engineer one copy of the latest edition of the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance: Part 1-Pruning and Part 5-Construction Management Standard. Provision of reference shall be incidental to this item.

#### Materials

Trunk armoring shall be such that it prevents damage to the trunk from construction equipment. Selected materials shall be such that installation and removal will not damage the trunk.

Acceptable materials include 2x4 wood cladding with wire or metal strapping, or, for instances when duration of construction activities is less than three months, corrugated plastic pipe mounted with duct tape. Height of cladding shall be from base of tree (including root flare) to the bottom of the first branch or as recommended by the Arborist. Materials and methods shall be approved by the Engineer.

Other materials or methods may be acceptable if approved by MassDOT Landscape Design or an Arborist.

#### Methods of Work

Prior to construction activities, the Engineer, the Contractor, the Town Tree Warden, and the Arborist shall review trees noted on the plans to be protected. Final decision as to trees armored and/or pruned shall be per the Engineer.

**ITEM 102.511** (Continued)

Care shall be taken to avoid damage to the bark during installation and removal of armoring. Trunk armoring shall be replaced and maintained such that it is effective for as long as required and shall be removed immediately upon completion of work activities adjacent to trees.

Pruning of limbs shall conform to the techniques and standards of the most recent ANSI A300 standards.

**Damages & Penalties**

In the event that trees designated for protection under this item are damaged, including root damage from unapproved trespassing onto the root zone, the Contractor shall, at its own expense, obtain an Arborist. The Arborist shall be approved by MassDOT.

If, based on the recommendations of the Arborist, the Engineer determines that damages can be remedied by corrective measures, such as repairing trunk or limb injury, soil compaction remediation, pruning, and/or watering, the damage shall be repaired as soon as possible within the appropriate season for such work and according to industry standards.

If the Engineer determines that damages are irreparable, the Contractor shall pay for the damages in the amount of \$500.00 per inch diameter at breast height (DBH) per tree.

Additionally, if the Engineer determines that the damages are such that the tree is sufficiently compromised as to pose a future safety hazard, the tree shall be removed. Tree removal shall include clean up of all wood parts, grinding of the stump to a depth sufficient to plant a replacement tree or plant, removal of all chips from the stump site, and filling the resulting hole with topsoil.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Tree Protection – Armoring and Pruning will be measured and paid at the Contract unit price per each, which price shall include all labor, materials, equipment, and incidental costs to complete the work. No separate payment will be made for the removal and disposal of the protective materials upon completion of the Contract, but all costs in connection therewith shall be included in the Contract unit price bid.

Payment under this item will be scheduled throughout the length of contract:

- 40% of value will be paid upon installation of trunk armoring and completion of pruning work, if required.
- 60% will be paid at the end of construction operations that would damage the tree and after protection materials have been removed and disposed of by the Contractor. In the event of repairable damages, payment will be made after the completion of remediation measures.

In the event of tree damage, cost of remediation measures shall be paid by the Contractor. In the event of irreparable damage due to lack of proper protective measures being taken, tree removal shall be paid by the Contractor in addition to the \$500.00 per inch diameter penalty.

Arborist services will be paid separately under Item 102.55.

**ITEM 102.513**      **TREE PROTECTION – AIR EXCAVATION AND**      **EACH**  
**ROOT PRUNING**

The purpose of this item is for the services of excavating soil with an air pressure tool in order to expose tree roots, and for associated services and materials required to complete the work of pruning, backfilling with existing soil, watering, mulching, and fertilizing. This item shall include the furnishing and operating of the air excavating tool.

ASSOCIATED ITEM: All references to Arborist herein shall refer to the Arborist under Item 102.55. Arborist shall meet the requirements as specified under Item 102.55 and shall be compensated under that item.

RELATED DOCUMENTS: Arborist Report prepared by Professional Environmental Services, LLC, Lynn, MA dated May 24, 2021. (See Document A00804)

Trees to be protected with temporary fence shall be as determined by the Engineer per the recommendations of the Arborist.

REFERENCES

The standards from American National Standards Institute (ANSI): A300 (Part 8)-2013 Root Management with special attention to Section 84 shall apply to this work. If requested, the Contractor shall provide to the Engineer one copy of this reference. Provision of reference shall be incidental to this item.

METHODS

Prior to construction activities, the Engineer, the Contractor, the Town Tree Warden, and the Arborist shall review trees noted on the plans to be protected, air excavation and root pruning.

Air excavation and pruning work shall be performed by or overseen by the Arborist.

Air excavation of soil and root pruning shall occur any time prior to equipment work within the root zone of marked trees.

Air excavation shall be done along the limit of proposed excavation. Trench shall be of sufficient width to observe and cut roots and shall be to the depth of proposed excavation. Immediately following air excavation, roots shall be pruned.

Following pruning, roots shall immediately be fully covered with backfill and immediately watered. Roots shall continue to be watered and fertilized as required by the Arborist.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Tree Protection – Air Excavation and Root Pruning will be measured and paid at the Contract unit price per each, where air spading, pruning, watering, and fertilizing are performed. The Contract unit price for this item shall include full compensation for all labor, equipment, materials, and incidentals required to complete the work.

Arborist services will be paid separately under Item 102.55

**ITEM 102.521**                      **TREE AND PLANT PROTECTION FENCE**                      **FOOT**

The work under this item shall conform to the relevant provisions of Subsections 644 and 771 of the Standard Specifications and the following:

Work shall include furnishing, installing, removing, resetting, and maintaining fence in a vertical and effective position at all times, and final removal of temporary fence as shown on the plans or as required by the Engineer.

The purpose of the fence is to prevent damage to tree roots, tree trunks, soil, and all other vegetation within a delineated Tree and Plant Protection Zone (TPPZ) as shown on the plans, as required by the Engineer, and as described herein.

Protection shall be for the duration of the construction activities unless otherwise directed.

ASSOCIATED ITEM: All references to Arborist herein shall refer to the Arborist under Item 102.55. Arborist shall meet the requirements as specified under Item 102.55 and shall be compensated under that item.

Related Documents: Arborist Report prepared by Professional Environmental Services, LLC, Lynn, MA dated May 24, 2021. (See Document A00804)

Trees/plants to be protected with temporary fence as determined by the Engineer per the recommendations of the Arborist.

Materials

Temporary Fence shall be such that it provides a minimum 48-inch tall barrier that remains vertical and effective (not sagging) for the duration of period required. Fence shall be plastic orange safety fence (recommended where high visibility is required), wooden snow fencing, or other approved material.

Per the Arborist or Engineer, additional posts, deeper post depths, and/or additional attachments shall be used if the fabric or fence sags, leans or otherwise shows signs of failing to create a sufficient barrier to access.

References

If requested, the Contractor shall provide to the Engineer one copy of the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance Part 1, Pruning and Part 5, Construction Management Standard. Provision of reference shall be incidental to this item.

Establishment of TPPZ

Fencing shall be used for construction areas, staging areas, and stockpile areas as shown on the plans and as required by the Engineer to establish the Tree and Plant Protection Zone (TPPZ).



**ITEM 102.521** (Continued)

Fence shall be located as close to the work zone limit and as far from the trunk as possible to maximize the area to be protected. Fence shall run parallel and adjacent to construction activity to create a barrier between the work zone and the root zone or designated limit of plants and soils to be protected.

When construction activities surround (or have the potential to surround) trees or plants to be protected, a circular enclosure shall be used. In these instances, the TPPZ limit shall be the Drip Line of each tree or as close as possible to the Drip Line, and as shown on the plans and details. The Drip Line is defined as the limit of tree canopy.

The Contractor shall not engage in any construction activity within the TPPZ without the approval of the Engineer, including: operating, moving or storing equipment; storing supplies or materials; locating temporary facilities including trailers or portable toilets; and shall not permit employees to traverse the area to access adjacent areas of the project or use the area for lunch or any other work breaks.

**Method of Work**

Fence shall be installed prior to any construction work or staging activities and shall be installed and maintained in a vertical and effective position at all times.

Fence shall be repositioned where and as required for optimum effectiveness. Repositioning shall be incidental to this item. Fence shall not be moved without prior approval by the Engineer.

The TPPZ shall be protected at all times from compaction of the soil; damage of any kind to trunks, bark, branches, leaves, and roots of all plants; and contamination of the soil with construction materials, debris, silt, fuels, oils, and any chemicals substance. In the event of spills, compaction or damage, the Contractor shall take corrective action immediately using methods approved by the Engineer in coordination with an Arborist.

After construction activities are completed, or when required by the Engineer, fence, stakes, and other materials shall be removed and disposed off-site by the Contractor.

**Required Work Within The TPPZ**

In the event that grading, trenching, utility work, or storage is unavoidable within the TPPZ, the Engineer shall be notified. Measures may be required for tree protection and preservations, including air spading, the use of six inch depth of wood chips or approved matting for root protection, pruning of branches, and/or trunk protection. These protection measures will be paid under applicable items.

Landscaping work specified within the TPPZ shall be accomplished by hand tools. Where hand work is not feasible, with permission of the Engineer, work shall be conducted with the smallest mechanized equipment required.

**ITEM 102.521** (Continued)Tree and Plant Damages or Loss

If the TPPZ is intruded upon, at the discretion of the Engineer, the Contractor will be required to provide a more durable barrier (e.g. Jersey Barriers) to secure the area. Cost of furnishing and installing additional or more durable barrier shall be paid by the Contractor.

If the Contractor intrudes into a TPPZ without approval, soil will be considered compacted and tree root damage will be assumed. Action shall be taken as specified below.

In the event that trees designated for protection under this item are damaged, including root damage from unapproved trespassing onto the root zone, the Contractor shall coordinate with the Arborist. The Arborist shall be approved by MassDOT.

If, based on the recommendations of the Arborist, the Engineer determines that damages can be remedied by corrective measures, such as repairing trunk or limb injury, soil compaction remediation, pruning, and/or watering, the damage shall be repaired as soon as possible within the appropriate season for such work and according to industry standards.

If the Engineer determines that damages are irreparable, the Contractor shall pay for the damages in the amount of \$500.00 per inch diameter at breast height (DBH) per tree.

Additionally, if the Engineer determines that the damages are such that the tree is sufficiently compromised as to pose a future safety hazard, the tree shall be removed. Tree removal shall include clean up of all wood parts, grinding of the stump to a depth sufficient to plant a replacement tree or plant, removal of all chips from the stump site, and filling the resulting hole with topsoil.

Shrubs shall be replaced with a plant of similar species and equal size or the largest size plants reasonably available. The Engineer will approve the size and quality of the replacement plant. Replacement shall include a minimum of one year of watering and care.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Tree and Plant Protection Fence will be measured and paid for by the linear foot of fence installed, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work.

Payment of 40 percent of value will be made upon installation of fence. The remaining 60 percent will be made when protection materials have been removed and disposed off-site.

No separate payment will be made for maintenance, final removal and disposal of the protective materials, remedial actions, including addition of more durable barriers, or repair of damages, but all costs in connection therewith shall be included in the Contract unit price bid.

In the event of irreparable damage due to lack of proper protective measures being taken there will be no compensation in addition to the \$500.00 per inch diameter penalty.

Arborist services will be paid separately under Item 102.55.

**ITEM 102.533**

**TREE CARE - WATERING**

**GALLON**

The work under this item shall conform to the relevant provisions of Subsections 440 and 771 of the Standard Specifications and the following:

The purpose of this item is to provide watering for tree care during and after root pruning as directed by the Arborist. Watering shall occur during daytime hours only.

**MATERIAL**

Water shall be water from an approved source.

**SUBMITTALS**

Schedule for watering shall be determined in consultation with the arborist. Expected schedule shall be submitted to the Engineer. Source of the water shall be approved by the Engineer and included in the submittal.

Contractor shall submit metered record of water used or other measure approved by the Engineer. Record must show date of watering and quantity used.

**METHODS**

At least one day prior to watering on site, the contractor shall notify the Engineer.

Watering equipment shall be approved by the Engineer prior to watering under this item. Equipment shall be such that there is no water leaking from the tank, hoses, or any other parts. Water shall be pumped and have a minimum flow of 95 PSI. Gravity fed watering shall not be accepted under this item.

If water runs off root zone area due to slope, too high a flow rate, slow infiltration, or any other reason, water will not be approved for payment.

Watering method shall not damage plants or seeded areas or cause erosion. All damages shall be repair at the Contractor's expense.

**METHOD OF MEASUREMENT**

Item 102.533 will be measured by the Gallon and shall be based on the submittals described herein. Payment shall be for all labor, equipment, and materials to complete the work specified.

**BASIS OF PAYMENT**

Item 102.533 will be paid for at the Contract unit price per Gallon which price shall include all labor equipment, materials and incidental costs required to complete the work.

**ITEM 102.55****ARBORIST****HOOR**

The work under this item is for the services of a Certified Arborist. Arborist shall be an International Society of Arboriculture (ISA) Certified Arborist or a Massachusetts Certified Arborist. The Arborist shall have at least 10 years of experience in tree care, including tree protection during construction, and shall demonstrate a familiarity with the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance Part 1 Pruning, Part 5 Construction Management Standards, and Part 9 Tree Risk Assessment.

The Arborist's general responsibilities include protecting high priority trees within and adjacent to the project limits, staging areas, and access routes; recommending removal of diseased, damaged or otherwise unhealthy trees that pose a potential safety hazard; evaluating effects of construction on future health of trees close to proposed work; and recommending and/or overseeing tree work and care.

The Arborist for this item shall not be from the same company as the company responsible for selective clearing or tree removal work.

Related Documents: Arborist Report prepared by Professional Environmental Services, LLC, Lynn, MA dated May 24, 2021. (See Document A00804)

Arborist shall refer to the recommendations in the above referenced report as a guide in making recommendations.

For projects with multiple phases, projects where construction activities (work or stockpiling) shifts, or when otherwise required by the Engineer, the Arborist shall re-evaluate conditions and provide follow-up recommendations.

**SUBMITTALS**

1. Contractor shall submit to the Engineer for approval by MassDOT Landscape Design the qualifications and experience of the Arborist. Submittal shall include copy of current certification and a resume summarizing specific construction experience (including relevant MassDOT projects) for a minimum of five projects.
2. Arborist's Report documenting recommendations shall be submitted to the Engineer and an electronic copy forwarded to MassDOT Landscape Design Section. Report shall include the following:

**SCOPE OF WORK**

The Arborist shall be responsible for the following tasks:

- Initial Evaluation and Report
  - Recommend and prioritize trees that require removal as appropriate to contract scope, project limits and project intent;
  - Review and modify, if required, tree protection measures shown on the drawings
  - Review and mark limits of protective fencing for trees and groups of trees to be retained;

**ITEM 102.55** (Continued)

- Review and recommend protection measures for high priority trees;
- Submit a marked-up Construction Plan that briefly notes recommendations and decisions made in the field;
- Submit a corresponding report including photo documentation
- Oversight
  - Direct or execute pruning of branches and/or roots, air spading, and/or other tree care operations
- Monitoring and Inspections
  - Periodically inspect fencing and ensure root zones are protected and clear of equipment and materials as required by the Engineer
  - Reevaluate tree protection measures for various phases of a project
  - Submit inspection notes with relevant and dated photos to the Engineer
- Special Care
  - Oversee tree pruning for health and aesthetics
  - Recommend fertilizations and amendments
  - Recommend and oversee pest control

**METHODS**

Prior to any work, the Arborist shall walk the site with the Contractor, the Engineer, the Town Tree Warden and, if specified, the MassDOT Landscape Architect, to review trees, limits of construction activities, and other concerns. Where required for proper assessment of tree impacts, limits of work shall be staked or otherwise marked in the field prior to the site walk.

Trees to be removed shall be painted or otherwise marked.

Trees to be retained shall be marked such that it does not mar or damage the tree and such that marker is not easily removed. As applicable to the work and scope of the project, trees designated for removal or to be retained shall be noted on the plan and/or in the Arborist's report and photographed.

Trees designated to remain that are damaged or removed by construction activities shall be noted and photographed for inclusion in inspection reports submitted to the Engineer.

**METHOD OF MEASUREMENT**

Item 102.55 will be measured for payment by the Hour of time spent onsite.

**BASIS OF PAYMENT**

Item 102.55 will be for at the Contract unit price per hour of time spent on site, which price shall include all labor, materials, equipment, and incidental costs required to complete the work. Payment will be made upon submittal and acceptance of reports described above.

**ITEM 127.**

**CONCRETE EXCAVATION**

**CUBIC YARD**

The work under this item shall conform to the relevant provisions of Subsection 120 of the Standard Specifications and the following:

The work under this Item shall consist of the removal and disposal of existing concrete-encased conduit as shown on the plans or as required by the Engineer.

The existing Verizon Business/MCI-owned fiberoptic conduit is concrete-encased. The existing concrete-encased conduit is typically between 9 inches to 14 inches below the existing pavement elevation.

When encountered within the limits of roadway and trench excavation as shown on the Plans and verified to be abandoned, reinforced or unreinforced cement concrete shall be removed and disposed off-site.

**METHOD OF MEASUREMENT**

Item 127. will be measured for payment by the Cubic Yard of concrete excavated. Measurements will be taken in original encountered position by measuring the volume of concrete to be removed.

**BASIS OF PAYMENT**

Item 127.1 will paid for at the Contract unit price per Cubic Yard, which price shall include all labor, materials, equipment, disposal of all debris, sawcutting, and all incidental costs required to complete the work.

**ITEM 153.            CONTROLLED DENSITY FILL - EXCAVATABLE            CUBIC YARD**

The work under this item shall conform to the relevant provisions of Subsection 150 and the following:

Work under this item shall consist of furnishing and placing controlled density fill in trenches for utility lines installed in pavement milling and overlay areas where normal backfill cannot be placed and for filling abandoned utilities as identified on the Utility Plans and/or as required by the Engineer.

Controlled density fill material shall conform to Section M4.08.0 approved and listed on the MassDOT QCML. Controlled Density Fill and shall be Type 1E – Very Flowable (Excavatable) or Type 2E – Flowable (Excavatable).

**METHOD OF MEASUREMENT**

Item 153. will be measured for payment by the Cubic Yard, complete in place.

**BASIS OF PAYMENT**

Item 153 will be and paid for at the Contract unit price per Cubic Yard, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

**ITEM 180.01 ENVIRONMENTAL HEALTH AND SAFETY PROGRAM LUMP SUM**

The work shall consist of ensuring the health and safety of the Contractor's employees and subcontracting personnel, the Engineer, their representatives, the environment, and public welfare from any on-site chemical contamination present in air, soil, water and sediment.

The Contractor shall prepare and implement a site-specific Environmental Health and Safety Plan (EHASP) which has been approved and stamped by a Certified Industrial Hygienist (CIH) and includes the preparer's name and work experience. The EHASP shall include appropriate components required by OSHA Standard 29 CFR 1910.120(b) and the Massachusetts Contingency plan (MCP) 310 CMR 40.0018 and must comply with all applicable state and federal laws, regulations, standards and guidelines, and provide a degree of protection and training appropriate for implementation on the project. The EHASP shall be a dynamic document with provision for change to reflect new information, new practices or procedures, changing site environmental conditions or other situations which may affect site workers and the public. The EHASP shall be developed and implemented independently from the standard construction HASP required to work on all MassDOT construction projects.

Health and safety procedures provided by the Contractor shall comply with all the appropriate regulations that address employee working conditions, including but not limited to standards established by OSHA and National Institute for Occupational Safety and Health (NIOSH). Equipment used for the purpose of health and safety shall be approved by and meet pertinent standards and specifications of the appropriate regulatory agencies.

A copy of the most up-to-date version of the EHASP shall be maintained on-site at all times by the Contractor. The on-site copy shall contain the signature of the Engineer and each on-site employee of the MassDOT, Contractor, and Subcontractors involved with on-site activities. The employee's signature on the EHASP shall be deemed prima facie evidence that the employee has read and understands the plan. Updated copies of signature sheets shall be submitted to the Engineer.

The EHASP shall specify a Contractor Site Safety and Health Officer responsible for implementation of the EHASP and to oversee all construction activities, including handling, storage, sampling and transport, which require contact with or exposure to potentially hazardous materials.

The level of protection, required to ensure the health and safety of on-site personnel will be stipulated in the EHASP. The Site Safety and Health Officer shall implement the EHASP based on changing site and weather conditions, type of operation or activity, chemical compounds identified on-site, concentration of the chemicals, air monitoring data, physical state of the hazardous materials, potential duration of exposure to hazardous materials, dexterity required to perform work, decontamination procedures, necessary personnel and type of equipment to be utilized.



**ITEM 180.01** (Continued)

During implementation of the EHASP, a daily log shall be kept by the Site Safety and Health Officer and a copy shall be provided weekly to the Engineer. This log shall be used to record a description of the weather conditions, levels of personal protection being employed, screening data and any other information relevant to on-site environmental safety conditions. The Site Safety and Health Officer shall sign and date the daily log.

**Method of Measurement and Basis of Payment**

Preparation and implementation of the Environmental Health and Safety Program, including the monitoring, protection and storage of all contaminated materials, as well as subsequent modifications to the EHASP, will be measured and paid for at the Lump Sum Bid Price.

Payment of 50% of the Environmental Health and Safety Program contract price will be made upon the initial acceptance of the EHASP by the Engineer. Payment of the remaining 50% of the Environmental Health and Safety Program contract price will be made upon completion of the work. The bid price shall include preparation and implementation of the EHASP as well as the cost for its enforcement by the Site Safety and Health Officer along with any necessary revisions and updates. The work of implementing the Environmental Health and Safety Program includes work involving, but not limited to, the monitoring, protection, and storage of all contaminated materials.

**ITEM 180.02**

**PERSONAL PROTECTION LEVEL C UPGRADE**

**HOUR**

The work shall consist of providing appropriate personal protective equipment (PPE) for all personnel in an area either containing or suspected of containing a hazardous environment.

Contingencies for upgrading the level of protection for on-site workers will be identified in the EHASP and the Contractor shall have the capability to implement the personal protection upgrade in a timely manner. The protective equipment and its use shall be in compliance with the EHASP and all appropriate regulations and/or standards for employee working conditions.

Personal Protection Level C Upgrade will be measured and paid only upon upgrade to Level C and will be at the contract unit price, per hour, per worker, required in Level C personal protection. No payment will be made to the Contractor to provide Level D PPE.

**ITEM 180.03****LICENSED SITE PROFESSIONAL SERVICES****HOUR**

Within limited areas of the project site, soils, sediments and/or groundwater may be contaminated. A Licensed Site Professional (LSP) shall be required to provide the services necessary to comply with the requirements of the MCP. These services may include sampling, analysis and characterization of potentially contaminated media, preparation of Immediate Response Action (IRA) Plans, Utility-Related Abatement Measure (URAM) and Release Abatement Measure (RAM) Plans, Imminent Hazard Evaluations, status reports, transmittal forms, release notification forms, risk assessments, completion statements, and related documents required pursuant to the Massachusetts Contingency Plan (MCP). LSP hours related to the characterization and disposal of contaminated soil and/or sediment are incidental to the disposal items. An estimate of LSP services to be provided shall be submitted to the Engineer for approval before any LSP activity begins.

The name and qualifications of the LSP and all environmental technicians to be assigned to the project shall be submitted to the Engineer for approval at least four weeks prior to initial site activities. The LSP shall have a current, valid license issued by the Massachusetts Board of Registration of Hazardous Waste Site Cleanup Professionals. The LSP shall have significant experience in the oversight of MCP activities at active construction sites. Qualification packages for the LSP and each technician shall include a resume, all recent work assignments with responsibilities identified (previous 5 years), and applicable training and certifications. A list of all Notices of Noncompliance, Notice of Audit Findings and Enforcement Orders issued by the DEP shall be submitted for all work assignments listed for the LSP and environmental technicians.

The LSP shall evaluate soil and/or sediment with discoloration, odor, and presence of petroleum liquid or sheening on the groundwater surface, or any abnormal gas or materials in the ground which are known or suspected to be oil or hazardous materials. Excavated soil and sediment which is suspected of petroleum contamination shall be field screened using the jar headspace procedures according to established DEP Guidance. All field screening equipment must be pre-approved by the Engineer. The LSP shall ensure proper on site calibration of all field screening instrumentation.

The Engineer shall be contacted immediately when observations or any field screening results verify contamination requiring further analysis, and/or enhanced management of suspect soil and/or sediment. Any enhanced management of contaminated soil to ensure proper stockpiling and storage is incidental to the LSP Services item. The LSP shall adequately characterize subsurface conditions prior to backfill in areas where contaminated material has been excavated. The Engineer shall approve the locations of the testing sites prior to the sampling.

**ITEM 180.03** (Continued)

Contaminated soil, sediment and/or groundwater shall be handled in accordance with all applicable state and federal statutes, regulations and policies. The LSP shall adequately characterize contaminated media for comparison to the requirements of the MCP. The Contractor and the LSP shall be aware of the reporting requirements for releases of oil and/or other hazardous material (OHM) as set forth in federal and state laws and regulations, and shall both be held responsible for performing the work in accordance with all applicable Federal and State laws and regulations. The LSP shall maintain written records in a clear and concise format which tracks the excavation, stockpiling, analysis and reuse/disposal of all suspect contaminated soils, sediments and groundwater. These records shall be up-to-date and available to the Engineer on a bi-weekly basis. The LSP shall review and summarize the laboratory data from any analyses performed on contaminated media. A report shall be delivered to the Engineer outlining the material sampling methods, laboratory analysis results and proposed course of action. The laboratory report together with Chain of Custody forms for all analytical results shall be submitted to the Engineer within 14 days after completion of such analyses.

The LSP and Contractor shall be held responsible for the submission of all MCP-related documents to the Engineer at least 14 days in advance of any timeframe specified in the MCP and for the timely submission of data and tracking information as noted within this Item. All documents prepared under this Item must be reviewed and signed by the approved LSP. The Contractor and LSP shall be responsible for all fines, penalties and enforcement requirements imposed by applicable regulatory agencies for failure to meet regulatory and contract timeframes. No compensation will be provided for such fines, penalties and enforcement actions.

The Contractor and the LSP shall be aware of the reporting requirements for releases of oil and/or other hazardous material (OHM) as set forth in federal and state laws and regulations, and shall both be held responsible for performing the work in accordance with all applicable Federal and State laws and regulations.

If the Contractor causes a release of OHM, the Contractor shall be responsible for assessing and remediating the release in accordance with all pertinent State and Federal regulations, including securing the services of a LSP, at his own expense.

The LSP shall coordinate all activities involving both MassDOT and the DEP through the Engineer. Any notification of release shall be approved by the Department before submittal to the DEP, except if an imminent hazard condition exists as defined in 309 CMR 4.03(4)(b).

**ITEM 180.03** (Continued)**Laboratory Testing in Support of LSP Services**

Laboratory testing provides for analytical testing in support of LSP services related to maintaining MCP compliance, such as delineating the extent and type of contamination present. Sampling and testing for disposal purposes are not included.

In order to maintain compliance with the MCP or other regulatory requirements, the LSP shall request approval from the Engineer to obtain samples from various locations and depths within the project area and to perform laboratory analyses on those samples. The samples shall be delivered to a DEP-certified laboratory using proper chain-of-custody documentation for analyses which, depending upon site conditions and suspected and/or identified contaminants of concern, may include, but are not limited to, metals, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polycyclic aromatic hydrocarbons (PAHs), extractable petroleum hydrocarbons (EPHs) and volatile petroleum hydrocarbons (VPHs). Subsequent testing, depending upon initial results, may be required for Toxicity Characteristic Leaching Procedure (TCLP) analyses (EPA Method 1311) for metals.

**Method of Measurement and Basis of Payment**

LSP Services for work under this item will be measured per person, per hour of service provided by LSP, Environmental Technicians and other approved personnel. Travel time shall not be included in the billable hours. LSP hours related to soil/sediment disposal (disposal characterization, landfill acceptance, disposal package preparation, etc.) shall be incidental to disposal items.

The quantity and type of laboratory tests must be approved by the Engineer beforehand. The contractor will be reimbursed upon satisfactory written evidence of payment. The contractor may be required to obtain cost estimates from three DEP certified laboratories for the Engineer to choose the service provider. Laboratory testing related to soil/sediment disposal (disposal characterization, landfill acceptance, disposal package preparation, etc.) shall be incidental to disposal items.

LSP Services will be paid at the Contractor bid price for each hour, or fraction thereof, spent to perform the work as described above. The bid price shall be a blended rate that includes the cost of the LSP, environmental technicians and other personnel, the performance of all work tasks and field screening, including required equipment, materials and instrumentation, and production of all documentation described above. All requests for payment must be accompanied by the following information: the names of the personnel associated with the work charged under LSP Services, dates and hours worked, work conducted, including, where appropriate, locations as identified on the construction plans, and a copy of the field diary for the dates submitted.

Laboratory Testing will be reimbursed upon receipt of paid invoices for testing approved by the Engineer.

<b><u>ITEM 181.11</u></b>	<b><u>DISPOSAL OF UNREGULATED SOIL</u></b>	<b><u>TON</u></b>
<b><u>ITEM 181.12</u></b>	<b><u>DISPOSAL OF REGULATED SOIL-IN-STATE FACILITY</u></b>	<b><u>TON</u></b>
<b><u>ITEM 181.13</u></b>	<b><u>DISPOSAL OF REGULATED SOIL-OUT-OF-STATE FACILITY</u></b>	<b><u>TON</u></b>
<b><u>ITEM 181.14</u></b>	<b><u>DISPOSAL OF HAZARDOUS WASTE</u></b>	<b><u>TON</u></b>

The work under these Items shall include the transportation and disposal of contaminated material excavated, or excavated and stockpiled. It shall also include the cost of any additional laboratory analyses required by a particular disposal facility beyond the standard disposal test set.

Excavation of existing subsurface materials may include the excavation of contaminated soils. The Contractor shall be responsible for the proper coordination of characterization, transport and disposal, recycling or reuse of contaminated soils. Disposal, recycling or reuse will be referred to as “disposal” for the purposes of this specification. However, regardless of the use of the term herein, there will be no compensation under these items for reuse within the project limits. The Contractor will be responsible for coordinating the activities necessary for characterization, transport and disposal of contaminated soils. Such coordination will include the Engineer and his/her designee overseeing management of contaminated materials. Contaminated soils must be disposed of in a manner appropriate for the soil classification as described below and in accordance with the applicable laws of local, state and federal authorities. The Contractor shall be responsible for identifying disposal facility (ies) licensed to accept the class of contaminated soils to be managed and assure that the facility can accept the anticipated volume of soil contemplated by the project. The Contractor shall be responsible for hiring a Licensed Site Professional (LSP) and all ancillary professional services including laboratories as needed for this work. The Contractor will be responsible for obtaining all permits, approvals, manifests, waste profiles, Bills of Lading, etc. subject to the approval of the Engineer prior to the removal of the contaminated soil from the site. The Contractor and LSP shall prepare and submit to the Engineer for approval all documents required under the Massachusetts Contingency Plan (MCP) and related laws and environmental regulations to conduct characterization, transport, and disposal of contaminated materials.

**CLASSES OF CONTAMINATED SOILS**

The Contractor and its LSP shall determine if soil excavated or soil to be excavated is unregulated soil or contaminated soil as defined in this section. Such materials shall be given a designation for purposes of reuse or disposal based on the criteria of the MCP. Soils and sediments which are not suitable for reuse will be given a designation for purposes of off-site disposal based on the characterization data and disposal facility license requirements. The Classes of Contaminated Soils are defined as follows:

**ITEMS 181.11 through 181.14** (Continued)

Unregulated Soil consists of soil, fill and dredged material with measured levels of oil and hazardous material (OHM) contamination at concentrations below the applicable Reportable Concentrations (RCs) presented in the MCP. Unregulated soil consists of material which may be reused (or otherwise disposed) as fill within the Commonwealth of Massachusetts subject to the non-degradation criteria of the MCP (310 CMR 40.0032(3), in a restricted manner, such that they are sent to a location with equal or higher concentrations of similar contaminants. Disposal areas include licensed disposal facilities, approved industrial settings in areas which will be capped or covered with pavement or loamed and seeded, and for purposes of this project should be reused as fill within the project site construction corridor whenever possible. The material cannot be placed in residential and/or environmentally sensitive (e.g. wetlands) areas. Under no circumstances shall contaminated soils be placed in an uncontaminated or less contaminated area (including the area above the groundwater table if this area shows no sign of contamination).

The Contractor shall submit to MassDOT the proposed disposal location for unregulated soils for approval. If such a disposal location is not a licensed disposal facility, the Contractor shall submit to the Engineer analytical data to characterize the disposal area sufficiently to verify that the unregulated material generated within the MassDOT construction project limits is equal to or less than the contaminant levels at the disposal site and meets the non-degradation requirements of the MCP. In addition, the Contractor shall provide written confirmation from the owner of the proposed disposal location that they have been provided with the analytical data for both the materials to be disposed as well as the disposal site characterization and that s/he agrees to accept this material. A Material Shipping Record or Bill of Lading, as appropriate, shall be used to track the off-site disposal of unregulated soil and a copy, signed by the disposal facility or property owner, shall be provided to the Engineer in order to document legal disposal of the unregulated material.

The cost of on-site disposal of unregulated soil within the project area will be considered incidental to the item of work to which it pertains.

**ITEMS 181.11 through 181.14** (Continued)

Regulated Soil consists of materials containing measurable levels of OHM that are equal to or exceed the applicable Reportable Concentrations for the site as defined by the MCP, 310 CMR 40.0000. Regulated soil which meets the MCP reuse criteria of the applicable soil/groundwater category for this project area may be reused on site provided that it meets the appropriate geotechnical criteria established by the Engineer. Regulated Soil may be reused (as daily or intermediate cover or pre-cap contouring material) or disposed (as buried waste) at lined landfills within the Commonwealth of Massachusetts or at an unlined landfill that is approved by the Massachusetts Department of Environmental Protection (DEP) for accepting such material, in accordance with DEP Policy #COMM-97-001, or at a similar out-of-state facility. It should be noted that soils which exceed the levels and criteria for disposal at in-state landfills, as outlined in COMM-97-001, may be shipped to an in-state landfill, but require approval from the DEP Division of Solid Waste Management and receiving facility. An additional management alternative for this material is recycling into asphalt. Regulated Soils may also be recycled at a DEP approved recycling facility possessing a Class A recycling permit subject to acceptance by the facility and compliance with DEP Policy #BWSC-94-400. Regulated Soil removed from the site for disposal or treatment must be removed via an LSP approved Bill of Lading, Manifest or applicable material tracking form. This type of facility shall be approved/permitted by the State in which it operates to accept the class of contaminated soil in accordance with all applicable local, state and federal regulations.

Hazardous Waste consists of materials which must be disposed of at a facility permitted and operated in full compliance with Federal Regulation 40 CFR 260-265, Massachusetts Regulation 310 CMR 30.000, Toxic Substances Control Act (TSCA) regulations, or the equivalent regulations of other states, and all other applicable local, state, and federal regulations. All excavated materials classified as hazardous waste shall be disposed of at an out-of-state permitted facility. This facility shall be a RCRA hazardous waste or TSCA facility, or RCRA hazardous waste incinerator. This type of facility shall be approved/permitted by the State in which it operates to accept hazardous waste in accordance with all applicable local, state and federal regulations and shall be permitted to accept all contamination which may be present in the soil excavate. The Contractor shall ensure that, when needed, the facility can accept TSCA waste materials i.e. polychlorinated biphenyls (PCBs). Hazardous waste must be removed from the site for disposal or treatment via an LSP approved Manifest.

**MONITORING/SAMPLING/TESTING REQUIREMENTS**

The Contractor shall be responsible for monitoring, sampling and testing during and following excavation of contaminated soils to determine the specific class of contaminated material. Monitoring, sampling and testing frequency and techniques should be performed in accordance with Item 180.03 – LSP Services. Additional sampling and analysis may be necessary to meet the requirements of the disposal facility license. The cost of such additional sampling and analysis shall be included in the bid cost for the applicable disposal items. The Contractor shall obtain sufficient information to demonstrate that the contaminated soil meets the disposal criteria set by the receiving facility that will accept the material.



**ITEMS 181.11 through 181.14** (Continued)

No excavated material will be permanently placed on-site or removed for off-site disposal until the results of chemical analyses have been received and the materials have been properly classified. The Contractor shall submit to the Engineer results of field and laboratory chemical analyses tests within seven days after their completion, accompanied by the classification of the material determined by the Contractor, and the intended disposition of the material. The Contractor shall submit to the Engineer for review all plans and documents relevant to LSP services, including but not limited to, all documents that must be submitted to the DEP.

**WASTE TRACKING:**

Copies of the fully executed Weight Slips/Bills of Lading/ Manifests/Material Shipping Records or other material tracking form received by the Contractor from each disposal facility and for each load disposed of at that facility, shall be submitted to Engineer and the Contractor's LSP within three days of receipt by the Contractor. The Contractor is responsible for preparing and submitting such documents for review and signature by the LSP or other appropriate person with signatory authority, three days in advance of transporting soil off-site. The Contractor shall furnish a form attached to each manifest or other material tracking form for all material removed off-site, certifying that the material was delivered to the site approved for the class of material. If the proposed disposition of the material is for reuse within the project construction corridor, the Contractor shall cooperate with MassDOT to obtain a suitable representative sample(s) of the material to establish its structural characteristics in order to meet the applicable structural requirements as fill for the project.

All material transported off-site shall be loaded by the Contractor into properly licensed and permitted vehicles and transported directly to the selected disposal or recycling facility and be accompanied by the applicable shipping paper. At a minimum, truck bodies must be structurally sound with sealed tail gates, and trucks shall be lined and loads covered with a liner, which shall be placed to form a continuous waterproof tarpaulin to protect the load from wind and rain.

**DECONTAMINATION OF EQUIPMENT**

Tools and equipment which are to be taken from and reused off site shall be decontaminated in accordance with applicable local, state and federal regulations. This requirement shall include, but not be limited to, all tools, heavy machinery and excavating and hauling equipment used during excavation, stockpiling and handling of contaminated material. Decontamination of equipment is considered incidental to the applicable excavation item.

**REGULATORY REQUIREMENTS**

The Contractor shall be responsible for adhering to regulations, specifications and recognized standard practices related to contaminated material handling during excavation and disposal activities. MassDOT shall not be responsible at any time for the Contractor's violation of pertinent State or Federal regulations or endangerment of laborers and others. The Contractor shall comply with all rules, regulations, laws, permits and ordinances of all authorities having jurisdiction including, but not limited to, Massachusetts DEP, the U.S. Environmental Protection Agency (EPA), Federal Department of Transportation (DOT), Massachusetts Water Resources Authority (MWRA), the Commonwealth of Massachusetts and other applicable local, state and federal agencies governing the disposal of contaminated soils.

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**ITEMS 181.11 through 181.14** (Continued)

All labor, materials, equipment and services necessary to make the work comply with such regulations shall be provided by the Contractor without additional cost to MassDOT. Whenever there is a conflict or overlap within the regulations, the most stringent provisions shall apply. The Contractor shall reimburse MassDOT for all costs it incurs, including penalties and/or for fines, as a result of the Contractor's failure to adhere to the regulations, specifications, recognized standard practices, etc., that relate to contaminated material handling, transportation and disposal.

**SUBMITTALS****I. Summary of Sampling Results, Classification of Material and Proposed Disposal Option.**

The following information, presented in tabular format, must be submitted to the Engineer for review and approval prior to any reuse on-site or disposal off-site. This requirement is on-going throughout the project duration. At least two weeks prior to the start of any excavation activity, the Contractor shall submit a tracking template to be used to present the information as stipulated below. Excavation will not begin until the format is acceptable to MassDOT.

Characterization Reports will be submitted for all soil, sediment, debris and groundwater characterized through the sampling and analysis program. Each report will include a site plan which identifies the sampling locations represented in the Report. The Construction Plan sheets may be used as a baseplan to record this information.

The Sampling Results will be presented in tabular format. Each sample will be identified by appropriate identification matching the sample identification shown on the Chain of Custody Record. The sample must also be identified by location (e.g. grid number or stockpile number). For each sample, the following information must be listed: the classification (unregulated, regulated, etc.), proposed disposal option for the stockpile or unit of material represented, and, all analytical results.

Each Characterization Report will include the laboratory analytical report and Chain of Custody Record for the samples included in the Report.

**II. Stockpiling, Transport, and Disposal.**

At least two weeks prior to the start of any excavation activity, the Contractor shall submit, in writing, the following for review and shall not begin excavation activity until the entire submittal is acceptable to MassDOT.

**Excavation and Stockpiling Protocol:**

Provide a written description of the management protocols for performing excavation and stockpiling and/or direct loading for transport, referencing the locations and methods of excavating and stockpiling excavated material.

**ITEMS 181.11 through 181.14** (Continued)

## Disposal and Recycling Facilities:

1. Provide the name, address, applicable licenses and approved waste profile for disposal and/or recycling location(s) where contaminated soil will be disposed. Present information substantiating the suitability of proposed sites to receive classifications of materials intended to be disposed there, including the ability of the facility to accept anticipated volumes of material.
2. Provide a summary of the history of compliance actions for each disposal/recycling facility proposed to be used by the Contractor. The compliance history shall include a comprehensive list of any state or federal citations, notices of non-compliance, consent decrees or violations relative to the management of waste (including remediation waste) at the facility. Material should not be sent to facilities which are actively considered by the DEP, USEPA or other responsible agency to be in violation of federal, state or local hazardous waste or hazardous material regulations. MassDOT reserves the right to reject any facility on the basis of poor compliance history.

## Transportation:

The name, address, applicable license and insurance certificates of the licensed hauler(s) and equipment and handling methods to be used in excavation, segregation, transport, disposal or recycling.

## III. Material Tracking and Analytical Documentation for Reuse/Disposal.

The following documents are required for all excavation, reuse and disposal operations and shall be in the format described. At least two weeks prior to the start of any excavation or demolition activity, the Contractor shall submit the tracking templates required to present the information as stipulated below. Excavation or demolition will not begin until the format is acceptable to MassDOT.

All soils, sediments and demolition debris must be tracked from the point of excavation to stockpiling to onsite treatment/processing operations to off-site disposal or onsite reuse as applicable.

## Demolition Debris:

Demolition debris must be tracked if the debris is stockpiled at a location other than the point of origin or if treatment or material processing is conducted. Identification of locations will be based on the station-offset of the location. The tracking table will identify date and point of generation, any field screening such as PID or dust monitoring, visual observations/comments, quantity, and stockpile ID/processing operation location. For each unit of material tracked, the table will also track reuse of the material on-site, providing reuse date, location of reuse as defined by start and end station, width of reuse location by offset, the fill elevation range, quantity, and finish grade for said location. For demolition debris which is not reused on site, the table will also track disposal of the material as defined by disposal date, quantity and disposal facility. The table must provide a reference to any analytical data generated for the material.

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**ITEMS 181.11 through 181.14** (Continued)**Soil/Sediment:**

Soil excavation will be identified based on the station-offset of the excavation location limits. The tracking table will identify date and point of generation, any field screening such as PID or dust monitoring, visual observations, quantity, and stockpile number/location. For each unit of material tracked, the table will also track reuse of the material on-site and disposal of the material off-site using the same categories identified for demolition debris above.

**Method Of Measurement And Basis Of Payment**

Disposal of contaminated soil shall be measured for payment by the Ton of actual and verified weight of contaminated materials removed and disposed of. The quantities will be determined only by weight slips issued by and signed by the disposal facility. The most cost-effective, legal disposal method shall be used. The work of the LSP for disposal under all of these items shall be incidental to the work with no additional compensation.

Item 181.11 Measurement for Disposal of Unregulated Soil shall be under the Contract Unit Price by the weight, in tons, of contaminated materials removed from the site and transported to and disposed of at an approved location or licensed facility, and includes any and all costs for approvals, permits, fees and taxes, additional testing/characterization required by the facility beyond the standard disposal test set, decontamination procedures, transportation and disposal.

Item 181.12 Measurement for Disposal of Regulated Soil – In-State Facility shall be under the Contract Unit Price by the weight in tons of contaminated materials removed from the site and transported to and disposed of at an approved in-state facility, and includes any and all costs for approvals, permits, fees and taxes, testing/characterization required by the facility beyond the standard disposal test set, decontamination procedures, transportation and disposal.

Item 181.13 Measurement for Disposal of Regulated Soil - Out-of-State Facility shall be under the Contract Unit Price by the weight in tons of contaminated materials removed from the site and transported to and disposed of at an approved out-of-state facility, and includes any and all costs for approvals, permits, fees and taxes, testing/characterization required by the facility beyond the standard disposal test set, decontamination procedures, transportation and disposal.

Item 181.14 Measurement for Disposal of Hazardous Waste shall be under the Contract Unit Price by the weight in tons of hazardous waste removed from the site and transported to and disposed of at the licensed hazardous waste facility, and includes any and all costs for approvals, permits, fees and taxes, testing/characterization required by the facility beyond the standard disposal test set, decontamination procedures, transportation and disposal.

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**ITEM 182.1**                    **INSPECTION AND TESTING FOR ASBESTOS**                    **LUMP SUM**

The work shall include the inspecting and testing of all materials suspected of containing asbestos. When any demolition is required to enable the inspection and testing of the suspected material it will be considered incidental to this Item and the Contractor must perform all asbestos handling and testing in accordance with the regulations stated below.

Dust suppression in the form of light water sprays, foams, dust suppressants and calcium chloride will be implemented as required to control dusting during any disturbance of asbestos suspected material. Alternatively, intrusive activities may be reduced or curtailed under high wind or heavy rain conditions, which in the opinion of the Health and Safety Plan (HASP) may pose a safety hazard to the workers.

The Contractor shall employ the services of a Massachusetts licensed "Asbestos Inspector" to inspect the material to determine whether or not "ITEM 182.2 REMOVAL OF ASBESTOS" is required. Should the asbestos inspector determine laboratory testing is required, a state certified laboratory shall be used to perform all necessary tests.

**REGULATIONS**

U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA) including but not limited to:

- 29 CFR 1910 Section 1001 and 29 CFR 1926 Section 58 Occupational exposure to Asbestos, Tremolite, Anthophyllite and Actinolite, Final Rule
- 29 CFR 1910 Section 134 Respiration Protection
- 29 CFR 1926 Construction Industry
- 29 CFR 1910 Section 2 Access to Employee Exposure and Medical Records
- 29 CFR 1910 Section 1200 Hazard Communication
- 29 CFR 1910 Section 145 Specifications for Accident Prevention Signs and Tags

U.S. Environmental Protection Agency, (EPA) including but not limited to:

- 40 CFR 762, CPTS 62044, FRL 2843-9, Federal Register Vol. 50 no.134, July 12, 1985 p.28530 - 28540 Asbestos Abatement Projects Rule
- 40 CFR 61 Subpart A Regulation for Asbestos
- 40 CFR 61 Subpart M (Revised Subpart B) National Emission Standard for Asbestos

U.S. Department of Transportation 49 CFR 172 and 173

Massachusetts Department of Labor Standards Regulations, (DLS) including but not limited to:

- 454 CMR 28.00 Removal, Containment and Encapsulation of Asbestos

**ITEM 182.1** (Continued)

Massachusetts Department of Environmental Protection (DEP) including but not limited to (supplementing subsection 7.01):

310 CMR 7.00, Section 7.09 Odor and Dust, Section 7.10 Noise, Section 7.15 Air Pollution Control Regulations  
310 CMR 18.00 and 19.00 Solid Waste Regulations

Massachusetts Division of Industrial Safety 45 CMR 10.00

Local Requirements including but not limited to those of Health Departments, Fire Departments and Inspection Services Departments

Wherever there is a conflict or overlap of the above references, the most stringent provision shall apply.

**Method of Measurement and Basis of Payment**

Measurement and payment will be at the contract unit price per Lump Sum for ITEM 182.1 INSPECTION AND TESTING FOR ASBESTOS as specified above including all materials, tools, equipment and labor to complete the inspecting and testing of the asbestos suspected material.

All costs in the connection with the protection of general public, private property, and all costs associated with the proper inspecting and testing of the material shall be included in the price and no additional compensation will be allowed.

**ITEM 182.2****REMOVAL OF ASBESTOS****FOOT**

The work shall include the removal and satisfactory disposal of existing asbestos. The Contractor's attention is directed to the fact that existing asbestos shall be inspected and tested prior to removal, to determine if special removal and disposal is required. The Contractor shall follow all the rules and regulations stated in "ITEM 182.1 INSPECTION AND TESTING FOR ASBESTOS". If asbestos is present, the Contractor shall follow all the rules and regulations stated in the section "REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS", under this item. The Contractor should notify and coordinate his/her efforts with the proper utility accordingly.

**REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS**

This section specifies the requirements for the handling and removal of asbestos containing material. The Contractor must perform all asbestos handling and removal work in accordance with these specifications and the following additional requirements.

U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA) including but not limited to:

- 29 CFR 1910 Section 1001 and 29 CFR 1926 Section 58 Occupational exposure to Asbestos, Tremolite, Anthophyllite and Actinolite, Final Rule
- 29 CFR 1910 Section 134 Respiration Protection
- 29 CFR 1926 Construction Industry
- 29 CFR 1910 Section 2 Access to Employee Exposure and Medical Records
- 29 CFR 1910 Section 1200 Hazard Communication
- 29 CFR 1910 Section 145 Specifications for Accident Prevention Signs and Tags

U.S. Environmental Protection Agency, (EPA) including but not limited to:

- 40 CFR 762, CPTS 62044, FRL 2843-9, Federal Register Vol. 50 no.134, July 12, 1985 p.28530 - 28540 Asbestos Abatement Projects Rule
- 40 CFR 61 Subpart A Regulation for Asbestos
- 40 CFR 61 Subpart M (Revised Subpart B) National Emission Standard for Asbestos

U.S. Department of Transportation 49 CFR 172 and 173

Massachusetts Department of Labor Standards, (DLS) including but not limited to:

- 454 CMR 28.00 Removal, Containment and Encapsulation of Asbestos

Massachusetts Department of Environmental Protection (DEP) including but not limited to (supplementing subsection 7.01):

- 310 CMR 7.00, Section 7.09 Odor and Dust, Section 7.10 Noise, Section 7.15 Air Pollution Control Regulations
- 310 CMR 18.00 and 19.00 Solid Waste Regulations

**ITEM 182.2** (Continued)

Massachusetts Division of Industrial Safety 45 CMR 10.00

Local Requirements including but not limited to those of Health Departments, Fire Departments and Inspection Services Departments

Wherever there is a conflict or overlap of the above references, the most stringent provision shall apply.

All asbestos material shall be removed and properly disposed of by a contractor or subcontractor with a current Massachusetts Abatement Contractors License issued by the Department of Labor Standards. Work shall be supervised by a competent person as required by OSHA in 29 CFR 1926 to ensure regulatory compliance. This person must have completed a course at an EPA Training Center or equivalent course in asbestos abatement procedures, have had a minimum of four years on-the-job training and meet any additional requirements set forth in 29 CFR 1926 for a Competent Person. This person must also be certified by the Commonwealth as an Asbestos Supervisor and Asbestos Project Designer as required by 454 CMR 28.00.

Asbestos removal work shall be coordinated with all other work under the contract and shall be completed prior to performing any activities which could disturb the asbestos material or produce airborne asbestos fibers.

Dust suppression in the form of light water sprays, foams, dust suppressants and calcium chloride will be implemented as required to control dusting during trenching and excavation. Alternatively, intrusive activities may be reduced or curtailed under high wind or heavy rain conditions, which in the opinion of the Health and Safety Plan (HASP) may pose a safety hazard to the workers.

**NOTIFICATION AND PERMITS**

The Contractor shall prepare a formal pre-notification form at least ten (10) days prior to the start of asbestos removal work. This form must be submitted to the appropriate Regional Office of the Massachusetts Department of Environmental Protection and to the U.S. Environmental Protection Agency Region I Air and Hazardous Material Division. A copy of the submitted forms must be provided to the Engineer and kept at the work site.

Prior to starting any work, the Contractor shall also obtain any required asbestos removal permit(s) from the city/town. A copy of the permit(s) must be provided to the Engineer and posted at the work site.

The Contractor shall also obtain and pay all other applicable asbestos waste transportation and disposal permits, licenses and fees.



**ITEM 182.2** (Continued)**STANDARD OPERATING PROCEDURES**

The standard operating procedure shall ensure the following:

1. Proper site security including posting of warning signs and restricting access to prevent unauthorized entry into the work spaces.
2. Proper protective clothing and respiratory protection prior to entering the work spaces.
3. Safe work practices including provisions for communications; exclusion of eating, drinking, smoking, or use of procedures or equipment that would in any way reduce the effectiveness of respiratory protection or other engineering controls.
4. Proper exit practices from the work space though the showering and decontamination facilities.
5. Removing asbestos containing material in ways that minimize release of fibers.
6. Packing, labeling, loading, transporting and disposing of contaminated material in a way that minimizes or prevents exposure and contamination.
7. Emergency evacuation of personnel, for medical or safety (fire and smoke) so that exposure will be minimized.
8. Safety from accidents in the work space, especially from electrical shocks, slippery surfaces and entanglements in loose hoses and equipment.
9. Provisions for effective supervision and OSHA - specified personnel air monitoring for exposure during work.

**REQUIRED SUBMITTALS**

The Contractor shall submit to the Engineer the following listed items at least ten (10) calendar days prior to the start of asbestos work. No asbestos removal work activities shall commence until these items are reviewed by the Engineer, unless otherwise waived. Submittals shall be clearly labeled and in sufficient detail to enable the Engineer to form an opinion as to its conformity to the specifications.

1. Name, experience and DLS certification of proposed Supervisors and Foreman responsible for asbestos work.
2. Summary of workforce by disciplines and a notarized statement documenting that all proposed workers, by name, have received all required medical exams and have been properly trained and certified for asbestos removal work, respirator use and appropriate Massachusetts DLS, EPA and OSHA standards.
3. Notarized statement that workers are physically fit and able to wear and use the type of respiratory protection proposed for the project. Notarized certification signed by an officer of the abatement contracting firm that exposure measurements, medical surveillance and worker training records are being kept in conformance with 29 CFR 1926.

**ITEM 182.2** (Continued)

4. Written plan of action and standard operating procedures (HASP) to include: location and layout of decontamination areas; sequencing of asbestos work; detailed schedule of work activities by date and interface with other project activities which affect work performance; methods used to assure safety and security; worker protection and exposure monitoring; contingency and emergency evacuation procedures; detailed description of methods to be employed to control pollution; waste handling procedures.
5. Written respiratory protection program specifying level of protection intended for each operation required by the project and details of daily inspection and maintenance elements.
6. Copies of the U.S. EPA, State and local asbestos removal pre-notification forms. If applicable, lists and copies of all permits, licenses, or manifests which will be applied for and used.
7. Name, location and applicable approval certificates for primary and secondary landfill for disposal of asbestos-containing or asbestos contaminated waste. Name, address and licenses number(s) of hauler permitted to transport waste. (Submit copies of completed manifests upon disposal).

The Contractor must provide copies of daily inspection and record logs upon request of the Engineer, at any time during project. This information will include but is not limited to work area entry data, respirator inspections and maintenance, HEPA-exhaust inspections and maintenance and other work applicable activities or reports of accidents or unusual events.

**Method Of Measurement:**

ITEM 182.2 will be measured by the FOOT for the complete removal and disposal of the asbestos containing material.

**Basis Of Payment:**

Payment will be at the contract unit price per FOOT for ITEM 182.2 REMOVAL OF ASBESTOS, as specified above including all materials, tools, equipment and labor necessary to complete the work specified above.

All costs in connection with the protection of the general public, private property and all costs associated with the proper disposal of the material removed shall be included in the price and no additional compensation will be allowed.

**ITEM 201.1**

**CATCH BASIN WITH DOUBLE GRATE**

**EACH**

The work to be done under this Item shall conform to the relevant provisions of Subsection 201 of the Standard Specifications, and the following:

The work shall consist of constructing catch basins where shown on the plans or where required by the Engineer.

Catch basins shall be precast with an inside diameter of 60 inches to accommodate the installation of a double grate at locations specified on the plans.

**METHOD OF MEASUREMENT**

Item 201.1 will be measured for payment by the Each catch basin with double grate furnished and installed, complete in place, regardless of the depth of the structure.

**BASIS OF PAYMENT**

Item 201.1 will be paid for at the Contract unit price per Each, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

Frames and grates will be included in this Item (Item 201.1).

Class B Rock Excavation shall be paid for separately under Item 144. Class B Rock Excavation.

Gravel Borrow Type b shall be paid for separately under Item 151. Gravel Borrow, as directed by the Engineer.

Extra depth excavation below the proposed bottom of structure to obtain a stable foundation will be paid for as Class B Trench Excavation.

**ITEM 203.12**                      **STORMWATER BASIN OUTLET STRUCTURE**                      **LUMP SUM**

The work under this Item shall conform to the relevant provisions of Subsection 201 of the Standard Specifications and the following:

The work under this Item shall include excavation and backfilling, furnishing and installing precast concrete structure, trash rack, and any other incidental work required to construct the stormwater basin outlet structure as detailed on the Plans or as required by the Engineer.

**MATERIALS**

Materials shall conform to the relevant provisions and requirements of Subsection 201 of the Standard Specifications. Stormwater basin outlet structure shall consist of a precast reinforced concrete structure as shown on the Plans. Concrete shall have a minimum 28-day strength of 4000 psi, with steel reinforcement meeting the requirements of ASTM A-615 Standards, Grade 60 1-inch minimum cover. The structure shall have a design loading of AASHTO HS20-44.

**CONSTRUCTION METHODS**

Precast concrete structure shall be as manufactured by a MassDOT Approved fabricator. Shop Drawings shall be submitted to the Engineer for review and approval. Excavation, dewatering, sheeting, and shoring operations where required shall conform to the relevant provisions and requirements specified in Section 140 of the Standard Specifications.

**BASIS OF PAYMENT**

Item 203.12 will be paid at the contract unit price LUMP SUM, which price shall be full compensation for all labor, tools, equipment, and materials required to complete the work as described above including, but not limited to, excavation and backfilling, furnishing and setting precast concrete structure, cast-iron frame and grate, crushed stone bedding, transportation, delivery, installation of the frame and grate, and all incidental costs required to complete the work.

No separate payment will be made for crushed stone (M2.01.1) placed below the bottom of the structure to obtain a stable base, but all costs in connection therewith shall be included in the lump sum price bid.

<b><u>ITEM 203.5</u></b>	<b><u>SPECIAL MANHOLE – 5 FOOT DIAMETER</u></b>	<b><u>EACH</u></b>
<b><u>ITEM 203.6</u></b>	<b><u>SPECIAL MANHOLE – 6 FOOT DIAMETER</u></b>	<b><u>EACH</u></b>
<b><u>ITEM 203.7</u></b>	<b><u>SPECIAL MANHOLE – 7 FOOT DIAMETER</u></b>	<b><u>EACH</u></b>

The work under these items shall conform to the relevant provisions of Subsection 201 of the Standard Specifications and the following:

The work shall include furnishing and installation of 5-foot, 6-foot and 7-foot diameter precast concrete manholes at the locations shown on the plans and as required by the Engineer. Special manholes shall be precast concrete and capable of supporting H-20 vehicle loading.

Shop drawings and clock diagrams shall be submitted for review and approval prior to fabrication.

**METHOD OF MEASUREMENT**

Item 203.5, Item 203.6, and Item 203.7 will be measured for payment by the Each special manhole installed, regardless of the depth of the structure, complete in place.

**BASIS OF PAYMENT**

Item 203.5, Item 203.6, and Item 203.7 will be paid for at the respective Contract unit prices per Each, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

Frames and covers will be paid for separately under Items 221. Frame and Cover or 222.3 – Frame and Grate (or Cover) Municipal Standard.

**ITEM 222.3 FRAME AND GRATE (OR COVER) MUNICIPAL STANDARD EACH**

The work under this item shall conform to the relevant provisions of Subsections 201 and 220 of the Standard Specifications and the following:

The work shall include furnishing of municipal frame and grate (or cover) municipal standard.

Frames and grates shall have a two-directional or “grid-pattern” type and shall be manufactured by a MassDOT-approved fabricator listed on the Qualified Construction Materials List (QCML). Casting date shall be listed on the QCML.

Frames and covers shall have a diamond pattern; pick holes and the appropriate word “DRAIN” or “SEWER” cast in 3-inch letters to match the corresponding utility. Frames and covers shall be manufactured by a MassDOT-approved fabricator listed on the QCML. Casting date shall be listed on the QCML.

Shop drawings shall be submitted to the Engineer for review and approval prior to ordering materials.

**METHOD OF MEASUREMENT**

Item 222.3 will be measured for payment by the Each frame and grate (or cover) municipal standard furnished.

Frame and Grate or Frame and Cover shall be considered as a one unit.

**BASIS OF PAYMENT**

Item 222.3 will be paid for at the Contract unit price per Each, which price shall include all labor, materials, equipment, loading, unloading, storage, transportation, and all incidental costs required to complete the work.

**ITEM 222.31**

**FRAME AND GRATE (BEEHIVE)**

**EACH**

The work under this Item shall conform to relevant provisions of Section 200 and 220 of the Standard Specifications, and the following:

The work under this item shall include the furnishing of the Beehive Frame and Grates and all other incidental work as shown on the plans. Beehive Frame and Grate castings shall be approved by the Engineer. The casting shall be set in a concrete collar.

Beehive Frame and grates shall be cast iron and dome shaped with a minimum diameter of 24 inches as shown on the plans. All Beehive Frames and Grates shall conform to MassDOT's Standard Specifications M8.03.0, shall be selected from MassDOT's Qualified Construction Materials List (QCML), and shall comply with AASHTO M306 and M105. Metal used in the manufacture of castings shall conform to ASTM A48 for Gray Iron and ASTM A536 for Ductile Iron.

**METHOD OF MEASUREMENT**

Item 222.31 will be measured for payment by the Each frame and grate (beehive) furnished.

Frame and Grate or Frame and Cover shall be considered as a one unit.

**BASIS OF PAYMENT**

Item 222.31 will be paid for at the Contract unit price per Each, which price shall include all labor, materials, equipment, loading, unloading, storage, transportation, and all incidental costs required to complete the work.

**ITEM 269.12**

**12 INCH SLOT-PERFORATED  
CORRUGATED PLASTIC PIPE (SUBDRAIN)**

**FOOT**

The work under this item shall conform to the relevant provisions of Subsection 260 of the Standard Specifications.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

12 Inch Slot-Perforated Corrugated Plastic Pipe (Subdrain) will be measured and paid at the Contract unit price per foot of pipe installed, which price shall include all labor, materials, sawcutting, excavation, backfilling, and incidentals costs required to complete the work.



<b><u>ITEM 271.121</u></b>	<b><u>12 INCH AND UNDER PIPE REMOVED AND DISCARDED</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 271.181</u></b>	<b><u>18 INCH PIPE REMOVED AND DISCARDED</u></b>	<b><u>FOOT</u></b>

The work under this item shall conform to the relevant provisions of Section 270 of the Standard Specifications and the following:

The work under Items 271.121 and 271.181 shall include the removal and discarding of existing drainage pipes that are damaged or unsuitable for abandonment in place and as directed by the Engineer. The Contractor shall backfill the void left by the removal of the drainage pipe with ordinary borrow, compacted in lifts no greater than 12 inches up to the bottom of proposed subgrade.

The work under Item 271.121 shall also include the removal of the existing water line as noted on the Plans.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

12 Inch and Under Pipe Removed and Discarded and 18 Inch Pipe Removed and Discarded will be paid at the Contract unit price per foot of pipe removed discarded, which price shall include all excavation, shoring, bracing, and protection of existing utilities.

No separate payment shall be made for the off-site disposal of existing pipes, unless classified as asbestos or other hazardous material, but all costs in connection therewith shall be included in the unit price bid under these items.

**ITEM 336.1**  
**ITEM 336.2****1 INCH PLASTIC WATER PIPE**  
**2 INCH PLASTIC WATER PIPE****FOOT**  
**FOOT**

The work under these items shall conform to the relevant provisions of Subsections 120 and 301 of the Standard Specifications, the Westford Water Department specifications (See Document A00807), and the following:

The work shall include all labor, equipment, and incidental costs to furnish and install polyethylene (PE) water service pipes and fittings at the locations shown on the plans and as required by the Engineer. PE water service pipes shall conform to the requirements of AWWA C901 for Polyethylene (PE) pressure pipe and tubing, ½ inch through 3 inches, for water service.

**Materials**

Polyethylene tubing shall be Polyethylene PE 3408, Class 200 tubing and shall conform to AWWA Specification C901 (latest version) and the latest revision of ASTM-D2737 and comply with NSF 61.

The tubing shall be copper O.D. size (copper tube size – CTS) and suitable for use with standard industry brass compression fitting without special adapters.

Tubing shall be manufactured by JM Eagle, Napco, Silver-Line Plastics, or approved equal.

**Construction Methods**

The new service piping shall be installed as shown on the Contract Drawings. The fittings for a new service shall include a corporation stop and a curb stop with extension service box set to grade. Stainless steel inserts within the PE pipe shall be used at all compression connections.

Work done beyond the described limits shall be at the Contractor's own expense and responsibility. Curbs and driveway that are damaged through negligence on the Contractor's part shall be replaced at the Contractor's expense.

Minimum cover over the water service connections shall be 5-feet.

Trenches for water service connections shall be excavated to 6-inches below the bottom of the service pipe to allow for the placement of a sand envelope around the pipe.

The water service piping shall be laid to grade on 6-inches of moist coarse sand and backfilled to a level 6-inches above the piping in compacted courses.

All water service piping installations longer than 40-feet shall be flushed, disinfected and tested.

**ITEMS 336.1 and 336.2** (Continued)

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Items 336.1 and 336.2 will be measured and paid for at the Contract unit price per Foot, measured in-place in the trench as a straight run from the corporation stop to the point of connection to the old service.

This price shall include all labor, materials, sawcutting and removing existing pavements, excavation to a depth of 6 inches below the service pipe and appurtenances; furnishing and placing the envelope of coarse sand material to 6 inches below the service pipes and 6 inches above the top of service pipes; removing and disposing of existing service pipes and curb stops, replacement and restoration of existing walkways, curbs, walls, sods, shrubs, mail boxes, fences, lawns and other surface materials beyond the street lines; removal and restoration of existing underground sprinkler systems; protection and support of public and private utilities; all temporary sheeting and bracing; pumping, dewatering and backfilling; furnishing of jointing materials; furnishing, laying and jointing of all service pipes; furnishing all fittings, couplings and locating wire; field coring new service penetrations through existing concrete foundations; and for all other water service line work and appurtenances, all field tests and disinfecting service lines, and the furnishing of labor, equipment, tools and expense for the tests and disinfection, including the expense of replacing materials damaged by the Contractor in handling or found to be defective after being installed, and all incidental costs required to complete the work.

Trench restoration for paved roadways and driveways will be paid for separately under Items 451., 472. and 702., as applicable.

<b><u>ITEM 345.1</u></b>	<b><u>1 INCH TEMPORARY SERVICE PIPE</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 345.41</u></b>	<b><u>4 INCH TEMPORARY WATER BYPASS PIPE</u></b>	<b><u>FOOT</u></b>

The work under these items shall conform to the relevant provisions of Subsection 301 of the Standard Specifications, and the following:

All work done under these items shall be in close coordination with the Town of Westford Water Department and the Engineer. The Contractor shall notify the Town of Westford at least 48 hours in advance of any work done associated with these items.

The Contractor shall furnish, install, test, disinfect, and maintain temporary water bypass pipe and temporary service pipe, as required to maintain service to all abutting properties within the limit of new water pipe work until the new water pipe is in place and operational. Once the new water pipe is operational, the Contractor shall remove the temporary water pipe.

The 4 Inch Temporary Water Service Pipe shall be made of fused-joint HDPE, steel, or PVC suitable for conveying domestic water. All fittings, connectors and any other appurtenances required to complete the connection between the existing water main and the temporary service pipe shall be considered incidental to this item.

All disinfection procedures associated with the temporary water service pipe and service pipes shall be done in accordance with Section 301.60.K.

The Town of Westford Water Department will be responsible for operating all valves and hydrants.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

4 Inch Temporary Water Bypass Pipe and 1 Inch Temporary Service Pipe will be measured and paid for at the Contract unit price per foot of pipe installed, which price shall include all labor, materials, equipment and incidental costs required to perform the work, including fittings, connectors, testing, disinfection, protection of existing temporary pipes while they are in use, monitoring, maintenance and repairs, decommissioning, and removal of the temporary pipe after the permanent pipe is installed and approved by the Town of Westford Water Department.

**ITEM 355.04      4 INCH GATE AND GATE BOX REMOVED AND STACKED      EACH**  
**ITEM 376.3                      HYDRANT - REMOVED AND STACKED                      EACH**

The work under these items shall conform to the relevant provisions of Subsection 301 of the Standard Specifications and the following:

Work shall include the removal and stacking of existing water gates, gate boxes and hydrants as shown on the plans, to a location designated by the Engineer for pick-up by the Town Water Department. Gates, gate boxes and hydrants determined to be unsatisfactory for reuse shall become the property of the Contractor and shall be removed and discarded. All gates, gate boxes and hydrants designated to be reused shall be carefully removed, transported and stacked on boards in a secure area. Those designated by the Engineer to be unsatisfactory for reuse shall be disposed of in accordance with all applicable regulations, with no additional compensation.

The Contractor shall give at least 48 hours written notice to the Town Water Department prior to removing a gate and gate box or hydrant.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

4 Inch Gate and Gate Box Removed and Stacked and Hydrant Removed and Stacked will be measured and paid for at the Contract unit price per each, complete and approved, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

No separate payment will be made for disposal of gates, gate boxes or hydrants designated by the Engineer to be unsatisfactory for reuse, but all costs in connection therewith shall be included in the Contract unit price bid.

<b><u>ITEM 371.04</u></b>	<b><u>4 INCH COUPLING</u></b>	<b><u>EACH</u></b>
<b><u>ITEM 371.06</u></b>	<b><u>6 INCH COUPLING</u></b>	<b><u>EACH</u></b>
<b><u>ITEM 371.08</u></b>	<b><u>8 INCH COUPLING</u></b>	<b><u>EACH</u></b>
<b><u>ITEM 371.12</u></b>	<b><u>12 INCH COUPLING</u></b>	<b><u>EACH</u></b>

The work under these items shall conform to the relevant provisions of Subsections 120 and 301 of the Standard Specifications, the Westford Water Department specifications (See Document A00807), and the following:

**Materials**

Solid sleeves shall have long body type (12 inches minimum) and mechanical joints with retainer glands.

Couplings and transitional couplings for pipe less than or equal to 12 inches in diameter shall consist of a long body cast iron sleeve and shall have gaskets suitable for the pipe being joined. The bolts and nuts shall be corrosion resistant high strength and low alloy steel such as weathering steel. Couplings shall be Hymax models 2000/2100, Romac Industries, Inc. Macro HP, Smith-Blair 421 Series or approved equal. Transition couplings for pipe less than or equal to 12 inches in diameter shall be Dresser Style 162, Rockwell Type 441, Smith Blair Omni Style 442, or equivalent.

Provide couplings with an exterior epoxy coating.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Couplings will be measured and paid for at the Contract unit price per each measured complete in place, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

**ITEM 376.5****HYDRANT – ADJUSTED****EACH**

The work under this item shall conform to the relevant provisions of Subsection 301 of the Standard Specifications and the following:

All hydrants designated to be “Adjusted” shall be done so one hydrant at a time. The Contractor shall have all the required tools, materials, equipment and workmen needed to do the work on site and ready before any hydrant is removed. The Contractor shall give at least 48 hours written notice to the Town of Westford Water Department prior to working on any hydrant. Hydrants which will be out of service for more than twenty-four (24) hours shall be replaced by temporary hydrants.

**HYDRANT ADJUSTED**

Hydrants noted on the plans to be adjusted shall be carefully removed and temporarily set on blocks. The Contractor shall install a riser extension of the appropriate length on the existing riser and reset the hydrant. Extension sections used to adjust hydrants shall be ductile iron only and shall adapt readily to the existing hydrant and fittings. Extension sections shall also include extensions for hydrant stem approved by the Town, including all fittings. Extensions shall be a minimum of 6-inch long. The hydrant shall be reset to a height that provides 2-inch to 4-inch of clear distance from the top of finished grade to the bottom of the breakaway flange.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Hydrant Adjusted will be measured and paid for at the Contract unit bid price per each, complete in place, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

No separate payment will be made for furnishing and installation of crushed stone drainage well, connection to existing, tie rods, restraining glands, extension sections, ductile iron pipe, and ductile iron fittings, but all costs in connection therewith shall be included in the Contract unit price bid.

Thrust blocks, where required, will be paid for at the Contract unit price per cubic yard under Item 903. 6-inch coupling as shown on the plans, if required, will be measured for payment under Item 371.06.

**ITEM 382.****METER BOX****EACH**

The work under this item shall conform to the relevant provisions of Subsection 301 of the Standard Specifications and the following:

The work under this item shall include installation of a new water meter box adjacent to Town Common as shown on the plans.

**MATERIALS**

Meter boxes shall adhere to the following:

1. Box material shall be plastic type intended for outdoor subsurface installation.
2. Lid type shall be a standard double lid frost proof cover imprinted with the words "WATER METER".
3. Box size shall be 18" diameter x 48" deep.
4. Inlet valve type shall be a 1" angle ball compression valve.
5. Outlet valve type shall be 1" angle check valve.
6. Inlet/Outlet meter size shall be 5/8" x 3/4".
7. Inlet/Outlet type shall be male iron pipe.
8. All brass components shall conform to AWWA C800.
9. Service lines shall be a minimum of 2-inches from pit walls to prevent "frost jump".
10. Meter boxes shall be manufactured by Ford Meter Box Company Inc., Southern Pipe Supply Co., Everett J. Prescott, Inc., or approved equal.

The Contractor shall give at least 48 hours written notice to the Town Water Department prior to installation of the meter box.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Meter Box will be measured and paid for at the Contract unit bid price per each, complete in place, which price shall include all labor, materials, equipment and incidental costs required to complete the work.



**ITEM 382.2**

**METER BOX REMOVED AND STACKED**

**EACH**

The work under these items shall conform to the relevant provisions of Subsection 301 of the Standard Specifications and the following:

Work shall include the removal and stacking of the existing meter box adjacent to Town Common as shown on the plans, to a location designated by the Engineer for pick-up by the Town Water Department.

Meter boxes determined to be unsatisfactory for reuse shall become the property of the Contractor and shall be removed and discarded.

The Contractor shall give at least 48 hours written notice to the Town Water Department prior to removing the meter box.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Meter Box Removed and Stacked will be measured and paid for at the Contract unit price per each, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

No separate payment will be made for disposal of gates, gate boxes or hydrants designated by the Engineer to be unsatisfactory for reuse, but all costs in connection therewith shall be included in the Contract unit price bid.

**ITEM 403.2****FULL DEPTH RECLAMATION WITH  
EMULSIFIED ASPHALT STABILIZATION****SQUARE YARD**

The work under this item shall conform to Subsection 403 of the Standard Specifications, the Special Provision for Item 403.21, Emulsified Asphalt for Stabilization, and the following:

All existing pavement areas within the project limits designated on the plans to be reclaimed shall be reclaimed for use as base and/or sub-base course beneath pavement and sidewalk areas on the project.

The work under this item shall consist of development and submittal of a Full Depth Reclamation (FDR) job mix formula with an emulsified asphalt stabilization, pulverizing the existing pavement structure and a portion of the existing roadway base material into a homogenous mass, grading, windrowing, excavating, compacting, performing multiple passes to blend emulsified asphalt stabilizer, and grading and compacting this material to the lines, grades, and dimensions shown on the plans or established by the Engineer. Note: Calcium chloride for dust control is prohibited for the reclamation operation with the emulsified asphalt stabilizer specified. Dust control as needed shall be water for dust control and controlled for the reclamation operation.

The Contractor shall first use all on-site reclaimed material, which is suitable or has been supplemented with Crushed Stone for Blending to be made suitable, under roadways, sidewalks, driveways, or other locations for base and sub-base courses as indicated on the Drawings or as required by the Engineer. After on-site reclaimed material has been exhausted, the Contractor may use additional, suitable borrow material brought in from off-site. The Contractor shall schedule its operations such that the re-use of reclaimed material be well coordinated with the generation of the material.

**MATERIALS**

Full Depth Reclamation: Reclaimed Pavement Borrow Material shall conform to the requirements of the latest Standard Specifications Subsection M1.09.0 of Division III Materials.

Emulsified Asphalt Stabilizer: The stabilizer shall be an emulsified asphalt, approved for full depth reclamation of asphalt pavements to provide sufficient time of curing for full depth reclamation operation to grade and compact the sub-base and/or base course. Approved emulsions are: Grade MS-2, SS-1, SS-1h, CSS-1 or CSS-1h or approved equal.

Material Sampling and Testing: A minimum of twenty-eight (28) days prior to the start of construction, the Contractor shall sample and test the pavement courses to be reclaimed. The samples shall be taken randomly for the various areas of the work and based on location and variations in existing pavement material courses to be reclaimed. Samples of pavement shall consist of 6-inch diameter cores of the existing pavement and 50 lbs. of the underlying materials as required for development of the FDR job mix formulas. The composite materials shall be tested for gradation and development of job mix formulas.

**ITEM 403.2** (Continued)

Developing and Testing for Full Depth Reclamation Job Mix Formula (JMF): The Contractor shall submit job mix formulas to the Engineer for review, comment and approval. The reclaimed sub-base material prior to stabilization shall be compacted to not less than 95 percent of the maximum dry density per the Standard Specifications for Highways and Bridges, Section 401.60 Gravel Sub-base.

JMF with Emulsified Asphalt: A minimum three-point curve based on either Marshall Stability (50 blow) or Tensile Strength with at least one point before and one point after the maximum Stability or Strength will be prepared using 50 blows per side specimen cured at 104F degree in a forced air oven for sixteen (16) to twenty four (24) hours. The recommended Asphalt Emulsion percentage in the specimens shall be evaluated at 1.5%, 2.5%, 3.5% or as needed to result in an acceptable curve. The Design shall be performed at 3% moisture content. All test data shall accompany the JMF and recommendations.

New Aggregate or Additional Recycled Material: If additional new or recycled aggregate material is required, the material properties and gradation shall be in accordance with Section 403. Reclaimed Pavement Borrow for Base and/or Sub-base Course. The aggregate material shall be from an approved source and sampled, tested and approved for use in the work. Crushed Stone and Recycled Asphalt Pavement to be provided if required, shall be free of winter sand, granular fill, construction debris, and other materials.

**EQUIPMENT**

Reclaimer: The reclaiming equipment shall be a self-propelled machine, specially manufactured for stabilizing with emulsified asphalt injection and mixing unit to introduce the emulsified asphalt stabilizer into the pulverized material. The mixing unit shall contain a liquid distribution and mixing system which has been specifically manufactured for FDR with emulsion injection type work, capable of mixing the pulverized material with an evenly metered distribution of emulsified asphalt into a homogeneous mixture, to the depth and width required.

The reclaimer shall be capable of uniformly treating the reclaimed material in a single pass and shall have a full width spray bar consisting of a positive displacement pump interlocked to the machine speed so that the amount of emulsion being added is automatically adjusted with changes in machine speed. The injection system shall be capable of incorporating the emulsified asphalt stabilizer at the specified rates in the JMF. Under no circumstances shall the bituminous material be spray applied on the road surface in front of the reclaimer, and incorporated into the FDR material with subsequent passes.

Motor Grader: The Motor Grader shall be of sufficient horsepower with hydraulic moldboard and cutting edge for roadway construction. The motor grader shall be able to grade profile and cross slope to lines and grades shown on plans. The Motor Grader shall be equipped with low gears, a ground speedometer to prevent excessive speed, and a crown gauge to provide constant slope reading. Grader moldboard shall have cutting edges in good condition with straight edge without excessive wear or uneven sections. Cutting edges shall provide a straight cross slope from centerline crown to shoulder. The Operator shall be experienced with this equipment and roadway grading in order to construct the proposed lines and grades.

**ITEM 403.2** (Continued)

Water Truck: A Water truck shall be available to moisten the surface to be graded to provide better smoothing and reshaping of the surface as needed. Water is not intended for use prior to preparation of surface to be stabilized with the emulsified asphalt.

Rollers: Rollers shall have a gross weight of not less than 15 tons. A minimum of two rollers shall be provided, a rubber-tired roller and a smooth-drum roller. The steel drum roller shall compact the recycled material in vibratory mode utilizing high amplitude/low frequency settings as required to achieve specified density. After completion of a reclaiming pass, the road shall be compacted with rubber tire roller and shaped as shown on plans. A steel drum roller in vibratory mode shall compact all shaped sections. The Contractor shall submit the rolling plan for each pass and for the stabilized surface for review.

Compaction density, testing, and testing frequency of the reclaimed sub-base shall be the same as that for gravel sub-base in the Standard Specifications for Highways and Bridges, Section 401.60.

**CONSTRUCTION REQUIREMENTS**

Weather Limitations: FDR with Injected Asphalt Emulsion Stabilization work shall not be performed when the atmospheric temperature is below 50°F or falling below, or when weather conditions are such and/or forecasted that proper pulverizing, spreading, mixing bituminous stabilizer and curing are unfavorable to proper construction procedure or compaction of the pulverized material cannot be accomplished.

Pulverizing and Emulsified Asphalt Stabilization: The reclaiming operation shall be scheduled and constructed with multiple passes of the reclaiming equipment as required for optimal blending/mixing, grading and compaction of the reclaimed pavement borrow material, for dust control (with stabilizing agent) and for opening to traffic. The full depth reclamation operation shall require multiple passes with the reclamation operation for mixing and adding the stabilizing agent.

The existing road shall be reclaimed to the depth of approximately 2 times the average existing pavement thickness, or as required by the Engineer. After completion of the first pass, the road shall be shaped and compacted to meet density, lines and grades for base and/or sub-base course.

Where the existing pavement's cross slopes meet appropriate standards, then the cross slope of the finished reclaimed pavement section shall match existing. Where non-standard cross slopes are identified in the contract documents and identified by the Engineer and the Contractor, the Contractor and the Engineer shall confer with the Design Engineer as required for a method that brings the cross slopes of the reclaimed pavement section into conformance with lines and grades shown on plans and for a smooth pavement.

The stabilization shall occur within three (3) working days of the initial reclamation operation. A final pass of the reclaimer shall be completed to add the required amount of emulsified asphalt to be mixed and blended into the top **4 inches** of the compacted reclaimed pavement borrow base and/or sub-base course material. The emulsified asphalt stabilizer shall be injected, mixed and blended in the reclaimer mixing drum, at the rate specified in the JMF.

**ITEM 403.2** (Continued)

Grading and Compaction: The completed surface of the FDR with Asphalt Emulsion Stabilization shall be shaped and maintained in a timely manner to allow asphalt to cure. The final grades and compacting shall be per the lines, grades and typical cross-sections shown on the plans or established by the Engineer.

The maximum density will be determined on a Test Strip as follows:

A Test Strip of not more than three hundred (300) feet and one or two widths of the asphalt stabilizer/reclaimer shall be constructed as specified. Compaction will proceed using the required equipment (rubber tire and vibratory steel drum rollers). The Engineer and/or Contractor shall use a nuclear density gauge (soil-type) to determine the Maximum Density. Multiple roller passes and density readings will be performed until the density readings either reach a peak or begin to drop off. The peak reading will become the Maximum Density of the Full Depth Reclamation and the Reclaimed with Asphalt Emulsion Stabilization for QC and Acceptance purposes.

Special care shall be taken in monitoring the rolling pattern. The Test Strip data shall be used to establish a rolling pattern that shall be used throughout the project.

Note: To aid compaction, the addition of water may be required. Water shall be applied from a spray bar mounted on a water truck with an adjustable volume control. The initial pass may be watered to provide better consistency for grading and lubrication of vibratory compaction.

Caution: Excess use of water on the asphalt stabilized reclamation pass may result in flushing of the asphalt emulsion from the reclaimed mixture. The Contractor shall minimize water for reclaiming that can cause any flushing of the emulsified asphalt.

Curing: The grading and compacting of the stabilized surface shall be timely to provide for the curing of the emulsified asphalt stabilization. No new pavement shall be placed on the asphalt stabilized base until a minimum curing period as needed to establish JMF moisture content. Additional curing may be needed if weather conditions warrant as directed by the Engineer.

Traffic Control: Unless otherwise specified or as directed by the Engineer, the roadway shall be kept open to traffic at all times, with traffic discontinued on the lane being reclaimed. Controlled traffic may be permitted as soon as the base is stabilized and/or asphalt stabilization is cured sufficiently for opening to traffic while preventing tracking or pick up of asphalt emulsion.

Structures: All drainage and utility structures shall be lowered 6 inches below subgrade and plated in accordance with Subsection 403.62 of the Standard Specifications. Lowering and plating of structures shall be considered incidental to Item 403.2 Full Depth Reclamation with Asphalt Stabilization.

Because of pipe outlet elevations, some precast drainage structures cannot be lowered to this extent. For those drainage structures, the Contractor shall excavate around the precast units to avoid damaging the structures during reclaiming operations. Reclaimed base course shall be windrowed and compacted thoroughly around the structures. The cost of excavating windrowing and compacting around structures shall be considered incidental to Item 403.2 Full Depth Reclamation with Asphalt Stabilization.

**ITEM 403.2** (Continued)

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Full Depth Reclamation with Emulsified Asphalt Stabilization will be measured and paid for at the Contract unit price by the Square Yard of existing pavement area reclaimed for use on the project.

The accepted quantity of Full Depth Reclamation with Emulsified Asphalt Stabilization, will be paid for at the contract unit price per square yard, per the Standard Specifications Section 403. and including all sampling and testing and development of Reclaimed Pavement Borrow job mix formula (JMF), furnishing all equipment, material and labor for pulverizing, blending and adding asphalt stabilizer, grading, compacting, and for all incidentals required to complete the work at the required depth and stabilization depth specified herein.

The stabilizer agent, Emulsified Asphalt, for the full depth reclamation will be paid for at the Contract unit price per gallon (GAL) per Item 403.21. Crushed stone, if required to correct gradation deficiencies, will be paid for separately under Item 403.1, Crushed Stone for Blending.

No separate payment will be made for stockpiling or transporting reclaimed material to be used under roadways, sidewalks and driveways.

No separate payment will be made for lowering and plating of drainage structures.

Removal and disposal of unsuitable material, surplus reclaimed material, or any sub-base/subgrade material required for grade changes that is not reused shall be paid for at the Contract unit price per cubic yard for Item 120.1 Unclassified Excavation.

**ITEM 403.21**

**EMULSIFIED ASPHALT  
FOR FULL DEPTH RECLAMATION**

**GALLON**

The work under this item shall conform to the relevant provisions of Section 403 of the Standard Specifications, the Special Provision for Item 403.2 Full Depth Reclamation with Emulsified Asphalt Stabilization, and the following:

Emulsified asphalt for stabilization shall be in accordance with the special provisions found in Item 403.2 Full Depth Reclamation with Emulsified Asphalt Stabilization.

**METHOD OF MEASUREMENT**

Emulsified Asphalt for Full Depth Reclamation shall be calculated by measuring the proposed full depth reclamation area plus the proposed full depth pavement within reclamation area and multiplying the sum by the application rate applied for the approved JMF.

**BASIS OF PAYMENT**

The accepted quantity of Emulsified Asphalt for full depth reclamation will be paid for at the contract unit price per gallon complete in-place including addition of emulsified asphalt stabilizer into the Full Depth Reclamation operation and all sampling and testing and development of job mix formula (JMF) and all incidental work as required for the full depth reclamation with emulsified asphalt stabilization.

**ITEM 487.1****IMPRINTED PREFORMED  
THERMOPLASTIC CROSSWALKS****SQUARE YARD**

Work under this Item shall conform to the relevant provisions of Subsection 701 of the Standard Specifications and the following:

A durable imprinted aggregate reinforced preformed thermoplastic pavement marking system (herein “System”) that provides a textured, highly attractive and durable topical treatment to the surface of asphalt pavement. Typically, the system replicates, in relief, the grout lines common to brick or other types of unit pavers but may also be used to create other patterns. It provides a seamless, aesthetic look without the trip hazards and ongoing maintenance often associated with pavers and stamped concrete.

The aggregate reinforced preformed thermoplastic is typically supplied in panels measuring 2 ft. x 2 ft. [ $\pm 1/8$  in.].

The System must be able to be applied to asphalt surfaces without preheating the application surface to a specific temperature.

The System must be able to be applied in temperatures down to 45°F without any special storage, preheating or treatment of the material before application.

The System is applied to asphalt pavement using reciprocating infrared heating equipment in accordance with the manufacturer’s recommended installation methods. A two-part epoxy sealer specified by the manufacturer must be applied to the substrate prior to preformed thermoplastic application to ensure proper adhesion, and to provide reinforcement for larger volumes of material. Immediately following sealer application, panels of aggregate reinforced preformed thermoplastic are positioned properly on the asphalt substrate. The preformed thermoplastic is then heated to the required melting temperature. Additional aggregate may be applied to the preformed thermoplastic surface as needed following the melting process, to achieve added friction properties and a uniform surface appearance. As the material is cooling, it is imprinted with a vibratory plate compactor and a template made from 3/8 in. flexible wire rope in the required design to create crisp, clean lines which define the pattern. For crosswalks, it is typically demarcated by applying white preformed thermoplastic transverse lines on both sides of the installation.

The System is available in a variety of standard colors and patterns. Color can be used to create patterns within the crosswalk area to reflect the typical white “continental” crosswalk bars for additional visibility and awareness. The final color and pattern shall be approved by the Engineer and the Town of Westford prior to installation.

The System shall utilize a resilient, aggregate reinforced preformed thermoplastic product which contains a minimum of thirty percent (30%) intermixed anti-skid/anti-slip elements and where the top surface contains anti-skid/anti-slip elements. These anti-skid/anti-slip elements must have a minimum hardness of 6 (Mohs scale).

The System must be resistant to the detrimental effects of motor fuels, antifreeze, lubricants, hydraulic fluids, etc.



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**ITEM 487.1** (Continued)**Manufacturing Control and ISO Certification**

The System manufacturer must be ISO 9001:2008 certified for design, development and manufacturing of preformed thermoplastic, and provide proof of current certification.

**MATERIALS****Preformed Thermoplastic**

Must be composed of an ester modified rosin impervious to degradation by motor fuels, lubricants, etc. in conjunction with aggregates, pigments, binders, and anti-skid/anti-slip elements. Pigments and anti-skid/anti-slip elements must be uniformly distributed throughout the material. The material conforms to AASHTO designation M249, with the exception of the relevant differences due to the material being supplied in a preformed state, being non-reflective, and potentially being of a color different from white or yellow.

**Pigments***White*

The material shall be manufactured with sufficient titanium dioxide pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected.

*Other Colors*

The pigment system must not contain heavy metals nor any carcinogen, as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

*Skid Resistance*

The surface of the material shall contain factory applied anti-skid/anti-slip elements with a minimum hardness of 6 (Mohs scale). Upon application the material shall provide a minimum skid resistance value of 60 BPN when tested according to ASTM E 303.

*Slip Resistance*

The surface of the material shall contain factory applied anti-skid/anti-slip elements with a minimum hardness of 6 (Mohs scale). Upon application the material shall provide a minimum static friction of coefficient of 0.6 when tested according to ASTM C 1028 (wet and dry), and a minimum static coefficient of friction of 0.6 when tested according to ASTM D 2047.

*Thickness*

The material must be supplied at a minimum thickness of 150 mil.

**ITEM 487.1** (Continued)*Environmental Resistance*

The material must be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

*Storage Life*

The material may be stored for 12 months, if stored indoors and protected from the elements.

*Transverse Lines to Supplement System Application*

Supplied as white, retroreflective preformed thermoplastic line stripe material in 90 mil or 125 mil thicknesses, material is available in 6 in., 8 in. or 12 in. widths. This preformed thermoplastic material may be supplied and applied by the certified applicator in conjunction with the System and is available from the System manufacturer. (Consult the manufacturer's published application instructions for the preformed thermoplastic line stripe material selected, for proper application methods.)

**SPECIALIZED APPLICATION EQUIPMENT***Stamping Templates*

A wire rope template is required in the execution of the System. The template is used for imprinting the defined pattern once the preformed thermoplastic has been applied. The wire rope diameter for the imprinting template used for the specified pattern is 3/8 in. The stamping templates are distributed by the System manufacturer.

*Heating Equipment*

The System manufacturer shall distribute reciprocating infrared heating equipment designed specifically to elevate the temperature of the preformed thermoplastic material and asphalt pavement without adversely affecting it. The primary heating unit must employ a bank of propane-fired infrared heaters, mounted on a track device that allows the heater bank to reciprocate back and forth over a designated area, thereby allowing the operator to monitor the temperature of the preformed thermoplastic at all times during the pavement heating process.

A smaller, mobile infrared heater distributed by the System manufacturer is designed specifically to heat areas such as borders and narrow areas that are inaccessible to the primary heaters. This secondary heater also allows the operator to monitor the temperature of the preformed thermoplastic at all times during the heating process.

An approved hand-held propane heat torch distributed by the System manufacturer shall be used to heat isolated areas of the preformed thermoplastic.

**ITEM 487.1** (Continued)*Sealer*

A two-part epoxy sealer specified and distributed by the System manufacturer must be applied to the substrate prior to material application to ensure proper adhesion, and to provide reinforcement for larger volumes of material.

*Specialized Sealer Dispensing Gun*

Used to dispense the required two-part epoxy sealer onto the substrate. The sealer dispensing guns are distributed by the System manufacturer.

*Handheld Finishing Tool*

Enables the applicator to complete the imprinting of the thermoplastic in areas around permanent structures, such as curbs and manholes covers, which may be inaccessible to the stamping template. The handheld finishing tools are distributed by the System manufacturer.

*Aggregate*

Supplemental anti-skid/anti-slip elements to be applied to the surface of the molten thermoplastic as needed, if the factory applied anti-skid/anti-slip elements embed too deeply into the surface of the molten thermoplastic material during the heating process. (Embedded aggregate is exposed upon wear for extended skid resistance.) The aggregate is distributed by the System manufacturer.

*Air Powered Spray Hopper*

Used to spray supplemental anti-skid/anti-slip elements (aggregate) on the surface of the molten preformed thermoplastic in a uniform manner. The air powered spray hoppers are distributed by the System manufacturer.

*Vibratory Plate Compactor (700-900 lb.)*

Shall be used for pressing the 3/8" wire rope stamping templates into the thermoplastic to create the specified pattern in both the thermoplastic and asphalt substrate. The System manufacturer does not supply vibratory plate compactors.

**CONSTRUCTION**

Manufacturer Certified Applicator Requirement: The System shall be supplied and applied only by an applicator certified by the System manufacturer. The applicator shall provide proof of current certification before commencing work. The Certified Applicator shall follow the System manufacturer's current published application procedures.

**ITEM 487.1** (Continued)

Substrate Condition: The System must only be applied to a stable, high quality asphalt pavement substrate over a stable base that is free of defects, as per the manufacturer published Substrate Guide. The asphalt pavement surface shall be dry and free from all foreign matter, including but not limited to dirt, dust, de-icing materials, and chemical residue.

Procedure: The System is applied to asphalt pavement using proprietary reciprocating infrared heating equipment. The material must be able to be applied at ambient and road temperatures down to 45°F without any preheating of the pavement to a specific temperature. A two-part epoxy sealer specified by the manufacturer must be applied to the substrate prior to preformed thermoplastic application. Immediately following sealer application, the panels of aggregate reinforced preformed thermoplastic are positioned properly on the asphalt substrate with the aggregate side facing up. The preformed thermoplastic is then heated to the required melting temperature. Additional aggregate may be applied to the preformed thermoplastic surface as needed following the melting process.

As the material is cooling, it is imprinted with a stamping template made from 3/8 in. flexible wire rope in the required design using a vibratory plate compactor. The preformed thermoplastic material is then allowed to cool thoroughly before being opened to vehicle or pedestrian traffic. (Consult the manufacturer's published application procedures for complete information.)

The System shall not be applied to Portland Cement Concrete.

The preformed thermoplastic material shall be packaged in cardboard cartons with a plastic sheet between each layer of preformed thermoplastic. The cartons in which packed shall be non-returnable and shall not exceed 25 inches in length and 25 inches in width. The cartons shall be labeled for ease of identification. The weight of the individual carton must not exceed seventy (70) pounds. A protective film around the carton must be applied in order to protect the material from rain or premature aging.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Imprinted Preformed Thermoplastic Crosswalks will be measured and paid at the Contract unit price per Square Yard, which price shall include all labor, material, equipment mobilization, and incidental costs required to complete the work.

No deductions shall be made for structures within the work area such as manholes, catch basins or water covers.

**ITEM 504.2**

**GRANITE CURB TYPE VA4 – SPLAYED END**

**EACH**

The work under this item shall conform to the relevant provisions of Subsection 501 of the Standard Specifications and the following:

Granite curb shall be 6-feet minimum in length and machine cut to match that adjacent granite edging or hot mix asphalt berm, per the detail included in the plans.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 504.2 will be measured and paid for at the Contract unit price per each splayed end section installed, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work.

No separate payment will be made for sawcutting or cement concrete, but all costs in connection therewith shall be included in the Contract unit price bid.

**ITEM 691.1      BALANCE STONE WALL REMOVED AND STACKED                      FOOT**

The work under this item shall conform to the relevant provisions of Subsection 690 of the Standard Specifications and the following:

The work shall include removing and stacking of existing balance stone walls as shown on the plans. The Contractor shall coordinate the removal of the balance stone wall with the Engineer and abutting property owner. The Contractor shall stack the balance stone wall on the owner's property at a location determined by the property owner, as approved by the Engineer. Any damage caused by the Contractor's operations to private property during the removing and stacking process shall be repaired or replaced by the Contractor at no additional cost to the satisfaction of the Engineer.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Balance Stone Wall Removed and Stacked will be measured and paid for at the Contract unit price per foot, measured along the front face of wall prior to removal, which price shall include all labor, materials, equipment, and incidental costs required to complete the work.

Stones which the abutting property owner refuses shall be disposed of by the Contractor at no additional compensation.

**ITEM 693.1**

**GRANITE WALL REMOVED AND RESET**

**FOOT**

The work under this item shall conform to the relevant provisions of Subsections 580 and 690 of the Standard Specifications and the following:

The work shall include removing and resetting the existing granite wall and end posts adjacent to 14 Boston Road to the location shown on the plans and to the same exposed reveal height as the existing wall. The Contractor shall coordinate the removal and resetting of the wall with the Engineer and the adjacent property owner.

All stone work shall be cleaned thoroughly to remove stains, excess mortar, dirt and other discoloration or blemishes. A setting bed of 8-inches of crushed stone shall be placed and compacted prior to placement of the stones in their new position.

The Contractor shall replace any existing granite wall that is to be reset, which is lost or damaged as a result of their operations, or because of their failure to store and protect it to prevent its loss or damage.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Granite Wall Removed and Reset will be measured and paid for at the Contract unit price per foot, measured along the front face of wall, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work as described.

No separate payment will be made for excavation, and backfill, but all costs in connection therewith shall be included in the unit price bid.

Crushed stone setting bed will be paid for separately under Item 156., Crushed Stone.

**ITEM 697.1****SILT SACK****EACH**

Work under this item shall conform to the relevant provisions of Subsections 227 and 670 of the Standard Specifications and the following:

The work under this item includes the furnishing, installation, maintenance and removal of a reusable fabric sack to be installed in drainage structures for the protection of wetlands and other resource areas and the prevention of silt and sediment from the construction site from entering the storm water collection system. Devices shall be ACF Environmental (800)-448-3636; Reed & Graham, Inc. Geosynthetics (888)-381-0800; The BMP Store (800)-644-9223; or approved equal.

**CONSTRUCTION**

Silt sacks shall be installed in retained existing and proposed catch basins and drop inlets within the project limits and as required by the Resident Engineer.

The silt sack shall be as manufactured to fit the opening of the drainage structure under regular flow conditions, and shall be mounted under the grate. The insert shall be secured from the surface such that the grate can be removed without the insert discharging into the structure. The filter material shall be installed and maintained in accordance with the manufacturer's written literature and as directed by the Engineer.

Silt sacks shall remain in place until the placement of the pavement overlay or top course and the graded areas have become permanently stabilized by vegetative growth. All materials used for the filter fabric will become the property of the Contractor and shall be removed from the site.

The Contractor shall inspect the condition of silt sacks after each rainstorm and during major rain events. Silt sacks shall be cleaned periodically to remove and disposed of accumulated debris as required. Silt sacks, which become damaged during construction operations, shall be repaired or replaced immediately at no additional cost to the Department.

When emptying the silt sack, the contractor shall take all due care to prevent sediment from entering the structure. Any silt or other debris found in the drainage system at the end of construction shall be removed at the Contractors expense. The silt and sediment from the silt sack shall be legally disposed of offsite. Under no condition shall silt and sediment from the insert be deposited on site and used in construction.

All curb openings shall be blocked to prevent stormwater from bypassing the device.

All debris accumulated in silt sacks shall be handled and disposed of as specified in Section 227 of the Standard Specifications

**COMPENSATION**

Silt sacks will be measured and paid at the Contract unit price per each, complete in place, which price shall include all labor, materials, equipment and incidental costs required to complete the work. No separate payment will be made for removal and disposal of the sediment from the insert, but all costs in connection therewith shall be included in the Contract unit price bid.



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**ITEM 698.3**                    **GEOTEXTILE FABRIC FOR SEPARATION**                    **SQUARE YARD**

The work under this item shall conform to the relevant provisions of Subsections 670, 751, and 767 of the Standard Specifications and the following:

The work under this item includes the furnishing and installation of geotextile fabric for proposed slopes greater than two-foot horizontal per one-foot vertical (2H:1V), under the modified rockfill slope, beneath stone pipe ends and below sediment forebay paving as shown on the Contract Drawings or as required by the Engineer.

Materials shall conform to M9.50.0 and shall be listed on the MassDOT Qualified Construction Materials List.

The geotextile fabric shall be installed per the manufacturer's instructions and AASHTO M-288, whichever is more stringent.

At locations of fabric installation, the subgrade shall first be graded and compacted. All rocks, vegetation, and other obstructions shall be removed before placement of fabric. The fabric shall be installed and fastened in place in conformance with the manufacturer's recommendations for installation on slopes.

Geotextile fabric shall be rolled vertically down the slope and there shall be no overlaps in the vertical direction. Adjacent strips of geotextile shall overlap at least 2 feet. The geotextile shall be secured in place at the overlaps with steel pins at least 18 inches long and spaced at 2 feet on center. The pins shall be fitted with washers at least 1.5 inches in diameter.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Geotextile Fabric for Separation will be measured and paid for at the Contract unit price per square yard, complete in place, which price shall include all labor, material, equipment and incidental costs required to complete the work.

No separate payment will be made for material required for overlap areas, but all costs in connection therewith shall be included in the Contract unit price bid

**ITEM 703.3**            **CONCRETE BLOCK REMOVED AND STACKED**            **EACH**

The work under this item shall conform to the relevant provisions of Subsection 120 of the Standard Specifications and the following:

The work includes removing and stacking concrete blocks in the locations shown on the plans.

The concrete blocks shall be carefully removed, stored and handled with care to protect from staining, chipping or other damage.

Concrete blocks removed and stacked shall be carefully removed and stacked at a location on the adjacent property, as required by the Engineer, in coordination with the property owner.

The Contractor shall exercise care and make every effort to protect the concrete block and keep it intact during removal and transport.

Any damage caused by the Contractor's negligence to private property during the removing and stacking process shall be repaired or replaced by the Contractor at no additional cost to the satisfaction of the Engineer.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Concrete Block Removed and Stacked will be measured and paid for at the Contract unit price per each, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

No separate payment will be made for transportation, but all costs in connection therewith shall be included in the Contract unit price bid.

Concrete block which the abutting property owner refuses shall be disposed of by the Contractor at no additional compensation.

**ITEM 703.4**

**CONCRETE POST REMOVED AND STACKED**

**EACH**

The work under these items shall conform to the relevant provisions of Subsections 120 and 150 of the Standard Specifications and the following:

The work includes removing and stacking concrete posts in the locations noted on the plans.

The posts shall be carefully removed and stacked at a location on the adjacent property, as required by the Engineer, in coordination with the property owner. The Contractor shall exercise care and make every effort to protect the posts and keep them intact during removal and transport.

Any damage caused by the Contractor's negligence to private property during the removing and stacking process shall be repaired or replaced by the Contractor at no additional cost to the satisfaction of the Engineer.

The Contractor shall backfill with compacted gravel or suitable existing material all holes resulting from the removal of the posts.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Concrete Post Removed and Stacked will be measured and paid for at the Contract unit price per each, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

No separate payment will be made for excavation, backfill, or transportation but all costs in connection therewith shall be included in the Contract unit price bid.

Existing posts which the abutting property owner refuses shall be disposed of by the Contractor at no additional compensation.

**ITEM 706.**  
**ITEM 706.1****BRICK WALK**  
**BRICK WALK REMOVED AND RELAID****SQUARE YARD**  
**SQUARE YARD**

The work under these items shall conform to the relevant provisions of Subsections 150, 170, and Section 700 of the Standard Specifications and the following:

The work under Item 706. includes furnishing and installation of new or extended brick walks in the locations shown on the plans.

The work under Item 706.1 includes removing and resetting existing brick between existing walkways and the back of proposed sidewalk. The work shall also include careful removal and stacking of existing excess bricks on the adjacent property, if desired by the property owner; exact location on the property shall be as required by the Engineer, in coordination with the property owner.

New brick work shall closely match the size, type and color of the existing adjacent brick walk. Relaid walks shall use the existing brick that has been removed. Should some of the existing brick become damaged or unusable to be relaid, the Contractor shall replace them with brick work of similar size, type and color. The Contractor shall provide a sample of new brick work to be supplied for approval by the Engineer prior to installation. New and reset brick work shall be installed in a pattern consistent with the existing adjacent walk (i.e. running bond, basket weave, stringer course, etc.). Steel edging shall be installed along new or relaid brick work, unless otherwise required by the Engineer.

Subsequent to excavation of the area to the approximate subgrade elevation, the subgrade shall be fine graded and compacted, and an 8-inch compacted lift of gravel borrow (Type d) shall be placed as the subbase. A 1.5-inch deep setting bed of sand borrow, meeting ASTM C33, shall then be placed. Brick work shall be placed with hand tight joints (max.  $\frac{3}{4}$ -inch gap). In conjunction with setting bricks, 1.5-inch steel edging shall be installed and secured with 10-inch spikes. Subsequent to setting bricks, the walk shall be back-sanded with polymeric sand and watered-in according to manufacturer instructions.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Brick Walk and Brick Walk Removed and Relaid will be measured and paid for at the Contract unit price per square yard installed, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work.

Sand borrow shall be considered incidental to Item 706. Gravel will be paid for separately under Gravel Borrow, Item 151.

No separate payment will be made for grading and compacting of the gravel base and sand setting bed, for steel edging, polymeric sand joint treatment, or replacement of damaged brick or cobblestone, but all costs in connection therewith shall be included in the Contract unit price bid for the respective item.

**ITEM 706.41**  
**ITEM 706.42**  
**ITEM 706.43**

**GRANITE STEPS LOCATION NO. 1**  
**GRANITE STEPS LOCATION NO. 2**  
**GRANITE STEPS LOCATION NO. 3**

**LUMP SUM**  
**LUMP SUM**  
**LUMP SUM**

The work under these Items shall conform to the relevant provisions of Subsection 685 of the Standard Specifications and the following:

The work shall include the construction of granite steps as shown on the plans.

Location No. 1 - 10 Boston Road

Location No. 2 - 24 Boston Road

Location No. 3 - 32 Boston Road

The granite steps shall conform to the requirements for Granite Curb Type VA4, M9.04.1. Construct all steps shown on the construction plans and details. All steps shall have positive cross pitch of 1.5% ( $\pm 0.5\%$  construction tolerance) for drainage.

**BASIS OF PAYMENT**

Granite Steps Location No. 1, Granite Steps Location No. 2, and Granite Steps Location No. 3 will be paid for at the respective Contract unit prices Lump Sum, which price shall full compensation for all labor, tools, equipment, materials, and all incidental costs required to complete the work.

Gravel Borrow used as a backfill for the granite steps shall be considered incidental to this item within the limits of the granite stairs.

**ITEM 706.45**

**GRANITE STEPS REMOVED AND STACKED**

**LUMP SUM**

The work under this item shall conform to the relevant provisions of Subsections 120 and 150 of the Standard Specifications and the following:

The work includes carefully removing and stacking granite steps adjacent to 11 Boston Road to a location on the adjacent property, as required by the Engineer, in coordination with the property owner.

The Contractor shall exercise care and make every effort to protect the granite steps to keep them intact during removal and transport.

Any damage caused by the Contractor's operations to private property during the removing and stacking process shall be repaired or replaced by the Contractor at no additional cost to the satisfaction of the Engineer.

The Contractor shall backfill with compacted gravel or suitable existing material all holes resulting from the removal of the granite.

**BASIS OF PAYMENT**

Granite Steps Removed and Stacked will be paid for at the Contract unit price per lump sum, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

No separate payment will be made for excavation, backfill, or transportation but all costs in connection therewith shall be included in the Contract unit price bid.

**ITEM 706.61**      **GRANITE THRESHOLD REMOVED AND RESET**      **LUMP SUM**

The work under this item shall conform to the relevant provisions of Subsections 120 and 150 of the Standard Specifications and the following:

The work includes carefully removing and resetting a granite threshold adjacent to 10 Boston Road to a location on the adjacent property, as required by the Engineer, in coordination with the property owner.

The Contractor shall exercise care and make every effort to protect the granite threshold to keep them intact during removal, transport and resetting.

The Contractor shall reset the granite threshold at the top of the constructed granite stairs with no more than a 1/8 inch difference in height between the threshold and the granite stairs.

The Contractor shall backfill with compacted gravel or suitable existing material all holes resulting from the removal of the granite.

**BASIS OF PAYMENT**

Granite Threshold Removed and Reset will be paid for at the Contract unit price per lump sum, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

No separate payment will be made for excavation, backfill, or transportation but all costs in connection therewith shall be included in the Contract unit price bid.

Gravel Borrow used as a backfill for the Granite Threshold shall be considered incidental to this item within the limits of the threshold.

**ITEM 706.7**

**COBBLESTONE PAVERS**

**SQUARE YARD**

The work under this item shall conform to the relevant provisions of Subsection 701 of the Standard Specifications and the following:

The work under this item shall include the installation of flush cobblestone median islands at the locations shown on the plans and as directed by the Engineer.

The Contractor shall submit a sample to the Engineer for approval prior to any work being done related to the cobblestone medians.

**CONSTRUCTION METHODS**

Cobblestones shall be placed on a 1 1/2" leveling bed of stone dust, over 4" superpave intermediate course (SIC-19.0) over gravel borrow (min. 8" depth) to replace unsuitable material with hand tight joints (max. 3/4" gap). Joints between cobblestones shall be filled with cement mortar a minimum of 1" wide until joints are completely filled.

Flush granite curb and curb corners shall be set in 6" of cement concrete surrounding curb.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Cobblestone Pavers will be measured and paid for at the Contract unit price per square yard, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work as described.

Gravel borrow base, cement mortar, stone dust, hot mix asphalt pavement, cement concrete and sawcutting shall be considered incidental to the item.

Granite curbing and curb corners shall be paid for separately under Item 506. Granite Curb Type VB-Straight and Item 516. Granite Curb Corner Type A, respectively.



**ITEM 706.71**      **COBBLESTONE EDGING REMOVED AND RESET**      **FOOT**

The work under this item shall conform to the relevant provisions of Subsections 580 and 690 of the Standard Specifications and the following:

The work shall include removing and resetting the existing cobblestones around the existing landscaped area adjacent to 22 Boston Road. The Contractor shall coordinate the removal and resetting of the cobblestones with the Engineer and the adjacent property owner.

The Contractor shall replace any existing cobblestones that are to be reset, which is lost or damaged as a result of their operations at no additional compensation.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Cobblestones Removed and Reset will be measured and paid for at the Contract unit price bid per foot, measured along the front face of the edging, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work as described.

No separate payment will be made for excavation, and backfill, but all costs in connection therewith shall be included in the unit price bid.

**ITEM 706.72      COBBLESTONE WALK REMOVED AND RESET    SQUARE YARD**

The work under this item shall conform to the relevant provisions of Subsections 580 and 690 of the Standard Specifications and the following:

The work shall include removing and resetting the existing cobblestones walkway adjacent to 14 Boston Road. The Contractor shall coordinate the removal and resetting of the cobblestones with the Engineer and the adjacent property owner.

The Contractor shall replace any existing cobblestones that are to be reset, which is lost or damaged as a result of their operations at no additional compensation.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Cobblestone Walk Removed and Reset will be measured and paid for at the Contract unit price per square yard, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work as described.

Gravel borrow base, cement mortar, stone dust, and hot mix asphalt pavement shall be considered incidental to the item.

**ITEM 706.73**            **COBBLESTONES REMOVED AND STACKED**            **SQUARE YARD**

The work under this item shall conform to the relevant provisions of Subsections 580 and 690 of the Standard Specifications and the following:

The work shall include removing and stacking the existing cobblestones located adjacent to the existing mailbox at 44 Boston Road. The Contractor shall coordinate the removal of the cobblestones with the Engineer and abutting property owner. The Contractor shall stack the cobblestones on the owner's property at a location determined by the property owner, as approved by the Engineer.

The Contractor shall exercise care and make every effort to protect the cobblestones during removal and transport.

Any damage caused by the Contractor's operations to private property during the removing and stacking process shall be repaired or replaced by the Contractor at no additional cost to the satisfaction of the Engineer.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Cobblestones Removed and Stacked will be measured and paid for at the Contract unit price per square yard, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work as described.

Cobblestones which the abutting property owner refuses shall be disposed of by the Contractor at no additional compensation.

**ITEM 712.**

**BOUND REMOVED AND STACKED**

**EACH**

The work under this item shall conform to the relevant provisions of Subsection 710 of the Standard Specifications and the following:

The work shall include the careful removal of existing stone bounds and delivery to the MassDOT Maintenance Depot at 80 Boston Road in Westford.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Bound Removed and Stacked will be measured and paid for at the contract unit price per Each, which prices shall include all labor, materials, transportation, equipment, and incidental costs required to complete the work.

**ITEM 740. ENGINEERS FIELD OFFICE AND EQUIPMENT (TYPE A) MONTH**

The work under this Item shall conform to the relevant provisions of Subsection 740 of the Standard Specifications and the following:

Three computer systems and printer system meeting minimum requirements set forth below including installation, maintenance, power, paper, disks, and other supplies shall be provided at the Resident Engineer's Office:

All equipment shall be UL approved and Energy Star compliant.

The Computer System shall meet the following minimum criteria or better:

Processor:	Intel, 3.5 GHz
System Memory (RAM):	12 GB
Hard Drive:	500 GB
Optical Drive:	DVD-RW/DVD+RW/CD-RW/CD+RW
Graphics Card:	8 GB
Network Adapter:	10/100 Mbit/s
USB Ports:	6 USB 3.0 ports
Keyboard:	Generic
Mouse:	Optical mouse with scroll, MS-Mouse compliant
Video/Audio	the computer system shall be capable of allow video calling and recording:
Video camera	shall be High Definition 1080p widescreen capable video calling and recording with built in microphone. The microphone system shall capture natural audio while filtering out background noise.
Audio	shall be stereo multimedia speaker system delivering premium sound.
OS:	Latest Windows Professional with all security updates
Web Browser:	Latest Internet Explorer with all security updates
Applications:	Latest MS Office Professional with all security updates Latest Adobe Acrobat Professional with all security updates Latest Autodesk AutoCAD LT Antivirus software with all current security updates maintained through the life of the contract.
Monitors:	Two 27" LED with Full HD resolution. Max. resolution 1920 x 1080
Flash drives:	2 (two) - 128GB USB 3.0
Internet access:	High Speed (min. 24 mbps) internet access with wireless router.

**ITEM 740.** (Continued)

The Multifunction Printer System shall meet the following minimum criteria or better:

Color laser printer, fax, scanner, email and copier all in one with the following minimum capabilities:

- Estimated volume 8,000 pages per month
- LCD touch panel display
- 50 page reversing automatic document feeder
- Reduction/enlargement capability
- Ability to copy and print 11" x 17" paper size
- email and network pc connectivity
- Microsoft and Apple compatibility
- ability to overwrite latent images on hard drive
- 600 x 600 dpi capability
- 30 pages per minute print speed (color),
- 4 Paper Trays Standard (RADF) (not including the bypass tray)
- Automatic duplexing
- Finisher with staple functions
- Standard Ethernet. Print Controller
- Scan documents to PDF, PC and USB
- ability to print with authenticated access protection

The Contractor shall supply a maintenance contract for next day service, and all supplies (toner, staples, paper) necessary to meet estimated monthly usage.

The Engineer's Field Office and the equipment included herein including the computer system, and printer shall remain the property of the Contractor at the completion of the project. Disks, flash drives, and card readers with cards shall become the property of the Department.

Compensation for this work will be made at the contract unit price per month which price includes full compensation for all services and equipment, and incidentals necessary to provide equipment, maintenance, insurance as specified and as directed by the Engineer.

**ITEM 751.765      COMPOST AND SEED OVER MODIFIED ROCK      CUBIC YARD**

The work under this Item shall conform to the relevant provisions of Subsection 751, 767, and 765 of the Standard Specifications and the following.

Work shall consist of furnishing and pneumatically applying compost in conjunction with the specified native seed on designated areas of modified rock and achieving satisfactory establishment of seeded species as specified herein.

**QUALIFICATIONS**

Compost application and seeding shall be done by a company having a minimum of five years of experience with native seed establishment. Prior to beginning work, the seeding Contractor shall furnish proof of qualifications to the Engineer for approval. Proof of qualifications shall include providing documentation (photos and contacts) to demonstrate knowledge and expertise with native seeding and establishment and proof of having completed successful native seeding projects.

**MATERIAL AND SUBMITTALS**

Compost

Compost shall meet the relevant provisions for Type 2 Compost, found in Section M1.06 of the Supplemental Standard Specifications.

The Engineer shall approve the Contractor's equipment for application.

Seed Mix

Seed Mixes and Submittals shall be per the item(s) for the permanent seed mix. Mix shall be:

Item 765.415 – Native Short Grassland Mix

**SEEDING SEASON**

The season for seeding native mixes is April 1 - May 15 and October 1 - December 1 for dormant seeding. Written approval must be obtained for seeding outside the seeding season and, if approved, the permanent seed rate shall be increased by 50%

**CONSTRUCTION METHODS**

Method of application and equipment to be used shall be reviewed and approved by the Engineer prior to placement of material.

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**ITEM 751.765** (Continued)**Placement of Compost**

Compost shall be placed as shown on the Plans and in the Detail and as required by the Engineer. Material shall be placed so that settled material is at or slightly below the surface plane of the stone. The Contractor shall ensure that there will be adequate quantity, including adjustment for settlement.

For purposes of estimation, required compost quantities should be 300 cubic yards per acre to achieve the target depth.

**Seeding**

For areas smaller than half an acre, unless otherwise approved by the Engineer, seeding shall be done by broadcast method. Seeding shall be done in conjunction with or immediately following Compost application. Alternative seeding methods must be submitted and approved by the Engineer 14 days in advance of compost and seed application.

**Hydroseeding**

Hydroseeding may be used for sites over half an acre in size or when the rock slope does not permit safe application via a broadcasting method. Hydroseed shall be per the manufacturer's directions and as follows.

Tank and hoses shall be cleaned from all previous hydroseeding and hydromulching projects. Seed shall be mixed into the slurry immediately before application and slurry applied within 30 minutes after seeds have been placed in the tank. Once seed has been placed in the tank, tank shall be agitated only enough to mix the seeds and keep slurry from separating.

**When Seeding Occurs after Application of Compost or after December 1**

When seeding is done more than 3 days after Compost application or when Compost is applied after December 1, seeding rate shall be increased by 50%.

**Over-Seeding**

Large extents of bare area (greater than 5-6 feet and depending on modified rock slope conditions) shall be over-seeded with the specified mix during the appropriate season for seeding. Rates, methods, and submittals shall be as specified under the relevant Seed Mix Item and Materials above.

Over-seeding, mulch, watering, and all work for over-seeding shall be incidental.



**ITEM 751.765** (Continued)**Determining Satisfactory Establishment**

A reasonably well-established stand of the specified seeded species as determined by the Engineer and the MassDOT Landscape Architect or designated Specialist will be required for Final Acceptance. The expectation is that an acceptable number and variety of the desired permanent seeded species will be visible. For seeding with compost over modified rock this shall generally be:

- A minimum of 50% coverage by the specified permanent seeded species after one growing season (considered June-September 15). Of that percentage, generally, depending on the mix species:
  - At least 2 types of permanent seeded grass species shall be visible.
  - At least 2 species of wildflowers shall be visible.
- There will be no more than 25% coverage by weed species.
- There will be no invasive or aggressive species within the stand at the time of acceptance.
- There shall be no evidence of seed from non-native mixes (ex., clover) due to using an incorrect or modified mix or due to failure to clean the hydroseeding tank if a hydroseeder is used.

Invasive and aggressive weeds (such as mugwort, vetch, knapweed, and chicory) must be cut, pulled with roots removed, or treated with herbicide by a licensed and approved applicator prior to going to seed for Interim Acceptance. Weed removal shall be coordinated with MassDOT Landscape Architect. No herbicides shall be used without approval and coordination with MassDOT Landscape Design Section.

**Acceptance of Seeding and Establishment Work**

**Conditional Acceptance** shall be based on approval of seed mix submittals and proper application of seed as specified herein.

**Final Acceptance of Seed Establishment** shall be given upon satisfactory Establishment as described above. If the seeded area fails to meet the requirements of Establishment by the end of the growing season, contractor shall propose and implement remediations and site shall be inspected during the following growing season after July 1st. Otherwise, Contractor shall forego the payment for Final Acceptance. All remediation shall be at the contractor's expense.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Compost and Seed for Modified Rock will be measured and paid for at the Contract unit price per Cubic Yard which price shall include all labor, materials, equipment, site preparation, and all incidental costs required to complete the work.

Schedule of payment shall be as follows:

- 60% upon approval of Compost application and Conditional Acceptance of seeding as specified above
- 40% upon Final Acceptance of Seed Establishment

Native Seed Mix will be compensated at the bid price per the specified seed mix item by pound.

**ITEM 756. NPDES STORM WATER POLLUTION PREVENTION PLAN LUMP SUM**

This Item addresses the preparation and implementation of a Storm Water Pollution Prevention Plan required by the National Pollutant Discharge Elimination System (NPDES) and applicable Construction General Permit (CGP) issued by the U.S. Environmental Protection Agency (EPA).

Pursuant to the Federal Clean Water Act, construction activities which disturb one acre or more are required to apply to the EPA for coverage under the NPDES General Permit for Storm Water Discharges from Construction Activities. The Contractor shall be fully responsible for compliance with the most recently issued CGP and any subsequent revisions. Should a fine or penalty be assessed against it, or MassDOT, as a result of a local, state, or federal enforcement action due to non-compliance with the CGP, the Contractor shall take full responsibility.

The NPDES CGP requires the submission of a Notice of Intent (NOI) to the EPA prior to the start of construction (defined as any activity which disturbs land, including clearing and grubbing). There is a fourteen (14) day review period commencing from the date on which EPA enters the Notice into their database. Based on the review of the NOI, EPA may require additional information, including but not limited to, the submission of the Storm Water Pollution Prevention Plan (SWPPP) for review. Work may not commence on the project until final authorization has been granted by EPA. Any additional time required by EPA for review of submittals will not constitute a basis for claim of delay.

In addition, if the project discharges to an Outstanding Resource Water, vernal pool, or is within a coastal ACEC as identified by the Massachusetts Department of Environmental Protection (DEP), a separate notification to DEP is required. DEP may also require submission of the Storm Water Pollution Prevention Plan for review and approval. Filing fees associated with the notification to DEP and, if required, the SWPPP filing to DEP shall be paid by the Contractor.

The CGP also requires the preparation and implementation of a SWPPP in accordance with the afore-mentioned statutes and regulations. The Plan will include the CGP conditions and detailed descriptions of controls of erosion and sedimentation to be implemented during construction. The contractor shall prepare the SWPPP and update it as necessary. The Contractor shall submit the Plan to the Engineer for approval at least four (4) weeks prior to any site activities. It is the responsibility of the Contractor to comply with the CGP conditions and the conditions of any state Wetlands Protection Act Order, Water Quality Certification, Corps of Engineers Section 404 Permit and other environmental permits applicable to the project and to include in the SWPPP the methods and means necessary to comply with applicable conditions of said permits.

It is the responsibility of the Contractor to complete the SWPPP in accordance with the EPA CGP, provide all information required, and obtain any and all certifications as required by the CGP. Any amendments to the SWPPP required by site conditions, schedule changes, revised work, regulations, construction methodologies, and the like are the responsibility of the Contractor. Amendments will require the approval of the Engineer prior to implementation.

**ITEM 756. (Continued)**

In addition to the CGP requirements for inspections, MassDOT requires inspection of all erosion controls and site conditions on a weekly basis. Inspections are also required at portions of sites that discharge to sediment or nutrient impaired or high quality waters per the CGP when each incidence of rainfall exceeding 0.25 inches in twenty-four hours or after snowmelt discharge from a storm event that produces 3.25 inches or more of snow within twenty-four hours occurs. The CGP requires that inspections be performed by a qualified individual as outlined in the CGP. MassDOT requires proof of completion of a 4 hour minimum sedimentation and erosion control training class current to the latest CGP. This individual can be, but not limited to, someone that is either a certified inspector, certified professional, or certified storm water inspector. The documentation shall be included as an appendix in the SWPPP. The inspector's qualifications shall be submitted to the Engineer for approval prior to beginning any work. This individual shall be on-site during construction to perform these inspections. In addition, if the Engineer determines at any time that the inspector's performance is inadequate, the Contractor shall provide an alternate inspector. Written weekly inspection forms, storm event inspection forms, and Monthly Summary Reports must be completed and provided to the Engineer. Monthly Summary Reports must include a summary of construction activities undertaken during the reporting period, general site conditions, erosion control maintenance and corrective actions taken, the anticipated schedule of construction activities for the next reporting period, any SWPPP amendments, and representative photographs.

The Contractor is responsible for preparation of the Plan, all SWPPP certifications, inspections, reports and any and all corrective actions necessary to comply with the provisions of the CGP. The Standard Specifications require adequate erosion control for the duration of the Contract. All control measures must be properly selected, installed, and maintained in accordance with manufacturer specifications and good engineering practices. If periodic inspections or other information indicates a control has been used inappropriately or is no longer adequate, it is the responsibility of the Contractor to replace or modify the control for site conditions at no additional cost to the Department. Contractor must maintain all control measures and other protective measures in effective operating conditions and shall consider replacement of erosion controls for each construction season.

This Item addresses acceptable completion of the SWPPP, any revisions/amendments required during construction, and preparation of monthly reports. In addition, any erosion controls beyond those specified in bid items which are selected by the Contractor to facilitate and/or address the Contractor's schedule, methods and prosecution of the work shall be considered incidental to this item.

The CGP provides specific requirements for temporary and final stabilization. This shall be incorporated into the project schedule. The permit defines specific deadline requirements for Initial Stabilization ("immediately", i.e., no later than the end of the next work day following the day when earth-disturbing activities have temporarily or permanently ceased) and for Complete Stabilization Activities (no later than 14 calendar days after the initiation of stabilization). Stabilization criteria for vegetative and non-vegetative measures are provided in the CGP.

**ITEM 756. (Continued)**

The CGP requires the submission of a Notice of Termination (NOT) from all operators when final stabilization has been achieved, as well as removal and proper disposal of all construction materials, waste and waste handling devices, removal of all equipment and construction vehicles, removal of all temporary stormwater controls, etc. Approval of final stabilization by the Engineer and confirmation of submission of the NOT will be required prior to submission of the Resident Engineer's Final Estimate. The permittee shall use EPA's website to prepare and submit the NOT.

**Compensation**

Payment for all work under this Item shall be made at the contract unit price, lump sum, which shall include all work detailed above, including Plan preparation, required revisions, revisions/addenda during construction, monthly reports and filing fees.

Payment of fifty (50) % of the contract price shall be made upon acceptance of the NPDES Stormwater Pollution Prevention plan. Payment of forty (40) % of the contract price shall be made in equal installments over the expected duration of stormwater pollution prevention measures. Payment of the final ten (10) % of the contract price shall be paid upon satisfactory submission of a Notice of termination (NOT) when final stabilization has been achieved.

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**ITEM 765.21      ANNUAL COVER CROP FOR NATIVE SEEDING      POUND**

Work under this item shall be in according with Subsection 765 of the Standard Specifications and the following.

**DESCRIPTION**

Work consists of furnishing and applying the appropriate annual grass to be seeded as a cover crop in conjunction with upland native seeding and at the rate specified herein.

A cover crop shall be used for following conditions:

- when specified under Application Rate for the permanent native upland seed mix
- for slopes 2:1 or steeper and an annual is not already specified as part of the permanent mix
- when seeding out of season and the native seed mix does not already specify an annual
- as required to prevent erosion until the permanent seed establishes.

A cover crop is not necessary for wetland seeding and is not typically necessary for soil stabilization when seeding in conjunction with a compost blanket application.

Annual rye (*Lolium multiflorum*) will not be accepted as an annual cover crop.

Using annual rye or exceeding the application rate such that a dense stand of annual grasses prevents germination of the native grasses will require mowing of annual grasses. In this instance, mowing of cover crop will be incidental to this item.

**Seed and Application Rate**

Add 30 pounds/acre of the following seed based on seeding season:

Avena sativa (Grain Oats):    1 January to 31 July  
Cecale cereale (Grain Rye):    1 August to 31 December

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Annual Cover Crop will be measured for payment per pound of seed per pound of seed, complete in place.

Annual Cover Crop will be paid at the contract unit price per pound upon approval of seed bag tags or other documentation of correct application rate and species, and upon acceptance of a satisfactory stand of annual grasses three weeks following seeding.

Application and care of cover crop will be paid for separately under Item 765.635 Native Seeding and Establishment.

**ITEM 765.415**  
**ITEM 765.553****NATIVE SHORT GRASSLAND MIX**  
**WETLAND – RIPARIAN MIX****POUND**  
**POUND**

Work under these items shall consist of furnishing the mix(es) specified below in the required quantity.

**SUBMITTALS**

- 1) Pre-Verification of Seed Availability. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer the supplier's verification of availability of seed species in the required quantities and for the anticipated date of seeding. Verification shall be on the supplier's letterhead and notarized by the supplier's notary. Species not expected to be available should be noted and substitutions recommended.
- 2) Final Verification of Seed Availability. No earlier than 21 days prior to ordering, the Contractor shall submit to the Engineer the supplier's verification of availability of seed species and in the required quantities. Verification shall be on the supplier's letterhead and notarized by the supplier's notary. A copy of this submittal shall be forwarded to the MassDOT Landscape Design Section. Substitutions or changes in the mix at this time must be approved by MassDOT Landscape Design Section.
- 3) Seed Worksheet provided herein shall be submitted to the Engineer prior to ordering seed to determine the number of pounds of Pure Live Seed required.
- 4) Seed Tags. The contractor shall submit original seed tags from each bag of seed used on the project or ensure that each tag is photo documented by the Engineer while on the unopened bag.

Number of tags submitted must correspond to number of bags delivered.

Species listed on the seed tag shall match the Final Verification of Seed Availability (Submittal #2) unless approved otherwise. Tag must include: variety and species name; lot number; purity; percentage of inert matter; percentage of weeds, noxious seeds, and other crop seeds; germination, dormant or hard seed; total viability; origin of seed; germination test date, net weight, and name and address of seller. The origin of seed must be listed on the seed tag for all species in the mix to provide verification of original (generation 0) seed source. The smallest known geographic area (township, county, ecotype region, etc.) shall be listed. Ecotypes and cultivars shall be as close to Massachusetts as possible and appropriate to the site conditions.

A copy of this submittal shall be forwarded to the MassDOT Landscape Design Section.

**ITEMS 765.415 and 765.553** (Continued)

- 5) Verification of Seed Delivery. Prior to payment, contractor shall submit the Seed Delivery Verification form contained within the contract or the Supplier's Verification on company letterhead or a bill of lading. Supplier verification must include all information requested on the Verification form within this contract. The bill of lading must include variety and species name, lot number, net weight shipped, date of sale, invoice, project or seeding location, and name and address of Supplier. All information must be filled in and complete for acceptance. Information must match the seed tags and quantity of seed used on the job. A copy of this submittal shall be forwarded to the MassDOT Landscape Design Section.
- 6) Seed Sample. If requested or if seed is from a previously opened bag, the contractor may be asked to submit to the Engineer a sample of seed from the seed bag (1-2 cups) at the time of seeding.

**SEEDING SEASON**

The appropriate seeding seasons are:

Spring: April 1 - May 15

Fall: October 1 - December 1 for dormant seeding

**PERMANENT SEED MIXES****Calculating Pure Live Seed (PLS)**

Quantities specified are PURE LIVE SEED. Greater quantities of ordered seed may be required to achieve actual specified seeding rates.

Pure Live Seed (PLS) is defined as a percentage calculated by multiplying the percent of pure seed by the percent of viable seed (total germination, hard seed, and dormant seed). For example:

If a seed label indicates 90% purity, 78% germination, 10% hard seed, and 2% dormancy, it is calculated to be  $90\% \times [78 + 10 + 2]\% = 81\%$  PLS.

Therefore, each pound of PLS would need  $1 \text{ pound} / 0.81 = 1.2$  pounds of seed with a 90% purity and 90% total germination

**Seed Mix(es)** shall be as specified below. Ecotypes and cultivars shall be as close to Massachusetts as possible and appropriate to the site conditions.

**ITEMS 765.415 and 765.553** (Continued)**765.415 Native Short Grassland Mix**

	<u>Botanical Name</u>	<u>Common Name</u>	<u>% PLS by Weight</u>
Grass	Schizachyrium scoparium	Little Bluestem	56.10%
	Elymus virginicus	Virginia Wild Rye	28.00%
	Dichanthelium clandestinum 'Tioga'	Deertongue grass 'Tioga'	8.00%
	Eragrostis spectabilis 'RI Ecotype'	Purple Lovegrass 'RI Ecotype'	2.00%
	Agrostis perennans	Upland Bentgrass	1.50%
	Juncus tenuis	Path Rush	<u>0.10%</u>
			95.70%
Herb/For b	Chamaecrista fasciculata	Partridge Pea	3.00%
	Solidago nemoralis	Grey Goldenrod	0.30%
	Penstemon digitalis	Beard-tongue	0.30%
	Achillea millefolium	Common Yarrow	0.10%
	Oenothera fruticosa var. fruticosa	Sundrops	0.10%
	Pycnanthemum tenuifolium	Slender Mountain Mint	0.10%
	Aster pilosus	Heath Aster	0.10%
	Aster laevis NY Ecotype	Smooth Aster NY Ecotype	0.10%
	Solidago bicolor	White Goldenrod	0.10%
	Aster lateriflorus	Calico Aster	<u>0.10%</u>
			4.30%
			100.00%



**ITEMS 765.415 and 765.553** (Continued)**765.553 Wetland – Riparian Mix**

	<u>Botanical Name</u>	<u>Common Name</u>	<u>% PLS by Weight</u>
Grass	Sorghastrum nutans	NY Eco Indiangrass	
		NY Ecotype	14.00%
	Schizachyrium scoparium	Little Blue Stem	14.00%
	Elymus riparius	Riverbank Wild Rye	10.00%
	Elymus virginicus	Virginia Wild Rye	10.00%
	Panicum clandestinum	'Tioga' Deer Tongue 'Tioga'	9.00%
	Andropogon gerardii NY Eco	Big Bluestem NY Eco	8.00%
	Carex vulpinoidea	Fox Sedge	7.00%
	Panicum virgatum	Switchgrass	3.00%
	Juncus effusus	Soft Rush	2.00%
	Agrostis perennans	Upland Bentgrass	2.00%
	Scirpus atrovirens	Green Bulrush	<u>1.00%</u>
			80.00%
Herb/Forb	Chamaecrista fasciculata	Partridge Pea	3.00%
	Verbena hastata	Blue Vervain	3.00%
	Asclepias incarnata	Swamp Milkweed	3.00%
	Heliopsis helianthoides	Ox-Eye Sunflower	2.00%
	Eupatorium perfoliatum	Boneset	2.00%
	Aster umbellatus	Flat Topped White Aster	1.00%
	Aster prenanthoides	Zig Zag Aster	1.00%
	Aster puniceus	Aster – Swamp	1.00%
	Aster novae-angliae	New England Aster	1.00%
	Eupatorium maculatum	Joe-pye Weed	1.00%
	Monarda fistulosa	Wild Bergamot	1.00%
	Vernonia noveboracensis	New York Ironweed	<u>1.00%</u>
			<u>20.00%</u>
			100.00%

**Application Rate****Mix 765.415:** 15 lbs/acre PLS.**Mix 765.553:** 20 lbs/acre PLS.

In addition, apply 30 pounds of cover crop (grain oats or grain rye) as appropriate to the season.

Any species substitutions shall be with a species having similar characteristics and function. Substitutions must be approved by MassDOT Landscape Design Section per the documentation submittal process.

**ITEMS 765.415 and 765.553** (Continued)

**50% Increase Adjustment for Field Conditions**

Seeding under the following conditions requires a 50% increase in the permanent mix at the time of construction:

- Seeding out of season  
OR
- Seeding after Compost Blanket has been applied (unless already increased for out of season).

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Native Short Grassland Mix and Wetland – Riparian Mix will be measured for payment by the pound of Pure Live Seed delivered and complete in place.

Native Short Grassland Mix and Wetland – Riparian Mix will be paid at the contract unit price per pound of Pure Live Seed delivered upon approval of all Seed Submittal Documentation. Overseeding required to correct poor germination or establishment shall be incidental to the item.

Cover crop not included as part of the permanent mix composition will be paid for under Item 765.21, Annual Cover Crop.

Application and care of native seed mix will be paid for separately under Item 765.635 Native Seeding and Establishment.

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**ITEM 765.635            NATIVE SEEDING AND ESTABLISHMENT            SQUARE YARD**

Work shall conform to the relevant provisions of Subsections 765 and 767 of the Standard Specifications and the following:

The work under this item shall consist of seeding, mowing, and other care to establish a stand of grass in the areas shown on the plans or as required by the Engineer. For the purposes of these specifications, the term “grass” shall apply to all the forbs, grasses, sedges, and rushes included in the materials.

**QUALIFICATIONS**

Seeding shall be done by a company having a minimum of five years of experience with native seed establishment. Prior to beginning work, the seeding Contractor shall furnish proof of qualifications to the Engineer for approval. Proof of qualifications shall include providing documentation (photos and contacts) to demonstrate knowledge and expertise with native seeding and establishment and proof of having completed successful native seeding projects.

**SEEDING SEASON**

Seeding seasons for native mixes is April 1 - May 15 and October 1 - December 1 for dormant seeding. Written approval must be obtained for seeding outside the seeding season and, if approved, the permanent seed rate shall be increased by 50%.

Seeding season for cover crops shall be grain oats January 1 – July 31 and grain rye August 1 – December 1.

**MATERIAL AND SUBMITTALS**

**Seed Mixes and Submittals** shall be per the item(s) for permanent and annual (cover crop) seed mixes.

**Compost Blanket**, if used, shall meet the material and submittal requirements for that item.

**Hydromulch** shall be wood fiber or straw applied per the Standard Specifications and at the rates specified below and per the manufacturer.

A certified statement shall be furnished, prior to start of work, to the Engineer by the Contractor as to the number of pounds of hydromulch, tackifier, and seed, per 100 gallons of water and as applicable to products used. This statement should also specify the number of square yards of seeding that can be covered with the solution specified above.

**Fertilizer**

No fertilizers shall be applied.

**ITEM 765.635** (Continued)**Water**

Water, including hose and all other watering equipment required for the work, shall be furnished by the Contractor to the site at no additional cost. Water shall be suitable for irrigation and free from ingredients harmful to plant life. All plants injured or work damaged due to the lack of water or the use of too much water shall be the Contractor's responsibility to correct.

**SEEDING**

Hand broadcast method shall be used for all areas smaller than half an acre and when specified on the plans for areas over half an acre.

Seeding shall occur within 72 hours of placement of loam and final grading or the Contractor shall propose a reasonable, alternative schedule that shall be approved by the Engineer.

**Surface Preparation**

No seeding or soil preparation shall be done if soils are muddy or dry and compacted. Bare soils shall be raked to remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Ruts and depressions shall be filled with additional loam or compost and the soil shall be re-graded to a relatively smooth finish corresponding to the required grades.

When seeding over existing or compacted soil or soil that has sat bare for more than 30 days, surface will be prepared by tilling or raking to a minimum depth of 2 inches prior to seeding and prior to Compost Blanket application (when applied).

Surface preparation shall be compensated for under for loam placement or topsoil rehandled and spread as appropriate to the project.

Jute or coir mesh, when specified in the contract, shall be placed after seeding and per the Standard Specifications and the manufacturer's instruction.

Surface preparation shall be approved by the Engineer prior to seeding.

**Seeding over Various Substrates**

**Loam:** Seeding shall occur within 72 hours of loam placement to prevent loss of topsoil. Seed shall be manually broadcast for areas less than half an acre (each area, not cumulative area) and when specified on the plans. Broadcasting shall be immediately followed by hydromulching as specified below. When not specified on the plans, larger areas may be hydroseeded as specified below.

**Compost Blanket:** Compost Blanket shall be applied as specified under that item. Seed should be hand broadcast at the same time as compost application to ensure a thin cover of compost over seed.

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**ITEM 765.635** (Continued)

When seeding is done after application of Compost Blanket the rate shall be increased by 50%. If the Compost Blanket is applied after December 1, seed shall be broadcast or hydroseeding over the compost in the Spring and the rate increased by 50% specified under Seed Application.

Compost Mulch over Modified Rock: Compost Mulch and seed shall be applied as specified under that item. No hydromulch is required.

**Cover Crop**

Cover crop shall be used when seeding out of season, when specified with the permanent native seed mix under that item, and as required to prevent erosion until the permanent seed establishes.

A cover crop should not be used with a steep slope mix or other permanent mix which already contains either cereal rye or oats in the composition of the mix. A cover crop is not necessary for wetland seeding and is not typically necessary for soil stabilization when seeding in conjunction with a compost blanket application.

**Seed Application**

All seed shall be mulched as specified herein.

Seed application shall be by broadcast seeding or by hydroseeding as described below.

**Broadcast Seeding**

Seed shall be broadcast spread using a cyclone or whirlwind seeder or hand broadcast. Small or light-seeded species such as bluestem may be mixed with approved filler to achieve an even distribution. Seed shall not be broadcast when wind velocities are greater than 15 mph.

Broadcast seeding shall be undertaken in two separate passes at ninety degrees to each other. One-half the seeding rate shall be applied in each direction (horizontally and vertically). To ensure seed to soil contact with broadcasting of seed, seeding shall be followed by rolling or tracking with equipment approved by the Engineer.

Broadcast seed shall be mulched with weed-free straw mulch unless seeding is done as part of Compost Blanket in which case it shall be as specified above under seeding with Compost Blanket application. Hydromulching shall be as specified under Hydromulching.

**Hydroseeding and Hydromulching**

Hydroseed and mulching shall be per the manufacturer's directions and as follows.

Hydroseeding shall only be used for sites over half an acre in size or with permission of the Engineer.

**ITEM 765.635** (Continued)

Tank and hoses shall be cleaned from all previous hydroseeding and hydromulching projects. Seed shall be mixed into the slurry immediately before application and slurry applied within 30 minutes after seeds have been placed in the tank. Once seed has been placed in the tank, tank shall be agitated only enough to mix the seeds and keep slurry from separating.

A 2-step process shall be used for seeding in conjunction with hydromulch. Seed shall be applied with 500 lbs/acre of hydromulch in the first pass. A second pass with 1,000 lbs/ acre of hydromulch shall be applied in a second pass. Each pass shall be applied in a different direction.

Once the seed has been added to the tank mixture a one-hour time limit is set for spreading the mixture on the soil. Once the one hour has passed the excess mixture must be discarded.

For broadcast seeding, hydromulch shall be applied immediately following seeding at a rate of 1,000 lbs/acre. Tank shall be cleaned from any previous hydroseeding.

**CARE DURING GERMINATION AND ESTABLISHMENT**

Contractor shall care for seeded areas as necessary for successful germination. Care will include watering and weed control as necessary to achieve establishment of the specified seeded species after one growing season as specified below.

The contractor shall maintain the stand of grasses to ensure healthy growth of the seeded species. Work shall include mowing or weed-whacking for weed control, watering if necessary, and removal of invasive plants.

Watering shall be sufficient to achieve soil moisture to a depth of 2 inches or more and such moisture is uniform. Method of watering shall not erode or damage soil or grassed surfaces.

General Weed Control: Weeds shall be mowed prior to weeds setting seed (by the end of July unless otherwise approved).

Control of Invasive and Aggressive Weeds: Invasive and aggressive weeds, including but not limited to mugwort, ragweed, knapweed, foxtail, crabgrass, and chicory must be cut or treated prior to going to seed. Herbicide treatment must be coordinated with MassDOT. Undesired species (such as chicory) introduced due to use of incorrect seed mix shall be removed at the Contractor's expense.

**MOWING FOR WEED CONTROL**

Mowing for weed control shall be completed after weeds have sprouted and show leaf and bud growth, but prior to setting seed, generally between July 7th and August 1st, unless directed otherwise by the MassDOT Landscape Architect and the Engineer.

Mowing height shall be as needed for weed control, generally to a height of 8 inches and not below 4 inches, unless directed otherwise. Mowing shall be with a brush hog mower or string trimmer other approved equipment. Conventional lawn mowers which cannot achieve the appropriate cut shall not be used.

**ITEM 765.635** (Continued)

Contractor shall give 48-hour notice prior to mowing work. Mowing shall only occur in dry sunny weather. Litter pickup should occur prior to mowing in all areas. If required, cut grass shall be raked and removed. Litter pickup and raking and removal of grass shall be incidental to the work.

Mowing equipment shall be approved by the Engineer prior to work.

**OVER-SEEDING**

Areas of bare ground greater than 2-3 feet in diameter shall be over-seeded with the specified mix during the appropriate season for seeding. Where required for overseeding mowing shall be as close to the soil as possible. Soil that is compacted shall be raked or otherwise roughened prior to over-seeding.

Over-seeding rates and methods shall those specified above under Materials and Methods. Following over-seeding, soil shall be lightly tamped to ensure seed to soil contact and areas shall be mulched with straw mulch and watered with a fine mist to moisten soil to a depth of at least 2 inches.

Over-seeding, mulch, watering, and all work for over-seeding shall be incidental.

**DETERMINING SATISFACTORY GRASS ESTABLISHMENT**

A well-established stand of the specified seeded species as determined by the Engineer and the MassDOT Landscape Architect will be required for Final Acceptance. The expectation is that an acceptable number and variety of the desired permanent seeded species (not the cover crop) will be visible. Generally:

- A minimum of 75% coverage by the specified permanent seeded species after one growing season. Of that percentage, generally, depending on the mix species:
  - At least 3 types of the permanent seeded grass species shall be visible.
  - At least 3 species of wildflowers shall be visible.
- There will be no significant gaps or bare soil (generally 2-3 feet in diameter or greater).
- There will be no more than 25% coverage by weed species.
- All soil shall be stabilized and there shall be no channeling or erosion.
- There will be no invasive or aggressive species within the stand at the time of acceptance.
- There shall be no evidence of seed from non-native mixes (i.e., clover) due to failure to clean the hydroseeding tank or using incorrect mix.

Invasive and aggressive weeds (such as mugwort, ragweed, knapweed, and chicory) must be cut or treated prior to going to seed for Interim Acceptance. Herbicide treatment must be coordinated with MassDOT.

A warm-season grass mix with perennials will not have uniform growth. A uniform stand of grass may indicate use of an incorrect mix.

**ITEM 765.635** (Continued)

**ACCEPTANCE OF SEEDING AND ESTABLISHMENT WORK**

Conditional Acceptance shall be based on proper application of seed as specified herein.

Interim Acceptance of Care. Seeding will be inspected by mid-July to assess germination and Establishment conditions as described above. When necessary for Interim Acceptance, areas shall be mowed prior to weed species producing seed and as specified above under Weed Control. Areas requiring weed control that are not mowed prior to weed seed dispersal will not be approved for Interim Acceptance. Seeding that shows good germination and is determined by the Engineer and

Landscape Architect to not require weed control at time of inspection shall be accepted for Interim Acceptance payment.

Final Acceptance of Establishment shall be given upon satisfactory Establishment as described above.

If the seeded area fails to meet the requirements of Establishment by the end of the growing season, contractor shall propose and implement remediations and site shall be inspected during the following growing season after July 1st. All remediation shall be at the contractor's expense.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Native Seeding and Establishment will be measured for payment by the square yard, complete in place.

Native Seeding and Establishment will be paid at the Contract unit price by the square yard upon Conditional, Interim, and Final Acceptances as described above. This price shall include all submittals, seeding, rolling to ensure seed-to-soil contact, weed control and mowing, water, over-seeding, labor, materials, equipment, and all incidental costs required to complete the work of establishing a satisfactory stand of grass.

Native seed and cover crop mixes shall be compensated under the respective items.

Site preparation, including raking, tilling, removal of debris and stones, and other work to the prepare site for seeding shall be compensated under loam placement or topsoil rehandled and spread as relevant to the project.

Mowing for weed control will be incidental to this item.

Schedule of payment shall be as follows:

30% upon Conditional Acceptance

20% upon Interim Acceptance of Care, except this amount will be reduced to zero and final payment will be reduced accordingly when areas requiring weed control are not mowed as specified in the Interim Acceptance criteria.

50% upon Final Acceptance of Establishment



**ITEM 767.121****SEDIMENT CONTROL BARRIER****FOOT**

The work under this item shall conform to the relevant provisions of Subsections 670, 751 and 767 of the Standard Specifications and shall include the furnishing and placement of a sediment control barrier. Sediment control barrier shall be installed prior to disturbing upslope soil.

The purpose of the sediment control barrier is to slow runoff velocity and filter suspended sediments from storm water flow. Sediment barrier may be used to contain stockpile sediments, to break slope length, and to slow or prevent upgradient water or water off road surfaces from flowing into a work zone. Contractor shall be responsible for ensuring that barriers fulfill the intent of adequately controlling siltation and runoff.

Twelve-inch diameter (after installation) compost filter tubes with biodegradable natural fabric (i.e., cotton, jute, burlap) are intended to be the primary sedimentation control barrier.

For small areas of disturbance with minimal slope and slope length, the Engineer may approve the following sediment control methods:

- 9-inch compost filter tubes
- Straw bales which shall be trenched

No straw wattles may be used. Additional compost filter tubes (adding depth or height) shall be used at specific locations of concentrated flow such as at gully points, steep slopes, or identified failure points in the sediment capture line.

When required by permits, additional sediment barrier shall be stored on-site for emergency use and replacement for the duration of the contract.

Where shown on the plans or when required by permits, sedimentation fence shall be used in addition to compost filter tubes and straw bales and shall be incidental to the item.

Sediment control barriers shall be installed in the approximate location as shown on the plans and as required so that no excavated or disturbed soil can enter mitigation areas or adjacent wetlands or waterways. Barriers shall be in place prior to excavation work. No work shall take place outside the barriers.

**MATERIALS AND CONSTRUCTION**

Prior to initial placement of barriers, the Contractor and the Engineer shall review locations specified on the plans and adjust placement to ensure that the placement will provide maximum effectiveness.

Barriers shall be staked, trenched, and/or wedged as specified herein and according to the Manufacturer's instructions. Barriers shall be securely in contact with existing soil such that there is no flow beneath the barrier.

**ITEM 767.121** (Continued)**COMPOST FILTER TUBE**

Compost material inside the filter tube shall meet M1.06.0, except for the following: no peat, manure or bio-solids shall be used; no kiln-dried wood or construction debris shall be allowed; material shall pass through a 2-inch sieve; and the C:N ratio shall be disregarded.

Outer tube fabric shall be made of 100% biodegradable materials (i.e., cotton, hemp or jute) and shall have a knitted mesh with openings that allow for sufficient water flow and effective sediment capture.

Tubes shall be tamped, but not trenched, to ensure good contact with soil. When reinforcement is necessary, tubes shall be stacked as shown on the detail plans.

**STRAW BALES**

Straw bales shall be used if shown on the plans or when specified by Orders of Condition or other permit requirements.

Bales should be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. All bales should be either wire-bound or string-tied. Straw bales should be installed so that bindings are oriented around the sides (rather than along the tops and bottoms) of the bales in order to prevent deterioration of the bindings.

The barrier should be entrenched and backfilled. A trench should be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. The trench must be deep enough to remove all grass and other material which might allow underflow. After the bales are staked and chinked (filled by wedging), the excavated soil should be backfilled against the barrier. Backfill soil should conform to the ground level on the downhill side and should be built up to 4 inches against the uphill side of the barrier.

Each bale should be securely anchored by at least 2 stakes or re-bars driven through the bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together. Stakes or re-bars should be driven deep enough into the ground to securely anchor the bales. For safety reasons, stakes should not extend above the bales but should be driven in flush with the top of the bale.

The gaps between the bales should be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency. Wedging must be done carefully in order not to separate the bales.

When used in a swale, the barrier should be extended to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale to assure that sediment-laden runoff will flow either through or over the barrier but not around it.

**ITEM 767.121** (Continued)**SEDIMENTATION FENCE**

Materials and Installation shall be per Section 670.40 and 670.60 of the Standard Specifications and the following:

Sedimentation fence shall only be used if shown on the plans or when specified by Orders of Condition or other permit requirements.

When used with compost filter tubes, the tube shall be placed on a minimum of 8 inches of folded fabric on the upslope side of the fence. Fabric does not need to be trenched.

When used with straw bales, an 8-inch deep and 4-inch wide trench or V-trench shall be dug on the upslope side of the fence line. One foot of fabric shall be placed in the bottom of the trench followed by backfilling with compacted earth or gravel. Stakes shall be on the down slope side of the trench and shall be spaced such that the fence remains vertical and effective.

Width of fabric shall be sufficient to provide a 36-inch high barrier after fabric is folded or trenched. Sagging fabric will require additional staking or other anchoring.

**MAINTENANCE**

Maintenance of the sediment control barrier shall be per Section 670.60 of the Standard Specifications or per the Stormwater Pollution Prevention Plan (SWPPP), whichever is more restrictive.

The contractor shall inspect the sediment barrier in accordance with relevant permits. At a minimum, barriers shall be inspected at least once every 7 calendar days and after a rain event resulting in 0.25 inches or more of rainfall. Contractor shall be responsible for ensuring that an effective barrier is in place and working effectively for all phases of the Contract.

Barriers that decompose such that they no longer provide the function required shall be repaired or replaced as directed. If the resulting berm of compost within the fabric tube is sufficiently intact and continues to provide effective water and sediment control, barrier does not necessarily require replacement.

**DISMANTLING & REMOVING**

Barriers shall be dismantled and/or removed, as required, when construction work is complete and upslope areas have been permanently stabilized and after receiving permission to do so from the Engineer.

Regardless of site context, nonbiodegradable material and components of the sediment barriers, including photo-biodegradable fabric, plastic netting, nylon twine, and sedimentation fence, shall be removed and disposed off-site by the Contractor.

**ITEM 767.121** (Continued)

For naturalized areas, biodegradable, natural fabric and material may be left in place to decompose on-site. In urban, residential, or other locations where aesthetics is a concern, the following shall apply:

- Compost filter tube fabric shall be cut and removed, and compost shall be raked to blend evenly (as would be done with a soil amendment or mulch). No more than a 2-inch depth shall be left on soil substrate.
- Straw bales shall be removed and disposed off-site by the Contractor. Areas of trenching shall be raked smooth and disturbed soils stabilized with a seed mix matching adjacent seeding or existing grasses (i.e., lawn or native grass mix).
- Sedimentation fence, stakes, and other debris shall be removed and disposed off-site. Site shall be restored to a neat and clean condition.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 767.121 will be measured and paid for at the contract unit price per foot of sediment control barrier which price shall include all labor, equipment, materials, maintenance, dismantling, removal, restoration of soil, and all incidental costs required to complete the work.

Additional barrier, such as double or triple stacking of compost filter tubes, will be paid for per foot of tube installed.

Barriers that have been driven over or otherwise damaged by construction activities shall be repaired or replaced as directed by the Engineer at the Contractor's expense.

**ITEM 767.9****JUTE MESH****SQUARE YARD**

The work under this item shall conform to the relevant provisions of Section 700 of the Standard Specifications and the following:

The work under this item shall consist of furnishing and installing jute mesh fabric to prevent soil erosion. Jute mesh shall be placed over all areas of exposed soil in locations shown on the plans or as required by the Engineer.

**MATERIALS**

Jute netting or similar material shall be new, unused, undyed, and unbleached 100% biodegradable yarn (no polypropylene) and of uniform plain weave. The materials should weigh approximately 1.0 (+/- 5%) pounds per linear yard (assuming a 4-foot width).

Shall meet the following minimum requirements:

Open Area: 70-75%

Mesh Size: approximately 1/2 inch with an open area of 60-65%.

Roll Weight: approximately 1.0 (+/- 5%) pounds per linear yard

Warp Ends: 78 per linear yard

Weft Ends: 41 per linear yard

Recommended flow: 6 fps (1.8 m/s)

Functional Longevity: 6-9 months

Anchoring devices shall be 11-gauge steel staples 6-inch minimum length. In loose soils the length of the staples shall be 9-inches.

For areas that will be routinely mowed anchoring devices shall consist of minimum 8" wooden stakes. Longer stakes shall be used where loose soils or other conditions obligate, as required by the Engineer.

**CONSTRUCTION METHODS**

Area shall be seeded prior to installation of jute netting.

Installation shall be such as to ensure continuous contact with soil without folds or wrinkles. Jute netting shall be laid such that upslope fabric is placed over lower slope fabric by a minimum of 3 feet. Adjoining rolls shall be overlapped a minimum 6 inches. The netting shall extend beyond at least 1 foot beyond the edge of the seeded area.

The Contractor shall bury the ends of the jute netting 6-8 inches in anchor trenches at top and bottom of slopes.

Jute netting shall be anchored in place with vertically driven metal staples. The staples shall be driven in until their tops are flush with the soil. Staples shall be placed at 12-inch intervals along the top of a slope and in staggered courses along the face of the slope to achieve a minimum of 3 staples per square yard, or at manufacturer's recommendations for the given site conditions.

**ITEM 767.9** (Continued)

Contractor shall reseed all trenched and otherwise disturbed areas with specified seed mix. The Contractor shall maintain the jute netting and make satisfactory repairs of any areas damaged until acceptance of seed establishment.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Jute Mesh will be measured and paid for at the Contract unit price per Square Yard, which price shall include all labor, materials, equipment, trenching, placing, and stapling of jute fabric, reseeding of trenched and disturbed areas, and all incidental costs required to complete the work.

Jute Mesh shall be measured across the surface of grade and does not include buried or overlapped portions. The quantity measured for payment shall not exceed that shown on the plans or as directed by the Engineer. Mesh that becomes loose or that is not otherwise functioning to stabilize soil shall be repaired and new or additional jute matting installed as required at the Contractor's expense. Soil erosion shall be repaired, and area shall be raked and reseeded with the original specified mix as required by the Engineer at the Contractors expense.

<b><u>ITEM 771.11</u></b>	<b><u>IRRIGATION SYSTEM REPAIR</u></b> <b><u>LOCATION NO. 1</u></b>	<b><u>LUMP SUM</u></b>
<b><u>ITEM 771.12</u></b>	<b><u>IRRIGATION SYSTEM REPAIR</u></b> <b><u>LOCATION NO. 2</u></b>	<b><u>LUMP SUM</u></b>
<b><u>ITEM 771.13</u></b>	<b><u>IRRIGATION SYSTEM REPAIR</u></b> <b><u>LOCATION NO. 3</u></b>	<b><u>LUMP SUM</u></b>

The work under these items shall conform to the relevant provisions of Subsection 301 and of the Standard Specifications and the following:

The work shall consist of cutting, capping, and removing the existing irrigation system within the limit of grading at the following locations:

- Location No. 1 - 10 Boston Road
- Location No. 2 - 24 Boston Road
- Location No. 3 - 26 Boston Road

**BASIS OF PAYMENT**

Items 771.11, 771.12 and Item 771.13 will be paid for at the respective Contract unit prices lump sum, which price shall include all labor, equipment, materials and incidental costs required to complete the work.

**ITEM 784.101 TREES – STREET CONTINGENCY – 2-2.5 INCH CAL. EACH**

The work under this item shall conform to the applicable requirements of Subsection 771 of the Standard Specifications and the following:

The work under this item consists of providing and planting additional trees within the project, primarily along the Boston Road and Crown Road, that are not shown on the plans. Trees under this item are intended for aesthetic enhancement and shade where space permits. The locations and species of trees will be determined by MassDOT during construction.

**MATERIALS**

Trees shall be 2” – 2.5” caliper and shall be normally available species native to the northeast region of the United States.

**CONSTRUCTION METHODS**

The work shall be conducted under the supervision of the MassDOT Landscape Architect and the Town of Westford. The contractor shall contact Stephanie Smoot at (857) 368-9175 to establish coordination for the conduct of the work. Tree locations shall be recommended by the Landscape Architect and approved by the Town of Westford. However, the contractor shall verify that there are no conflicts with existing or proposed utilities or the drainage system at the recommended locations. Contingency tree locations shall not compromise ADA and AAB accessibility requirements. No additional Right of Way or easements will be acquired for contingency trees.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Trees – Street Contingency – 2-2.5 INCH Cal. will be measured and paid for at the Contract unit price per Each, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

No payment will be made for replacement trees.



**ITEM 811.351**

**PULL BOX REMOVED AND STACKED**

**EACH**

The work under this item shall conform to the relevant provisions of Subsection 801 of the Standard Specifications and the following:

The work shall include the careful removal of the existing pull boxes located at Station 72+59± and Station 73+68± LT and delivery to the MassDOT Maintenance Depot at 80 Boston Road in Westford.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Pull Box Removed and Stacked will be measured and paid for at the contract unit price per Each, which prices shall include all labor, materials, transportation, equipment, and incidental costs required to complete the work.

No additional compensation shall be paid for splicing proposed conduit into the existing conduit run at this location.

**ITEM 813.811****ELECTRIC SERVICE RISER RELOCATION****LUMP SUM**

The work under this item shall conform to the relevant provisions of Subsection 813 and the following:

The work under this item shall consist of the removal and relocation of electric service risers attached to utility poles supplying secondary and or primary electrical service through underground conduit. The location is as follows:

Location No. 1 - Utility Pole #42 located at Station 67+29± LT

**The Contractor shall notify National Grid immediately following the Notice to Proceed from MassDOT to generate a Work Order for each Electric Service Riser requiring relocation.**

To initiate National Grid Electric Work Requests:

<https://ngus.force.com/electric/s/> or 1-800-375-7405, Option #2

The existing underground conduit shall be excavated and exposed for a necessary distance to allow for the re-alignment of the conduit to the relocated pole as determined by the local utility company servicing the property. The existing galvanized riser and sweep at the base of pole shall be removed and become the property of the contractor to dispose of in accordance with all applicable regulations. This service shall include the first 10' of the riser on the described utility pole, the sweep, a coil of wire acceptable to the local utility company and all other materials required for the relocation including any additional conduit.

The work shall include all excavation and backfill, compaction, new riser, new conduit, new wire and materials, concrete encasement or any other requirements in accordance with the latest edition of the National Electrical Code, the respective utility company, local codes and guidelines.

The work associated with disconnecting power and reconnecting power to the utilities secondary and primary power lines is the responsibility of the Contractor to coordinate with the local utility company and shall be performed at a time convenient to the property owners or tenants occupying the building. The actual time of day or evening for the disconnecting and reconnecting shall be agreed upon between the Engineer, the local power company servicing this location and the property owner/tenant during construction. A representative from the Contractor shall be present when this work is performed. No additional compensation shall be given for this work outside of normal work hours if necessary.

**BASIS OF PAYMENT**

Items 813.811 will be paid for at the Contract unit price Lump Sum, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

The work associated with the removal of utility poles and the transfer of the Utilities overhead primary and secondary wiring will be the responsibility of the respective utility companies and will not be paid for under this item.

**ITEM 813.812   TEMPORARY SERVICE STANCHION RELOCATION   LUMP SUM**

The work under this item shall conform to the relevant provisions of Subsection 813 and the following:

The work under this item shall consist of the removal and relocation of the temporary service stanchion providing service to the existing building at #66 Boston Road, Station 64+98 LT.

The work shall include all excavation and backfill, compaction, new wire and materials, or any other requirements in accordance with the latest edition of the National Electrical Code, the respective utility company, local codes and guidelines.

The work associated with disconnecting power and reconnecting power to the utilities secondary power lines is the responsibility of the Contractor to coordinate with the local utility company and shall be performed at a time convenient to the property owners or tenants occupying the building. The actual time of day or evening for the disconnecting and reconnecting shall be agreed upon between the Engineer, the local power company servicing this location and the property owner/tenant during construction. A representative from the Contractor shall be present when this work is performed. No additional compensation shall be given for this work outside of normal work hours if necessary.

**BASIS OF PAYMENT**

Items 813.812 will be paid for at the Contract unit price Lump Sum, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

The work associated with the transfer of the Utilities overhead secondary wiring will be the responsibility of the respective utility companies and will not be paid for under this item.

**ITEM 813.91     SOLAR PANEL AND TRANSMITTER RELOCATION     LUMP SUM  
LOCATION NO. 1**

The work under this item shall conform to the relevant provisions of Subsection 813 and the following:

The work under this item shall consist of the removal and relocation of an existing solar panel and transmitter attached to utility pole #37 located at STA. 61+64 RT.

**The Contractor shall contact the Town of Westford Fire Department to coordinate the relocation.**

The work shall include carefully removing the solar panel, transmitter, and all associated wiring, and installing them with new supports on the relocated utility pole at the same height as the existing solar panel and transmitter or as required by the Engineer. Subsequent to relocation, the operation of the transmitter shall be tested in coordination with the Westford Fire Department, and adjusted as required to ensure it is operating as required. The work shall be performed in accordance with the latest edition of the National Electrical Code, local codes and guidelines.

**BASIS OF PAYMENT**

Items 813.91 will be paid for at the Contract unit price Lump Sum, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

No separate payment will be made for conduit, handholes or wire, but all costs in connection therewith shall be included in the Contract lump sum price bid.

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<b><u>ITEM 816.01</u></b>	<b><u>TRAFFIC SIGNAL RECONSTRUCTION</u></b>	<b><u>LUMP SUM</u></b>
	<b><u>LOCATION NO. 1</u></b>	
<b><u>ITEM 816.02</u></b>	<b><u>TRAFFIC SIGNAL RECONSTRUCTION</u></b>	<b><u>LUMP SUM</u></b>
	<b><u>LOCATION NO. 2</u></b>	

Work under this item shall conform to the relevant provisions of Subsection 815 of the Standard Specifications, the 2009 Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), and the following:

The work shall include the furnishing and installation of part or all of the following items: mast arm assemblies with anchor bolts and foundations; signal posts, bases, and foundations; signal housings; retroreflective louvered backplates; vehicular and bicycle loop detection; pedestrian signals with countdown timers; accessible pedestrian signals (APS) push buttons with signage; all cable and wiring; ground rods, equipment grounding and bonding; removal of existing traffic signal equipment, and all other equipment, materials and incidental costs required to provide complete, fully operational traffic control signal system as specified herein and as shown on the plans at the following locations:

- Location 1 (Item 816.01): Boston Road / I-495 SB Ramps
- Location 2 (Item 816.02): Boston Road / I-495 NB Ramps

A list of major traffic signal items as required at these locations is included on the traffic signal plans. It is not intended that every fitting, minor detail or feature be shown and described, as the assumption is made that the Contractor and/or their Subcontractor is an expert in the particular area of responsibility and is capable of interpreting the plans, Specifications, and Special Provisions so that the bid and/or construction shall include all items required to provide complete, fully operational traffic control signal system and that they shall be provided and installed in accordance with all applicable guidelines, standards and specifications, and as required by the Engineer.

All traffic signal equipment shall comply with the MassDOT Qualified Traffic Control Equipment List unless otherwise approved by the Engineer:

(<http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ApprovedMaterialsandFabricators/QualifiedTrafficControlEquipment.aspx>)

### Maintenance of Traffic Signals

It shall be the responsibility of the Contractor to provide all labor, equipment and material required for the total maintenance and repair of all existing and proposed traffic signal control equipment, including damage by automobile accidents until final completion and acceptance of the project, unless otherwise specified under Subsection 7.17 "Traffic Accommodation: of the Standard Specifications as amended, in which case Subsection 7.17 will govern. These provisions will apply to the signalized location included as part of this construction Contract from the date of written notice given to the Engineer that the Contractor will work on or adjacent to the existing signals until the date when the Department accepts the complete project. This written notice shall be given before the Contractor may proceed with any work on a specified traffic signal location.

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**ITEMS 816.01 and 816.02** (Continued)

For the purpose of these Special Provisions, the phrase “Traffic Signal Control Equipment” is intended to include, but is not limited to, controllers, signal housings, supporting structures, cabinet accessories and panels, wires, conduit and all other ancillary electrical equipment used for traffic control.

**Shop Drawings and Certificate of Compliance**

Within 30 days following Notice to Proceed, the Contractor shall submit a list of equipment and manufacturer’s equipment specifications he proposes to install to the Engineer in accordance with the relevant provisions of Section 815.20. No equipment or accessories will be accepted unless type tested and approved by the MassDOT – Highway Division prior to the date of proposal, unless otherwise noted in the plans or the Special Provisions.

The Contractor shall commence no work until approval of the shop drawings has been received in writing from the Engineer. Approval of these drawings will be general in character and shall not relieve the Contractor from the responsibility of, or the necessity of, furnishing materials and workmanship required by the plans and these specifications.

Along with the shop drawings the Contractor shall deliver to the Engineer a certificate of compliance with the manufacturer for all materials purchased from the manufacturer.

**Existing Traffic Signal Installations**

All of the existing traffic signal equipment shall be retained unless otherwise indicated. For those components to be removed under this item and as indicated on the plans, the existing traffic signal equipment shall be maintained in operation throughout the construction period and until the new signal equipment is ready for operation.

The Contractor may use temporary supports for signal heads as required to allow construction activities. Any temporary installations shall be in conformance with the MUTCD at all times. Prior to installation any temporary installations not part of the original design shall be reviewed and approved by the Engineer. This includes adjusting (relocating) traffic signal heads to accommodate maintaining traffic requirements associated during construction. As applicable, this work includes adjusting existing and temporary traffic signal heads, wiring, fittings, cabling, and all other materials and labor required to ensure complete and operating traffic signals. If an existing signal is to be turned off temporarily to allow controller switch over or rewiring, police details shall be used to control traffic at the intersection. Once construction is completed and the new signals are in operation, unused items of the old signals shall be completely removed and stacked as required by the Engineer in accordance with Section 815.65. Old cable and unusable materials shall be disposed of by the Contractor.

Prior to initial turn-on of the new or modified signals, equipment, signal displays, and vehicle detection as shown on the plans and called for in these special provisions, shall be installed and operable. Applicable signs and pavement makings shall also be in place when the signals are put into operation.

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**ITEMS 816.01 and 816.02** (Continued)**Modifying Existing Controller and Cabinet**

The existing traffic signal controller(s), cabinet(s), and foundation(s) at Location(s) 1 & 2 (Items 816.01 & 816.02) are to be retained. Under Item(s) 816.01 through 816.02, the Contractor shall perform cabinet work to implement the proposed signal timings and phasing shown on the plans. All signal equipment within the cabinet shall be retained unless otherwise noted. The Contractor shall make all adjustments associated with the new loop detection.

**Service Connection**

Under Item 816.01 and Item 816.02, the service connections shown on the plans are approximate only. The existing service connections shall be maintained in operation throughout the construction period. It shall be the Contractor's responsibility to contact the utility company if needed. The electric company will connect and disconnect power as required. No work shall be done in manholes or on power poles without a representative of the electric company being present. The Contractor will be responsible for coordinating work with the electric company.

No direct reimbursement will be made under this contract to the Contractor for payments made to electric company, it being understood that full compensation for any payment made by the Contractor to the utility company will be included in the contract prices bid.

**Testing of Grounding System**

*Grounding Cable* - Grounding cable shall be bare copper No. 8 AWG wires.

The Contractor shall perform testing of the equipment grounding system in the presence of the Engineer and the Department in accordance with the Standard Specifications.

**Cabinet Door Sticker**

The Contractor shall supply and install updated laminated door sticker on all existing cabinets. This sticker shall be permanently affixed to the upper left-hand side of the interior main cabinet door, unless unable based on cabinet size. The sticker shall contain, at a minimum, the following:

- Plan view of traffic signals influence area; including signal housing locations, pole and post locations, detector zones, etc.
- Vehicle detection information including rack position, detector channel assignment, phase assigned, approach and termination points.
- Network communications information including IP address, subnet mask and MAC address.
- Per approach preemption information including channel, approach/direction and termination points.

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**ITEMS 816.01 and 816.02** (Continued)**Traffic Signal Cabinet Equipment**

The traffic signal controller unit (CU), MMU, detector amplifiers, cabinet power supply, bus interface units (BIUs) and all other ancillary traffic signal control components included in the traffic control cabinet shall comply with the NEMA Standard No. TS 2-1998, Traffic Controller Assemblies with National Transportation Communications for ITS Protocol (NTCIP) Requirements.

**Load Switches**

Load switches shall comply with Subsection 6.2 of the NEMA TS 2 standard. All load switches shall utilize optically isolated encapsulated modular solid-state relays. Discrete components on circuit boards are not acceptable.

Load switch indicator lights shall be LED-type and wired on the input side of the device.

**Flash Transfer Relays**

Flash transfer relays shall comply with Subsection 6.4 of the NEMA TS 2 standard. The field electrical loading for flash operation shall be wired through the transfer relays such that the load on the 2-circuit flasher is as balanced as possible within the limitations of the signal phasing.

Note: The controller cabinet assembly shall be supplied with a full complement of flash transfer relays to accommodate each available position of the back panel.

**Spare Equipment**

The Contractor shall provide the following spare signal equipment in the traffic signal controller cabinet listed below:

- A full complement of load switches to accommodate each available position on the back panel;
- A full complement of flash transfer relays to accommodate each available position on the back panel;
- Two (2) Bus Interface Units (BIU's)

**Emergency Vehicle Preemption**

The emergency vehicle preemption optical receiver located on UP #42 (STA 67+28 LT) shall be removed and reset to the new position of UP #42 (STA 67+28 LT). The cabling between UP #42, the repositioned UP #43 (STA 69+06), and the traffic signal controller shall be adjusted as necessary to maintain the advance preemption receiver location. This work shall be paid for under Item 816.01.



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**ITEMS 816.01 and 816.02** (Continued)**Loop Detector Amplifiers and Rack Assembly**

The detector rack assembly shall conform to Paragraph 5.3.4 of the NEMA TS 2 Standard. The detector rack assembly shall be supplied in a Type 2 configuration as defined in Table 5-9 of the NEMA TS 2 Standard.

The loop detector amplifiers shall conform to Subsection 6.5 of the NEMA TS 2 Standard. The loop detector amplifiers supplied shall be a Type C rack, two channel units with delay and extension timing internal to each unit's channel, as defined in Table 6-1 of the NEMA TS 2 Standard. (Note: Delay and/or extension timings shall be programmed in the controllers and not on the detector amplifiers). The two-channel card rack loop amplifier units shall occupy one of the rack slots in the assembly.

The detector unit shall be capable of operating in a voltage range from 10.8 to 26.5 VDC. The unit shall operate from the cabinet's external power supply at 12 VDC.

The front portion of the detector rack shall be provided with a marker strip to allow identification of detector phase assignments. In addition to the required marker strip, the Contractor shall supply and install on the upper left-hand corner of the back of the cabinet door a laminated, pictorial diagram depicting the traffic detector amplifier channel assignments. The assignment information contained shall include approach name, phase, detector number and terminal numbers.

**Vehicle and Bicycle Loop Detectors**

Wire loop detectors shall be installed in the roadway for vehicle and bicycle detection. In advance of the loop detector installation, the Contractor shall mark, on site, the loop detectors with any changes required by field conditions such as manholes. The loop detector layout shall be inspected and approved by the Engineer before the loop detectors are installed.

All wire loop detectors shall be installed prior to top course pavement application unless otherwise noted.

Loop wire shall be encased in a protected plastic tubing of PVC or polyethylene plastic, IMSA 51-5, 0.25 inches outside diameter, and the wire may have cross-linked polyethylene insulation or it may have THHN/THWN insulation.

Splicing insulator shall be an approved re-enterable rigid body splice kit with a non-hardening sealing compound compatible with the wire insulation.

Splice and Connection: Splicing and connection shall be made in the pull box / handhole nearest the roadway loop sensor but not exceeding four loops per pull box. All loops included in a detector group as shown on the plans shall be spliced in a single pull box. Each lead and lead-in connector shall be stripped back and spliced using a pressure type wire connector applied with a crimping tool. Multiple loop sensors shall be identified as detailed on the plans.

**ITEMS 816.01 and 816.02** (Continued)

Each lead-in cable shall run directly, without intermediate splices, from the loop detector splice kit to the terminal end connection in the controller cabinet. Lead-in splicing shall be staggered to prevent contact with each other. Each crimped splice shall be soldered and insulated. The insulation material shall be heat-shrink polyolefin. The shielded lead-in cable outer jacket and shield shall be stripped back sufficiently to ensure that the shield cannot come into contact with the spliced conductors. Follow the instructions of the kit manufacturer for this procedure when installing the re-enterable splice kit.

NOTE WELL: The above splice shall be done on the day of the loop wire installation to prevent the entrance of any moisture into the plastic tubing.

The lead-in conductors shall be connected to the appropriate terminals in the controller cabinet, by using crimped or soldered terminal ends. The heat source for soldering shall be electrical not exceeding 30W capacity.

**Testing of Loops**

The following test procedure shall be performed in the presence of the Engineer before and after the loop sensor is sealed in the pavement as detailed below. The cost of equipment, labor, and materials to perform such testing and similar re-testing following repairs, replacement, or adjustment of any detector within the project area shall be included in the contract lump sum unit price for this Item.

After installation of wire loop sensors in the roadway and installation of shielded lead-in connecting the loop sensors to the controller cabinet each loop sensor and lead-in combination shall be tested (at the controller cabinet) for proper installation. This includes testing for continuity, inductance, and the resistance for the loop-ground, loop-shield, and shield-ground. The resistance from lead to lead of the same loop shall not exceed three (3) ohms per one thousand (1,000) feet as measured by a high-quality meter suitable for measurements of low resistance in the range of 1 to 6 ohms.

A megohmmeter test at 500 volts DC shall be made between the two leads of a loop/lead-in combination temporarily spliced together, but otherwise disconnected from all terminals, and the shield drain wire and the earth ground connection. These resistances shall be at least one hundred (100) megohms.

A megohm meter test at 500 volts DC shall be made between lead-in shield and the earth ground rod. This resistance shall be at least one hundred (100) megohms.

The meter used for these tests shall be checked for calibration each day of use by using a resistor block of  $\pm 5\%$  resistors simulating loads of 1 megohm, 20 megohm and 100 megohms. The observed meter reading shall be  $\pm 10\%$  of the nominal resistor load.

If any loop sensor and lead-in combination fails to pass any one of the four (4) tests, it shall be repaired and then re-tested on two occasions at least two (2) weeks apart, and then shall pass on each re-test occasion. If the loop sensor lead-in combination does not pass all these re-tests, a new loop sensor and/or lead-in shall be installed, and shall pass these tests, at no additional cost.

**ITEMS 816.01 and 816.02** (Continued)

After the above tests have been satisfactorily completed, all loop sensor/shielded lead-in inductances shall be measured, a written report of the results shall be filed with the Engineer, and a copy stored with the “box prints” at the intersection.

Existing Loop or Video Detection

Existing loop detection shall be maintained unless otherwise noted for removal or replacement. If the existing detection is compromised by other work; detection shall be restored within 10 calendar days. For locations where new loop detectors are proposed, all lead-in cables shall be disposed by the contractor at no additional expense.

Mast Arms, Poles, and Foundations (less than 60 feet in length)

All mast arm poles shall be Type 2 steel monolevers primed to MassDOT standards, with shoe bases. Mast arms, poles, and foundations shall be fabricated and constructed in conformance with the MassDOT’s Overhead Signal Structure & Foundation Standard Drawings issued December 2015.

Acceptance of Type 2 mast arm poles will be contingent upon review and approval of shop drawings submitted by the Contractor. Longhand design calculations shall be submitted by the Contractor with the shop drawings for the Type 2 mast arm pole. The Contractor shall provide a set of calculations, stamped by a Structural Engineer registered in the Commonwealth of Massachusetts, along with plans and specifications for review by the Engineer.

The mast arm pole foundations shall be a cored pier foundation and constructed in conformance with MassDOT Standard Drawings included in the plans and priced per the table provided below.

Pier Foundation Assumptions for 110 MPH Wind Speed Zone

STA/OFF	Soil Type	Mast Arm Length	Fdn. Dia.	Fdn. Depth	Vertical Bars	Tie Bars
71+45.9 LT 45.1 ft	Dry Sand (Dense)	25-feet	3 ft-6 in	7’-6”	18-#8	#5 @ 12 inch

Concrete foundations shall be constructed of 4000 psi, 565 Cement Concrete. The Contractor shall submit shop drawings of any bolt circle details for approval by the Engineer. Anchor bolts shall be set accurately, and tops shall be formed neatly. The top forming of cast-in-place units shall extend downward for a minimum of 24-inches on the side of any foundation. The lower portions of all foundations shall be placed directly against undisturbed earth. At the time of foundation construction, the Contractor shall be responsible to complete material testing of mast arm foundation concrete and steel reinforcing bars in accordance with the Standard Specifications.

**ITEMS 816.01 and 816.02** (Continued)

Relocation of utilities for the convenience of drilling may be needed and shall be at the expense of the Contractor if requested. The Contractor shall be responsible for all items required to install traffic signal infrastructure at location(s); including, but not limited to, shielding of overhead primary / secondary wires within 10-feet, insulation of overhead wires, relocation of overhead wires, and/or for the potential use of other low-profile installation and/or excavation techniques as required.

The Contractor shall be responsible for making all required arrangements to have the proper utility company(s) relocate overhead wires in order for the proper mast arm clearances or visibility to traffic signal indications to be obtained, should any conflicts arise. The Contractor shall take extra care and precaution in placing signal heads to ensure the existing or proposed/future overhead utility wires do not interfere with the visibility of the signal heads located above the roadway. All measurements to determine the exact dimensions and clearances to existing overhead utility lines shall be made in the field by the Contractor for incorporation into the erection plans and shop drawings which are submitted for approval. This may require relocation of overhead wires in coordination with the utility company. No separate payment will be made for work considered incidental to the traffic signal equipment related to the utility company coordination or implementation as noted, but all costs in connection therewith shall be included in the lump sum bid price for Item 816.01.

In the event that soil conditions or ledge prevent the use of MassDOT standard foundation type, the Contractor shall coordinate with the Engineer to select and design alternative foundation types that fit within the existing right-of-way. Alternative foundation types could include spread footings, coring and socketing into rock or other foundations previously used to support similar loads, within reason.

The bottom of the signal head shall have a minimum clearance of not less than 17 feet-6 inches or greater than 19 feet above the pavement grade at the center of the roadway.

New mast arm pole foundations shall not obstruct a sidewalk or crosswalk so that passage by physically-challenged persons is impaired. The installation shall be in compliance with ADA/AAB standards.

No separate payment will be made for work considered incidental to the excavation, including but not limited to, mast arm foundations, dewatering, etc. but all costs in connection therewith shall be included in the lump sum bid price for Item 816.01.

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**ITEMS 816.01 and 816.02** (Continued)**Mast Arm Sign Hanger Brackets**

Sign hanger brackets for mast arms shall be used in all locations where a sign is to be mounted to the mast arm. Mast arm sign hanger brackets shall consist of a mast arm clamp assembly cast from 356-T6 aluminum alloy or equivalent, vertical support tube extruded from 6063 aluminum or equivalent, stainless steel bands, clamp screw, hardware and all miscellaneous materials required to fix mount the sign to the mast arm. The sign hanger bracket shall be universally adjustable capable of making horizontal, vertical and 360-degree rotational adjustments so that any sign mounted on a mast arm can be adjusted to provide proper alignment and sight perpendicular to the flow of traffic. Vertical support tubes shall be of sufficient length to allow mounting of the sign to within 3-inches of the top and bottom of the sign.

**Signal Posts / Stanchions and Foundations**

The new pedestal posts shall have transformer bases and be made of aluminum. Bases shall be square unless otherwise noted. Bases shall be provided with a door opening and a cast aluminum door, complete with a cap screw fastening device and a tapped hole for a grounding lug.

New signal base foundations shall not obstruct a sidewalk or crosswalk so that passage by physically challenged persons is impaired. The installation shall be in compliance with ADA/AAB standards. Sidewalk extensions shall be provided when needed in order to maintain minimum ADA/AAB compliance.

The new pedestal posts on new foundations may utilize either precast or cast-in-place cement concrete pedestal post foundations constructed in conformance with the MassDOT Standard Drawings.

No separate payment will be made for work considered incidental to the excavation, including but not limited to, pedestal post foundations, dewatering, etc. but all costs in connection therewith shall be included in the lump sum bid price for Item 816.01.

**Steel Equipment*****Galvanizing***

All bolts, screws, nuts, rods and washers shall be galvanized in accordance with AASHTO M232 and the Standard Specifications. The hardened machine screws may be electroplate galvanized. Stainless steel studs, bolts, screws, nuts, straps and washers shall not be galvanized. Galvanized hardware need not be painted; however, the ends of bolts, nuts, and washers shall be painted in the field according to section "Touch-up and Repairs." Immediately prior to galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The dry kettle galvanizing process shall be used.

All steel components, other than above, shall be galvanized after fabrication in accordance with AASHTO M111. The galvanizing bath shall contain nickel (0.05% to 0.09% by weight).

Galvanized members requiring shop assembly shall be welded and drilled prior to galvanizing.

### **ITEMS 816.01 and 816.02** (Continued)

The applicator shall ensure that all components are smooth and without sharp protrusions that would present an injury hazard to pedestrians. Also, the fabricator shall ensure that all welds shall be cleaned thoroughly in accordance with good practice and according to AWD D1.5 and ASTM A123-89a and shall have a suitable surface to accept the galvanizing.

#### *Touch-Up and Repairs*

Should any damage occur to the galvanized coating during shipping or handling at the job site, the Contractor shall repair and touch-up any damaged areas as required by the Engineer and the following:

Field touch-up procedures shall conform to the recommendations of the galvanizer. Touch-up of the finish coat shall be by applying a coating of a two-part urethane, as supplied by the Galvanizer, to achieve a dry film thickness of at least 4.0 mils. Prior to the application of the paint, remove all damaged coatings down to a solidly adhered coating and apply galvanizing repair paint as primer. Allow the primer to dry for at least 4 hours prior to top coating.

The Contractor shall also use the touch-up paint material and procedures to paint the galvanized hardware used in field erection that has not been finish coated previously.

#### Aluminum Equipment

All aluminum signal pedestal posts shall have a powder coat finish yellow in color. The coating shall be a polyester-TGIC (triglycidyl isocyanurate) resin system conforming to the following:

Quality	Test	Limits
Abrasion	Taber abraser CS-10, 1000 gram load, 1000 cycle, ASTM D4060	100 mg. Maximum weight loss
Adhesion	ASTM D .59 Initial 1000 hours	5A 5A
Gloss	ASTM D 523 60° - 600 hours 60° - 1000 hours	82% retention 90% retention (washed)
Hardness	ASTM D 3363	2H – No Gouge
Impact	ASTM D 2794 Direct	Pass 80 inch-lb.
Salt Spray Resistance	ASTM B 177 ASTM D 1654 1000 hours unscribed 400 hours scribed	Table 2-10 Table 1-10
Weather Resistant	ASTM G 23, 1000 hours, 18 min. waterspray, 102 min. light	No film failure
Color	Yellow	
Identify	Infrared fingerprint	Match
Flexibility	180° bend; ½-inch dia, mandrel within 10 seconds	No breaks, flaking or cracks. Tested with a Q-panel with 2 mils or less of coating
Humidity	ASTM D 2247, 1000 hours	No blister or film failure
Thickness		4 mils +/- 1 mils
Mar Resistance		Good

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**ITEMS 816.01 and 816.02** (Continued)**Signal Housings**

Signal housings mounted on mast arms shall be rigidly attached to the mast arms unless otherwise noted. All signal housings mounted overhead on mast arms shall be installed with the bottom of the signals at the same height. All traffic signal lenses shall be 12 inches in diameter unless otherwise noted on the plans. All proposed post-mounted signal housings shall be retrofitted or installed with retroreflective backplates. All backplates shall be 5-inch wide beyond the signal housing and consist of 3-inch yellow retroreflective strip. The border shall be made from an adhesive-backed retroreflective yellow micro-prismatic sheeting, Type III or IV, and cover the entire perimeter of the backplate. Each indication section of the signal housing shall be installed with a tunnel visor as noted on the plans. All signal housings shall be equipped with ball and/or arrow light emitting diode (LED) modules.

**LED Signal Modules**

All signal and pedestrian displays shall be equipped with LED signal modules. All red, yellow, green, and pedestrian signal housings with the exception of optically programmed and fiber optic housings shall conform to the following where applicable:

- ITE's Vehicle Traffic Control Signal Housings – Light Emitting Diode (LED) Arrow Traffic Signal Supplement, Dated April 3, 2006.
- ITE's Vehicle Traffic Control Signal Housings – Light Emitting Diode (LED) Circular Signal Supplement, Dated June 27, 2005.
- ITE's Pedestrian and Countdown Signal Modules Compliant to PTCSI - Part 2 Light Emitting Diode (LED), Dated, August, 2007.
  - Energy Star / EPACT Program Requirements for Traffic Signals
- On the MassDOT Traffic Signal Approved Equipment List.

An independent lab shall certify that the LED signal module complies with the applicable ITE specification. The independent report shall be submitted to MassDOT for review unless the module is already on the approved list.

To prevent the LED module warranty from being voided, the connecting leads on the module shall not be cut. The original LED module leads shall be connected to the signal housing terminal block as continuous wire without splices.

The LED signal module will be replaced or repaired by the manufacturer if it exhibits one of the following:

- A failure due to workmanship or material defects within the first 60 months of field operation
- A greater than 40 percent light output degradation or a fall below the minimum intensity levels (as defined by the latest ITE performance specifications) within the first 36 months of field operation

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**ITEMS 816.01 and 816.02** (Continued)**Pedestrian Signal Housings with Countdown Timers**

All pedestrian signal housings shall be 16-inch, single units, with countdown timers. All pedestrian signal housings shall include audible devices, if not installed as part of the push button, in conformance with the MassDOT Accessible Pedestrian Signal (APS) Installation Policy, dated June 1, 2012 and as revised. Pedestrian signal housing indications shall be illuminated L.E.D. type displaying graphical filled-in symbols of a walking person and/or upraised hand. The countdown module shall display the number of seconds remaining throughout the flashing don't walk (UPRAISED HAND) interval, and blank out during the steady walk (WALKING PERSON) and steady don't walk (UPRAISED HAND) intervals. The countdown module shall be automatically set by the intersection controller based upon the walk (WALKING PERSON) and flashing don't walk (UPRAISED HAND) signal intervals only.

The countdown module shall continuously monitor the intersection controller for any changes to the pedestrian phase timing and reprogram itself automatically. All L.E.D. indications on the pedestrian signal shall have an automatic dimming circuit for night illumination to reduce long-term degradation to the LEDs.

Pedestrian signal heads shall come equipped with cut-away visors. Heavy duty blind clamp fittings are required for mounting hardware as required. Where mast arm mounting is required, including at intermediate arm locations, signal heads shall be all vertically fixed-mounted.

**Pedestrian Push Buttons and Audible Devices**

Pedestrian push buttons shall be in conformance with the MassDOT Accessible Pedestrian Signal (APS) Installation Policy, dated June 1, 2012 and as revised. Pedestrian push buttons shall be 4-wire. Countdown signage shall be 9-inches x 15-inches. All push button assemblies shall be painted YELLOW without exception.

Pedestrian push button controls shall be raised from or flush with their housings and shall be a minimum of 2 inches in the smallest dimension. The force required to activate the controls shall be no greater than 5 pounds.

Pedestrian push buttons shall be located as close as practical to the sidewalk curb ramp serving the controlled crossing and shall permit operation from a clear ground space. If two crosswalks, oriented in different directions, end at or near the same location, the positioning of pedestrian pushbuttons and/or legends on the pedestrian push button signs shall clearly indicate which crosswalk signal is actuated by each pedestrian push button.

Upon installation, the push button shall be perpendicular to the crosswalks with the raised arrow on the push button parallel to the path of pedestrian travel. Where two crosswalks correspond to the same push button, a double arrow shall be provided. The audible device (which may be part of the push button assembly) shall be capable of providing alternative audio messages / sound for those locations in which two push buttons for two separate crosswalks are within ten (10) feet of each other. At locations where two separate push buttons are within ten (1) feet of each other, different audible tones shall be set for each audible device and the audible walk indication shall be a speech "WALK"-type message.



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**ITEMS 816.01 and 816.02** (Continued)

A maximum mounting height of 42-inches above the finish sidewalk grade shall be used for pedestrian push buttons. A maximum pedestrian reach from a level surface to any installed pedestrian push button shall be no more than 10-inches. Where final installation results in more than a 10-inch reach from a level surface, the contractor shall be responsible to retrofit the push button with an extension arm or device compatible with the push button and associated pole/post.

**Equipment Finish and Color**

Traffic signal equipment including, but not limited to, signal pedestal posts, bases, signal housings, visors (outside), doors, service meter socket box, optical preemption detectors, hardware, and rigid mounting brackets for signals and signs shall be painted standard colors, subject to the approval of MassDOT. The Contractor shall submit to the Engineer paint chips and sample finishes on steel and aluminum of the intended color prior to any work being done under this heading.

All push button assemblies shall be painted YELLOW without exception.

Signal housings, doors, visors, mounting brackets, and hardware supplied direct from the manufacturer in the color stipulated above may be acceptable provided it meets or exceeds the finish process for the material indicated below.

**Software**

All amplifier software shall be supplied with the latest available revision. Any software upgrades released by the manufacturer shall be supplied at no charge to the Owner for a period of five years after acceptance of the traffic signal installation.

**Data Base Programming**

Each programmable local hardware component (i.e., controller, malfunction management unit, preemption unit, and detector amplifier) shall be initially programmed by the Contractor based on information contained on the plans.

Three sets of hard copy programming per device shall be supplied by the Contractor.

The Contractor shall supply a laminated copy of the traffic signal design plans and sequence and timing chart to be left in the cabinet's documentation envelope mounted on the inside of the cabinet door.

**Electric Power Cost**

The payment for power under Item 816.01 & 816.02 will be undertaken by the Contractor during the construction period. After the project's completion and acceptance by the MassDOT, the utility charges and account will be transferred to the MassDOT.

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**ITEMS 816.01 and 816.02** (Continued)**Traffic Signal Timing – Fine Tuning**

After the Contractor has finished installing the controllers and all other associated signal control equipment and after the Contractor has set the signal equipment to operate as specified in the contract documents, the fine tuning, adjusting and testing period shall begin. The Contractor shall advise the Engineer, Department in writing of the date of the beginning of the fine-tuning and testing period.

During this period, the Contractor, under the direction of the Engineer will make required adjustments and tests to ensure safe and efficient operation of the equipment. This period shall not last be less than 30 days. The contract completion date shall take this testing period into consideration. No request for final acceptance will be considered until successful completion of the testing period.

The Contractor shall notify the MassDOT and the Engineer in writing of the starting date of the fine tuning period and shall have MassDOT present for an inspection of the traffic signal.

The cost of electrical energy consumed by the operation of the traffic signal during the construction, fine-tuning and testing until final acceptance of the signal shall be paid by the Contractor.

**Final Acceptance**

Upon successful completion of the 30 day testing period wherein the traffic signal system has operated for 30 days without failure, the Contractor shall notify the Department. The Engineer will make a final inspection of the installation in the presence of the Department and the Contractor. An inspection check will be made to ensure that all equipment, materials, installations and operations are in accordance with the construction contract, plans and specifications. Items to be checked will include, but not be limited to, traffic signal systems operation, cabinet equipment, documents (wiring diagrams, as-built plans, instruction manuals, parts list, warranties, grounding resistivity test report, etc.), signs, and pavement markings, and street hardware (posts, bases, housings, brackets, etc.).

The Engineer will notify the Contractor in writing of any items in which the inspection reveals that the work is incomplete, defective, or does not otherwise meet the project specifications. The Contractor shall perform the corrective actions required to achieve final acceptance by the Department. These corrective actions shall be done by and at the expense of the contractor and within 15 days of the date of the inspection report, unless otherwise approved in writing by the Department.

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**ITEMS 816.01 and 816.02** (Continued)**Guarantee After Final Acceptance**

The Contractor shall diagnose (troubleshoot) the system and replace any part of the traffic signal system found to be defective in workmanship, material or manner of functioning within six months from date of final acceptance of all the installations under this Contract. This requirement does not affect the one-year warranty period on equipment specified in Subsection 815.20 of the Standard Specifications. Note: some of the equipment installed under this Contract shall have a warranty period beyond one year as noted.

Upon the date of acceptance of the project by the Department, the Contractor shall turn over all guarantees and warranties to the Department.

**As-Built Plans**

It will be the responsibility of the Contractor to provide the Design Engineer with as-built traffic signal layout plans indicating all changes made during the construction.

The plans shall indicate the location of all traffic signal equipment installed including detectors, signal posts, mast arms, strain poles, pedestrian and vehicular signal heads, controller cabinets, conduit, pull boxes, service connections and pre-emption equipment. The plans shall also indicate the final as-built timing and sequence, major item list, power-pole number and meter number. Upon receipt of the above as-built information from the Contractor, the Design Engineer will field verify the as-built information and plans. Following field verification, the Design Engineer will prepare the as-built Traffic Signal Layouts and/or Permits for submission to the MassDOT prior to the final acceptance of the project.

The Contractor shall supply As-Built Plans and wiring diagrams in 2018 AutoCAD DWG, DWF, and PDF formats.

**Technical Manuals and “Box Prints”**

Per MassDOT Specifications the Contractor shall provide prior to final acceptance as furnished by the manufacturer.

1. Controller Unit, Flasher, Load Switches, Conflict Monitor and all external logic units.
  - a. Electronic schematic of circuit boards.
  - b. Pictorial layout of components on circuit boards.
  - c. Service manual for troubleshooting.
  - d. Manual describing the theory of operations.
  - e. Parts list showing manufacturer’s part number and location.
2. Controller cabinet.
  - a. Cabinet wiring diagram (3 sets).
  - b. Field wiring diagram (3 sets).

**ITEMS 816.01 and 816.02** (Continued)

**Traffic Signal Removed and Discarded**

The work under this item shall also consist of removing, transporting, protection, temporary storage and discarding existing traffic control signal equipment as shown on the plans.

**BASIS OF PAYMENT**

Items 816.01 and 816.02 will be paid for at the Contract at the respective Contract unit prices Lump Sum, which price shall include all labor, material, equipment and incidental costs required to complete the work.

Controlled Density Fill – Excavatable will be paid separately under Item 153.

Conduit will be paid separately under Item 804.3, 3-Inch Electrical Conduit, Type NM Plastic (UL).

Pull boxes and handholes will be paid separately under Items 811.22 Electric Handhole – SD2.022 and 811.31, 12 x 12-inch Pull Boxes - SD2.030, respectively.

**ITEM 823.72****HIGHWAY LIGHTING ARM AND  
LUMINAIRE REMOVED AND RESET****EACH**

The work under this item shall conform to the relevant provisions of Subsections 801 and 820 of the Standard Specifications and the following:

The work shall consist of dismantling and removing the existing highway luminaires and arms from the existing utility poles to be removed/relocated/upgraded and resetting them onto the new / relocated utility poles, as shown on the plans.

The Contractor shall exercise extreme care in the dismantling, removal, transporting, storage, and resetting of the existing luminaires and arms. Any equipment damaged or stolen through carelessness or lack of protection by the Contractor shall be replaced at no additional cost.

Work shall be in accordance with the latest edition of the National Electrical Code, Massachusetts Electrical Code, local codes and as required by the Engineer. All work shall be performed by an experienced licensed electrician licensed in the Commonwealth of Massachusetts and qualified to work in the electrical space on the National Grid/Verizon joint owned poles.

If the Engineer determines that an existing lighting arm and luminaire is not suitable to be reset, but the Town of Westford would still like to have it, the work shall also include dismantling, removing and stacking of the arm and luminaire. The Contractor shall notify the Westford Department of Public Works and verify if the Town would like to have the arm and luminaire. If the Town elects to have the arm and luminaire, the Contractor shall arrange a time to deliver and stack the arm and luminaire at the Town of Westford Garage located at 28 North Street, Westford, MA. If the Town decides to abandon part or all of the arm and luminaire, said materials shall become the property of the Contractor and shall be legally disposed of.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Highway Lighting Arm and Luminaire Removed and Reset will be paid for at the Contract unit price per each, complete in place, which price shall include all labor, material, equipment and incidental costs required to complete the work.

No separate payment will be made for dismantling, removing, transporting, cutting and capping of existing conduits if required, coordination with the Westford DPW, the removing and stacking of arms or luminaires or the disposal of unsuitable or abandoned materials, but all costs in connection therewith shall be included in the unit price bid.

If the existing lighting arm or luminaires are unsuitable for resetting, the Contractor shall stack the old one and pick up a new one from the Town, at no additional compensation.

**ITEM 824.501**

**LED EMERGENCY VEHICLE SIGN  
REMOVED AND RESET**

**LUMP SUM**

The work to be done under this Item shall conform to the relevant provisions of Section 800 of the Standard Specifications, and the following:

Work under this item includes the removal, transporting and resetting of the existing solar-powered LED Emergency Vehicle Sign (W11-8) on Boston Road adjacent to the Town of Westford Fire Department station as denoted on the Plans. The existing LED Emergency Vehicle Sign shall be removed and reset in a location as denoted by the Engineer.

**The Contractor shall contact the Town of Westford Fire Department to coordinate the relocation.**

The existing LED Emergency Vehicle Sign shall be removed and carefully transported to a location as required by the Town of Westford Fire Department during construction activities around the existing sign location. Subsequent to relocation, the operation of the transmitter shall be tested in coordination with the Westford Fire Department, and adjusted as required to ensure it is operating as required.

The Contractor shall note well that appropriate care during removal, transporting and resetting of all existing components of the LED Emergency Vehicle Sign including the solar panel, battery, and pushbutton among others is required. Any damage to any of the LED Emergency Vehicle Sign caused by the Contractor's negligence shall be repaired or replaced by the Contractor at no additional cost.

The existing LED Emergency Vehicle Sign foundation shall be removed and discarded. Excavation of the existing foundation shall be to a minimum depth of 12" below existing ground surface.

A new foundation shall be constructed in accordance with the MassDOT standard cement concrete traffic signal post base and manufacturer's recommended foundation size.

**BASIS OF PAYMENT**

LED Emergency Vehicle Sign Removed and Reset will be paid for at the contract unit price Lump Sum, which price shall include all labor, tools, equipment, excavation and disposal of the existing foundations, supplying and replacing of compacted gravel backfill, cement concrete foundations, and materials, and all incidental costs required to complete the work.

**ITEM 824.62****RADAR FEEDBACK SIGN ASSEMBLY****EACH**

Work under this item shall conform to the relevant provisions under Subsection 828 of the Standard Specifications and the following:

The work shall include the furnishing and installation of solar powered Radar Speed Feedback Sign assemblies with 16-foot pedestal post and foundation and associated control equipment and wiring at the locations shown on the plans.

All radar sign equipment shall comply with the MassDOT Qualified Traffic Control Equipment List unless otherwise approved by the Engineer:

(<https://www.mass.gov/lists/massdot-qualified-traffic-control-equipment-qtce>)

The furnished item shall be one of the following products or approved equal

- Radarsign, LLC – TC-600 (<https://www.radarsign.com/radar-speed-signs/tc-600-full-matrix-radar-speed-sign/> )
- TrafficCalm - M75-012SE-000x (<https://trafficalm.com/12-speed-indicator-signs/> )
- Traffic Logix – SafePace 100 (<https://trafficlogix.com/safepace-100/> )

The “your speed” sign face shall be WHITE.

**16-foot Pedestal Post with Foundation**

The new pedestal posts shall have transformer bases and be made of aluminum. Bases shall be square unless otherwise noted. Bases shall be provided with a door opening and a cast aluminum door, complete with a cap screw fastening device and a tapped hole for a grounding lug. Posts and bases shall be factory painted gloss black.

New signal base foundations shall not obstruct a sidewalk or crosswalk so that passage by physically challenged persons is impaired. The installation shall be in compliance with ADA/AAB standards. Sidewalk extensions shall be provided when needed in order to maintain minimum ADA/AAB compliance.

The new pedestal posts on new foundations may utilize either precast or cast-in-place cement concrete pedestal post foundations constructed in conformance with the MassDOT Standard Drawings.

No separate payment will be made for work considered incidental to the excavation, including but not limited to, pedestal post foundations, dewatering, etc. but all costs in connection therewith shall be included in the each bid price for Item 824.62.

**ITEM 824.62** (Continued)**MATERIALS**

Each Radar Feedback Sign Assembly shall, at a minimum, consist of the following items, which shall be included in the bid:

- (1) concrete foundation;
- (1) 16-foot traffic signal posts and pedestals;
- (1) Radar Speed Feedback sign;
- (1) MA-W13-4P & R21-2p sign panels with;
- (1) solar panel;
- (1) NEMA Type 3R or higher enclosure to house:
  - Electrical components, including wiring and solid-state circuit boards;
  - On-board user interface;
  - Battery; and
  - Frequency hopping spread spectrum (or other alternate FCC approved) wireless activation unit with a minimum 150-foot range; and
- All mounting and supporting hardware and wiring required to complete a working system

All signs shall be MUTCD-compliant. MA-W13-4P signs shall have a black border and legend on a yellow background; R21-2p signs shall have a black border and legend on a white background. All sign sheeting materials shall be per Subsection 828.41.

Any proprietary software required for the programming and/or operation of the system shall be included at no additional cost. A representative(s) for the installer, supplier, and/or manufacturer shall provide up to 2-hours of training for Town DPW and Police Department staff on the programming, operation, and data download/analysis functions of the system.

The solar panels shall be affixed to an aluminum plate and bracket, adjustable at an angle of 45° to 60° and each assembly shall be mounted on a 360° rotatable pole cap mount to facilitate adjustment for maximum solar collection and optimal battery strength. The solar panel assemblies shall be rated for 90 mph wind conditions.

The batteries shall conform to Battery Council International specifications and have a capacity allowing up to 30 days of autonomy without sunlight and varying with ambient temperature and number of activations. The batteries shall be rated for a minimum lifespan of 3 years. Batteries shall be replaceable independently of other components.

The solar panels and battery shall have a minimum operating temperature range of -40° to 122°F (-40° to 50°C).

The Contractor shall provide shop drawings and calculations to confirm solar panel sizing and battery/solar energy storage will meet the functional requirements of the system.



**ITEM 824.62** (Continued)

**CONSTRUCTION METHODS**

No work shall commence until the shop drawings are approved by the Engineer.

Foundation installations shall be per Subsection 801.62. The top of the foundation shall be ¼-inch to 1-inch proud of the sidewalk and chamfered at 45 degrees. Gaps between the sidewalk and foundation shall be no larger than ¼-inch and grouted with preformed joint filler.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 824.62 will be measured and paid for at the Contract unit price per each, which price shall include all labor, materials, equipment, and incidental costs required to complete the work.

**ITEM 824.621**

**RADAR FEEDBACK SIGN  
REMOVED AND RESET**

**LUMP SUM**

The work to be done under this Item shall conform to the relevant provisions of Section 800 of the Standard Specifications, and the following:

Work under this item includes the removal, transporting and resetting of the existing solar powered radar feedback sign located on Utility Pole 22 at STA 44+10 RT adjacent to Crown Road to the relocated UPL 26 at 48+95 RT as denoted on the Plans.

The Contractor shall note well that appropriate care during removal and transporting of all existing components of the radar feedback including the solar panel, and battery among others is required. Any damage to any of the radar feedback sign caused by the Contractor's negligence shall be repaired or replaced by the Contractor at no additional cost.

MA-W13-4 (30) and R21-2p sign panels shall be mounted on the utility pole above radar feedback sign assembly.

**BASIS OF PAYMENT**

Item 824.621 will be paid for at the Contract unit price Lump Sum, which price shall include all labor, materials, equipment, removal, transportation, resetting, and all incidental costs required to complete the work.

MA-W13-4 (30) and R21-2p sign panels and utility pole mounting equipment shall be included under Item 824.621 with no additional compensation.

**ITEM 841.81**      **SUPPORT FOR GUIDE SIGN (D1-3) S5X10 STEEL**      **EACH**

The work under this item shall conform to the relevant provisions of Subsection 840 of the Standard Specifications and the following:

The work under this item shall consist of fabricating and installing single steel beam breakaway support posts in 4000 psi concrete foundations for an extruded (Type B) aluminum D1-3 sign panel as shown on the plans or as required by the Engineer. All new supports provided under this item shall be designed to sustain a minimum wind speed of 90 mph. Base plate bolts shall be torqued per current MassDOT and AASHTO standards.

For bidding purposes, all signs are presumed to be mounted on single 5 inch by 5 inch S-shape steel posts; however, the exact size of post to be installed at each location shall be determined by the Contractor and approved by the Engineer prior to fabrication and installation.

**METHOD OF MEASUREMENT**

Item 841.81 will be measured for payment by the Each support for guide sign (D1-3) S5X10 steel installed, complete in place.

**BASIS OF PAYMENT**

Item 841.81 will be paid at the contract unit price per each, which price shall include materials, labor, equipment, and all incidental costs required to complete the work.

No separate payment will be made for the design of the supports, fabrication and installation, including the foundation, excavation, backfilling and compaction, but all costs in connection therewith shall be included in the Contract unit price bid.

Loam borrow and seeding, as part of ground restoration work where required or as required by the Engineer, will be paid for separately under Items 751. and Item 765, respectively.

**ITEM 849.1**

**HISTORIC DISTRICT SIGN POST**

**EACH**

The work under this item shall conform to the relevant provisions of Subsection 840 of the Standard Specifications and the following:

The work under this item shall consist of fabricating and installing nominal 4-inch x 4-inch pressure-treated wood posts with pyramid-cut tops in 4000 psi concrete foundations for signs in locations shown on the plans or as required by the Engineer, and in accordance with the detail shown on the plans.

The wood sign posts shall be stained grey and sized to provide a minimum of 7-feet clearance to signs. The proposed sign posts shall match the existing wood sign posts in color and style. Signs shall be through-bolted with hot-dipped galvanized hardware.

**METHOD OF MEASUREMENT**

Item 849.1 will be measured for payment by the Each historic district sign post installed, complete in place.

**BASIS OF PAYMENT**

Item 849.1 will be paid at the contract unit price per Each, which price shall include materials, labor, equipment, and all incidental costs required to complete the work.

No separate payment will be made for the design of the supports, fabrication and installation, including the foundation, excavation, backfilling and compaction, but all costs in connection therewith shall be included in the Contract unit price bid.

Loam borrow and seeding, as part of ground restoration work where required or as required by the Engineer, will be paid for separately under Items 751. and Item 765., respectively.

**ITEM 852.11**  
**ITEM 852.12****TEMPORARY PEDESTRIAN BARRICADE**  
**TEMPORARY PEDESTRIAN CURB RAMP****FOOT**  
**EACH**

Work under these items consist of furnishing, deploying, maintaining in proper operating conditions, and removing temporary pedestrian barricades and temporary pedestrian ramps as part of a Temporary Pedestrian Access Route (TPAR) in order to guide pedestrians around a fully- or partially-closed sidewalk. These devices are intended to prevent pedestrians from entering the work area and to prevent pedestrians from inadvertently entering the vehicle travel lane by providing visual and physical separation between each space.

**MATERIALS**

The Temporary Pedestrian Barricade shall have a continuous bottom rail or edge no more than two (2) inches above the ground and eight (8) inches in height (minimum) to accommodate cane users, have a smooth and continuous hand railing along the top edge no less than 32 inches above the ground and not obstruct or project into the pedestrian path of travel. Barricade walls shall be nearly vertical and generally within the same plane.

If exposed to traffic, Temporary Pedestrian Barricades shall be crashworthy.

The Temporary Pedestrian Curb Ramp shall provide a 48 inch minimum width, with a firm, stable, and non-slip surface. Protective edging with a two (2) inch minimum height shall be installed when the curb ramp or landing platform has a vertical drop of six (6) inches or greater.

The Temporary Pedestrian Curb Ramp walkway and landing area surface shall be of a solid, continuous, contrasting color abutting up to the existing sidewalk.

If a Temporary Pedestrian Curb Ramp leads to a crosswalk, a detectable warning pad must be used at the base of the ramp; if it leads to a protected path that does not conflict with vehicular traffic then a detectable pad shall not be used.

**CONSTRUCTION METHODS**

The Temporary Pedestrian Barricade shall be placed in an area that will provide pedestrians with a TPAR on a smooth, continuous hard surface for its entirety. The geometry and alignment of the facility shall meet the applicable requirements of the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities” and the Massachusetts Architectural Access Board.

The recommended width of the TPAR is 60 inches, but if constraints exist a minimum clear width of 48 inches shall be provided along its entirety. If a 60 inch width cannot be accommodated in full, a 60 inch by 60 inch passing space shall be provided every 200 feet or less along the TPAR.

Turning areas shall be 60 inches by 60 inches minimum.

Lateral joints between any surfaces shall not exceed 0.5 inches. Lateral edges may be vertical up to 0.25 inches high and shall be beveled at 1V:2H between 0.25 inches and 0.5 inches.

**ITEMS 852.11 and 852.12** (Continued)

The TPAR shall be kept clear of debris, snow, and ice and the Temporary Pedestrian Barricades and Temporary Pedestrian Curb Ramps shall not obstruct drainage.

Removal and/or resetting of Temporary Pedestrian Barricades and Temporary Pedestrian Curb Ramps shall be considered incidental.

**COMPENSATION**

Payment for Temporary Pedestrian Barricades will be made at the contract price per foot installed in place, including all incidental items. This price shall include the cost of furnishing, installing, resetting, removal, and maintaining in good working condition.

Payment for Temporary Pedestrian Curb Ramps will be made at the contract price per each unit installed in place, including all incidental items. This price shall include the cost of furnishing, installing, resetting, removal, and maintaining in good working condition.

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**ITEM 864.12**                      **RECESSED CONTRAST ROUTE SHIELD**                      **SQUARE FOOT**  
**(PREFORMED)**

The work under this Item shall conform to the relevant provisions of Subsection 860 of the Standard Specifications and the following:

The work shall include furnishing, and installation of a durable, high skid resistant, retro reflective pavement marking material suitable for use as interstate shields, route shields or roadway delineation and markings at the location and in accordance with patterns indicated on the plans, and in conformance with the MUTCD and these specifications.

The Contractor will be required to provide the Engineer with the manufacturer's specification and installation instructions for the preformed recessed markings.

The markings must be a resilient white, yellow or other color thermoplastic product, the surface of which must contain glass beads and abrasives in an alternating pattern. The markings must be resistant to the detrimental effects of motor fuels, lubricants, hydraulic fluids etc. Lines, legends and symbols are capable of being affixed to hot mix asphalt pavement by the use of the normal heat of a propane torch.

The markings must be capable of conforming to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastic when heated with the torch.

The markings shall not have minimum ambient and road temperature requirements for application, storage, or handling.

The markings shall include a black contrast border. The contrast border shall be a minimum of 1.5 inches in width. The material for the contrast border shall be skid resistant and non-reflective.

**MANUFACTURING CONTROL AND ISO CERTIFICATION**

The manufacturer must be ISO 9001:2008 certified and proof of current certification must be provided. The scope of the certification shall include manufacture of reflective highway markings.

**MATERIALS**

Markings shall be composed of an ester modified rosin resistant to degradation by motor fuels, lubricants etc. in conjunction with aggregates, pigments, binders, abrasives, and glass beads which have been factory produced as a finished product, and meets the requirements of the current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. The thermoplastic material conforms to AASHTO designation M249-79 (98), with the exception of the relevant differences due to the material being supplied in a preformed state.

**ITEM 864.12** (Continued)Glass Beads

The material must contain a minimum of thirty percent (30%) intermixed graded glass beads by weight. The intermixed beads shall be clear and transparent. Not more than twenty percent (20%) consists of irregular fused spheroids, or silica. The index of refraction shall not be less than 1.50.

The material must have factory applied coated surface beads and abrasives in addition to the intermixed beads at a rate of 1/2 lb. ( $\pm 20\%$ ) per 11 sq. ft. The surface beads and abrasives must be applied in an alternating arrangement across the surface of the material so that the surface is covered in what is best described as a “checkerboard” pattern of glass beads and abrasive materials. The abrasive material must have a minimum hardness of 8 (Mohs scale). These factories applied coated surface beads shall have the following specifications:

- 1) Minimum 80% rounds                      3
- 2) Minimum refractive index of        1.5
- 3) Minimum SiO<sub>2</sub> Content of            70%;
- 4) Maximum iron content of            0.1%;

Size Gradation		Retained %	Passing %
US Mesh	Um		
12	1700	0% - 2%	98% - 100%
14	1400	0% - 6%	94% - 100%
16	1180	1% - 21%	79% - 99%
18	1000	28% - 62%	38% - 72%
20	850	67% - 77%	29% - 38%
30	600	62% - 71%	23% - 33%
50	300	86% - 95%	5% - 14%
80	200	97% - 100%	0% - 3%

Pigment

White: The material shall be manufactured with sufficient titanium dioxide pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected.

Red, Blue, and Yellow: The material shall be manufactured with sufficient pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected. The yellow pigments must be organic and must be heavy-metal free.

Other Colors: The pigments must be heavy-metal free.

Heating Indicators: The top surface of the material (same side as the factory applied surface beads) shall have regularly spaced indents. These indents shall act as a visual cue during application that the material has reached a molten state so satisfactory adhesion and proper bead embedment has been achieved and a post-application visual cue that the installation procedures have been followed.



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**ITEM 864.12** (Continued)**Skid Resistance**

The surface of the preformed retro reflective marking materials, wherein every other shaped portion contains glass beads, or abrasives with a minimum hardness of 8 (Mohs scale), shall upon application provide a minimum skid resistance value of 60 BPN when tested according to ASTM: E 303.

**Thickness**

The width of the supplied markings shall have a minimum average thickness of 125 mils.

**Retroreflectivity**

The preformed retroreflective marking materials, upon application, shall exhibit uniform nighttime retroreflectivity.

Note: Initial retroreflection and skid resistance are affected by the amount of heat applied during installation. When ambient temperatures are such that greater amounts of heat are required for proper installation, initial retroreflection and skid resistance levels may be affected. Contractor must perform readings and report the result to the Engineer.

**Environmental Resistance**

The material must be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

**Abrasives**

The abrasives and surface beads must be applied in an alternating arrangement across the surface of the material so that the surface is covered in what is best described as a “checkerboard” pattern of glass beads and abrasive materials. The abrasive material must have a minimum hardness of 8 (Mohs scale).

**CONSTRUCTION****Application**

The materials shall be applied using the infrared heater method recommended by the manufacturer. The material must be able to be applied without minimum requirements for ambient and road temperatures and without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry and free of debris. Supplier must enclose application instructions with each box/package.

**ITEM 864.12** (Continued)

Recess Depth

The depth of the recess shall be per the manufacturer's recommendation.

Packaging

The preformed thermoplastic markings shall be placed in protective plastic film with cardboard stiffeners where necessary to prevent damage in transit. Linear material must be cut to a maximum of 3' long pieces. Legends and symbols must also be supplied in flat pieces. The cartons in which packed shall be non-returnable and shall not exceed 40" in length and 25" in width, and be labeled for ease of identification. The weight of the individual carton must not exceed seventy (70) pounds. A protective film around the box must be applied in order to protect the material from rain or premature aging.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 864.12 will be measured and paid per Square Foot, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

**ITEM 864.221**  
**ITEM 864.231**

**SYMBOLS FOR BIKE FACILITIES (PF)**  
**ARROWS FOR BIKE FACILITIES (PF)**

**EACH**  
**EACH**

The work under these Items shall conform to the relevant provisions of Subsection 860 of the Standard Specifications and the following:

Work under these items consists of furnishing and installing preformed pavement marking arrows, and symbols at the locations shown on the plans or as directed by the Engineer. All preformed markings shall be 125 mils in thickness.

Materials

Symbols and Arrows are composed of preformed thermoplastic with pigments, glass spheres or other reflective materials, and other additives to control color, retro-reflectivity, and skid resistance.

All pavement marking colors shall be white and conform to MUTCD standards, including the Daytime Color Specification Limits for Retroreflective Pavement Marking Material found in 23 CFR 655, Subpart F.

The dimensions shall conform to Figures 9C-3, 9C-7, and/or 9C-9 of the MUTCD, unless otherwise shown in the plans, and are generally categorized in the following table.

<b>Item (Type)</b>	<b>Typical Applications</b>
864.221 (Bicycle Symbols)	Helmeted Bicyclist or Bicycle Outline used in bike lanes; Shared Lane Marking (Sharrow) with chevrons; Bicycle Detector symbol;
864.231 (Bicycle Arrows)	Arrow used with bike lane markings; Lane Use arrows at intersections

Post-installation, the surfaces of all preformed markings shall provide a minimum skid resistance value of 35 British Pendulum Number (BPN) when tested in accordance with ASTM E303, with exception to the items for Bicycle Facilities, which shall provide a minimum of 55 BPN.

The leading edge(s) of all Symbols and Arrows shall be tapered to minimize risk of plow damage.

Retroreflective properties shall be verified by an independent laboratory prior to installation. The average initial retro-reflectance readings shall exceed the following minimum values:

<b>Test Method</b>	<b>*White Markings</b>
ASTM E1710 (Dry)	300 mcd/lux/m <sup>2</sup>

The Contractor shall provide a Certificate of Compliance verifying the product supplied will meet the color, friction, and retro-reflectivity requirements prior to installation.

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**ITEMS 864.221 and 864.231** (Continued)**CONSTRUCTION METHODS**

The Contractor shall supply Shop Drawings to the Engineer for approval a minimum of 30 days in advance of installation. Shop Drawings shall include the product manufacturer's instructions, material safety data sheets (MSDS) for all components including any primers and sealers, and all tools, equipment, and procedures to be used for the installation. No work shall commence until the Shop Drawings have been approved.

It shall be the responsibility of the Contractor to prepare the surface prior to the installation of any Symbols and Arrows. Any joints or cracks in the pavement shall be pre-treated per the manufacturer's recommendation. At larger cracks or joints the material shall be laid over the gap and off-cut 1 in. on each side of the crack or joint prior to installation.

The surface shall be clean and dry prior to installation of the system. If additional surface preparation is recommended by the manufacturer, such as the installation of a primer or preheating, it shall be completed per the manufacturer's specifications. All surface preparation shall be considered incidental to the cost of the item.

All existing pavement markings that are to remain, castings, curbs, and rumble strips within the vicinity of the Symbols and Arrows shall be protected by the Contractor. Existing pavement markings damaged during the installation shall be removed and replaced by the Contractor at no additional cost.

The Contractor shall follow all installation instructions from the manufacturer, including allowable ranges of temperature and humidity for installation, unless otherwise approved by the Engineer.

Upon completion of installation, a sealer shall be applied if recommended by the manufacturer. The sealer shall be installed per the manufacturer's specification. The application of a sealer shall be considered incidental to the cost of the item.

The Contractor shall maintain protection of the Symbols and Arrows installation from vehicle and foot traffic throughout the minimum cure time recommended by the manufacturer.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Symbols and Arrows will be paid for at the contract unit price per each. The contract prices shall include all material, labor, and equipment required or incidental to the satisfactory completion of the work.

<b><u>ITEM 864.33</u></b>	<b><u>SLOTTED PAVEMENT MARKER</u></b> <b><u>TWO-WAY WHITE/RED</u></b>	<b><u>EACH</u></b>
<b><u>ITEM 864.34</u></b>	<b><u>SLOTTED PAVEMENT MARKER</u></b> <b><u>TWO WAY YELLOW/RED</u></b>	<b><u>EACH</u></b>

Work under these items shall be conformed to the relevant provisions of Subsection 860 of the Standard Specifications; the relevant provisions of 1996 Traffic Standard Drawing TR.6.3 “Typical Pavement Markings for Freeways”, the plans, and the following:

The work to be done under these items consists of furnishing and installing two-way white/red and two-way yellow/red reflectorized pavement markers slotted in pavement.

Markers shall be installed on the I-495 Southbound off-ramp and I-495 Southbound on-ramp as depicted on the plans.

### **CONSTRUCTION METHODS**

The work shall include cutting the tapered pavement slot to the dimensions shown on the typical details for the two-way markers, application of the manufacturer’s recommended epoxy adhesive, and placing the reflectorized pavement marker in the proper position within the slot so that the reflective face is visible and perpendicular to oncoming traffic and so that the top of the marker is set 1/8± inch below the top of the adjacent pavement.

Surface preparation and installation shall be strictly in accordance with the manufacturer’s instructions.

### **MATERIALS**

Reflectorized pavement markers shall be 3M Series 290, Avery Dennison Lifelite Model 948 BW, Ray-O-Lite Model 200 or an approved equal.

### **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Two-way white/red and two-way yellow/red reflectorized pavement markers slotted in pavement will be paid for at the contract unit price per each under Item 864.33 and Item 864.34 respectively, and shall include cutting the tapered pavement slot, furnishing and installation of the reflectorized markers, including all materials, labor, equipment and incidental costs required to complete the work.

**ITEM 864.41      GREEN COLORIZED PAVEMENT MARKINGS      SQUARE FOOT**

The work under this Item shall conform to the relevant provisions of Subsection 860 of the Standard Specifications and the following:

Work under this item consists of furnishing and installing Colorized Pavement Markings at the locations shown on the plans or as required by the Engineer.

**MATERIALS**

Green Colorized Pavement Markings are composed of Epoxy, Methyl Methacrylate (MMA), or Preformed Thermoplastic Materials.

The initial daytime chromaticity coordinates for green colorized pavement shall fall within the area created by the following coordinates:

<b>Initial Daytime Chromaticity Coordinates (Corner Points) for Green Colorized Pavement Markings</b>				
	1	2	3	4
<b>x</b>	0.230	0.266	0.367	0.444
<b>y</b>	0.754	0.460	0.480	0.583

The surface of the Green Colorized Pavement Markings shall provide a minimum skid resistance value of 55 British Pendulum Number (BPN) when tested in accordance with ASTM E303.

The Contractor shall provide a Certificate of Compliance verifying the product supplied meets the specified daytime chromaticity requirements and friction requirements prior to installation.

**CONSTRUCTION METHODS**

The Contractor shall supply Shop Drawings to the Engineer for approval a minimum of 30 days in advance of installation. Shop Drawings shall include the product manufacturer's instructions, material safety data sheets (MSDS) for all components including any primers and sealers, and all tools, equipment, and procedures to be used for the installation. No work shall commence until the Shop Drawings have been approved.

It shall be the responsibility of the Contractor to prepare the surface prior to the installation of any Green Colorized Pavement Markings. Any joints or cracks in the pavement shall be pre-treated per the manufacturer's recommendation. The surface shall be clean and dry prior to installation of the system. If additional surface preparation is recommended by the manufacturer, such as the installation of a primer or preheating, it shall be completed per the manufacturer's specifications. All surface preparation shall be considered incidental to the cost of the item.

Any existing pavement markings that conflict with the Green Colorized Pavement Markings shall be removed by the Contractor in advance of installation; installation of colorized pavement over pavement markings shall not be allowed.

**ITEM 864.41** (Continued)

All existing pavement markings that are to remain, castings, curbs, and rumble strips within the vicinity of the colorized pavement application shall be covered and protected by the Contractor. Existing pavement markings damaged by the Green Colorized Pavement Markings installation shall be removed and replaced by the Contractor at no additional cost.

The Contractor shall follow all installation instructions from the manufacturer, including allowable ranges of temperature and humidity for installation, unless otherwise approved by the Engineer.

Upon completion of installation, a sealer shall be applied if recommended by the manufacturer. The sealer shall be installed per the manufacturer's specification. The application of a sealer shall be considered incidental to the cost of the item.

The Contractor shall maintain protection of the Green Colorized Pavement Markings installation from vehicle and foot traffic throughout the minimum cure time recommended by the manufacturer.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Green Colorized Pavement Markings will be paid for at the respective contract unit price per square foot. The contract prices shall include all material, labor, and equipment required or incidental to the satisfactory completion of the work.

<b><u>ITEM 868.106</u></b>	<b><u>6 INCH WET REFLECTIVE RECESSED WHITE LINE (THERMOPLASTIC)</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 868.112</u></b>	<b><u>12 INCH WET REFLECTIVE RECESSED WHITE LINE (THERMOPLASTIC)</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 869.106</u></b>	<b><u>6 INCH WET REFLECTIVE RECESSED YELLOW LINE (THERMOPLASTIC)</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 869.112</u></b>	<b><u>12 INCH WET REFLECTIVE RECESSED YELLOW LINE (THERMOPLASTIC)</u></b>	<b><u>FOOT</u></b>

Work to be completed under these items shall conform to the relevant provisions of Subsection 860 of the Standard Specifications and the following:

Work shall consist of grooving a slot in the pavement surface and the furnishing and installation of wet reflective thermoplastic pavement markings.

### MATERIALS

Wet reflective thermoplastic pavement markings shall consist of a liquid binder, first drop beads or elements to provide dry and wet retroreflectivity, and second drop glass beads to improve the durability of the pavement marking, reduce track-free times, and provide supplementary dry retroreflectivity.

The Contractor shall use one of the following binders or approved equivalents:

- Ennis-Flint Hydrocarbon Thermoplastic;
- Integrated Traffic Systems iTherm® Hydrocarbon;
- Ozark Materials Hydrocarbon Thermoplastic; or
- SWARCO Hydrocarbon Thermoplastic.

The Contractor shall use one of the following first drop beads or elements, or approved equivalents:

- 3M™ All Weather Series 90S Elements;
- Ennis-Flint HP300 Glass Beads;
- Potters VISIMAX® Glass Bead System; or
- SWARCO MEGALUX-BEADS®.

Second drop beads shall be manufactured from glass of a composition that is highly resistant to traffic wear and to the effects of weathering. If coating is required to meet the performance requirements, the second drop beads shall be coated to ensure sufficient embedment and adhesion. Second drop beads retained on a No. 40 U.S. Standard Mesh Sieve shall have a minimum crush strength of 30 lbs. when tested in accordance with ASTM D1213.

Second drop beads shall have a minimum refractive index of 1.51 when tested in accordance with AASHTO M247.

Second drop beads passing the No. 30 sieve shall have a minimum of 75 percent true spheres when tested in accordance with ASTM D1155. All second drop beads retained on the No. 20 and No. 30 sieves shall have a minimum of 80 percent true spheres as determined by ASTM D1155.



**ITEMS 868.106, 868.112, 869.106, and 869.112** (Continued)

Second drop beads shall meet the following gradation requirements when tested in accordance with ASTM D1214:

U.S. Standard Sieve No.	Percent Retained
20	3-10
30	15-35
50	45-75
70	0-10
Pan	0-5

**CONSTRUCTION METHODS**
Installation of Groove

Prior to cutting out the grooves for all recessed lines, the Contractor shall use a chalk line or other suitable method to layout the proposed pavement markings on the surface course so that the Engineer can inspect the locations. Once the Engineer has inspected and approved the proposed striping layout, the grooves for the proposed pavement markings may be cut. No pavement grooving shall be done without the prior approval of the Engineer.

Groove position shall be a minimum of 4 inches from the edge of the pavement marking to any longitudinal pavement joints. The groove shall not be installed on bridge joints, on drainage structures, or in other areas identified by the Engineer. The groove shall not be installed continuously for intermittent pavement markings, but only where markings are to be applied.

The use of gang stacked diamond cutting blades to grind a smooth square slot is required for producing all grooves. The spacers between blade cuts shall be such that there will be less than a 10 mil rise in the finished groove between the blades. The acceptability of the surface texture will be determined by the Engineer.

The diamond grinder shall have an articulating head so that the slots are installed correctly on grades and super elevated sections.

Grooves that are ground deeper or wider than the specified allowable limits shall be repaired per the direction of the Engineer at no additional cost. Grooves that are ground too shallow, too narrow, or with unacceptable rises between blade cuts shall be reground to the correct size, depth, and surface finish at no additional cost. Slots ground out of alignment shall be patched using an approved method and materials.

Grooves shall be 1 inch  $\pm$  ¼ inch wider than the pavement marking material. Groove depth shall be 150 mils  $\pm$  5 mils, unless otherwise approved by the Engineer. Depth shall be consistent across the full width of the groove. Depth plates shall be provided by the Contractor to the Engineer to assure that desired groove depth is achieved.

**ITEMS 868.106, 868.112, 869.106, and 869.112** (Continued)

Grooves shall be clean, dry and free of laitance, oil, dirt, grease, paint or other foreign contaminants. Shrouds and a vacuum apparatus shall be included as part of the grinder to remove larger pieces of pavement that are ground out. If water is used to clean the groove or the grooving process takes place during rainfall, a minimum of 24 hours of dry time is required prior to the placement of pavement markings.

After the depth, width, length, and surface condition has been approved by the Engineer, an air lance shall be used to remove fine particles from the groove. Air compressors shall initially be blown out away from the application area to prevent compressor condensation build-up from entering the groove. The Contractor shall prevent traffic from traversing the grooves and re-clean grooves, as required, prior to application of pavement markings at no additional cost to the Department.

All grooves shall be given final approval by the Engineer prior to the placement of pavement markings.

**Installation of Wet Reflective Thermoplastic**

Installation of wet reflective thermoplastic pavement markings shall conform to the Manufacturer's specifications and the following:

Application rate for binder and all beads and elements shall consider final pavement surface composition and smoothness in advance of application to ensure proper wet film thickness and embedment of all beads and elements. The Contractor shall provide the Engineer with documentation from the Manufacturer with all recommended application rates in advance of any pavement marking installation.

The minimum uniform wet thickness for the thermoplastic binder shall be 90 mils  $\pm$  5 mils. The line thickness shall be met across at least the middle  $\frac{2}{3}$  of the pavement marking width. Depth plates shall be provided by the Contractor to the Engineer to assure that desired thickness is achieved.

The finished white color shall be free from tint, with good opacity and visibility under both daylight and artificial light. The finished yellow color shall be defined by Federal Test Standard 595 - Color Chip Number 13538, using Federal Test Standard 141 (Method 4252). The finished lines shall be uniform in color and have clean, well-defined edges.

First and second drop beads and/or elements shall be applied to prevent rolling or bouncing, to ensure that exposed portions of beads are free of binder material. Beads and elements shall be embedded in the binder to a depth of approximately 50% of their diameter.

Drop rate for first drop bead or element shall be per the Manufacturer's specifications. Drop rate for second drop glass bead shall be 6.4-10.2 lbs. per gallon.

**ITEMS 868.106, 868.112, 869.106, and 869.112** (Continued)

Newly installed pavement markings shall be protected from tracking during the setting period per Subsection 860.63.

Once the installed pavement markings have been open for traffic for a minimum of 48 hours, the Contractor shall perform retroreflectance readings per the measurement and sampling procedures contained in ASTM D7585 (Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments) using the Referee Evaluation Protocol found in section 6.4. The following tests shall be performed during the measurement and sampling process:

- ASTM E1710 (*Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer*); and
- ASTM E2177 (*Standard Test Method for Measuring the Coefficient of Retroreflected Luminance ( $R_L$ ) of Pavement Markings in a Standard Condition of Wetness*).

The average initial retroreflectance readings shall exceed the following minimum values:

	*White Markings	*Yellow Markings
ASTM E1710 (Dry)	475 mcd/lux/m <sup>2</sup>	375 mcd/lux/m <sup>2</sup>
ASTM E2177 (Wet Recovery)	375 mcd/lux/m <sup>2</sup>	300 mcd/lux/m <sup>2</sup>

\*Observation Angle = 1.05°, Entrance Angle = 88.8°

Pavement markings with measured average initial retroreflectance readings that do not meet the specified minimum values using the procedures outlined in subsection 6.4.5 of ASTM D7585 shall be removed by a method approved by the Engineer and reapplied at no additional cost.

**Pavement Marking Asset Management**

Upon completion of the pavement marking installation, the following data shall be tabulated by the Contractor:

- Retroreflectance readings, including date(s), time(s), and location(s) where readings took place;
- Liquid binder type(s) and application rate;
- Reflective element type and drop rate;
- Date of groove installation;
- Lot, batch number, or any other material identifiers and manufacturing information;
- Date and time of final liquid marking installation;
- Highway location (including direction) of installation;
- Air and pavement temperature during application;
- Measured material application thickness, depth of groove; and
- Any other pertinent information that may assist MassDOT with Quality Control.

**ITEMS 868.106, 868.112, 869.106, and 869.112** (Continued)

Results for all readings shall be provided within 10 business days of testing to the Engineer, with a second copy sent to:

State Traffic Engineer  
Attention: Pavement Marking Installation & Testing  
10 Park Plaza, Room 7210  
Boston, MA 02116

The cost to prepare and submit this data shall be considered incidental to the cost of the items.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Wet Reflective Recessed Thermoplastic Pavement Markings will be measured and paid for by the Contract unit price per linear foot, complete in place, which price shall include all materials, labor, equipment, and incidental costs required to complete the work.

**ITEM 874.2**

**TRAFFIC SIGN REMOVED AND RESET**

**EACH**

Work under this item shall conform to the relevant provisions of Subsection 828 of the Standard Specifications and the following:

The Contractor shall carefully remove and reset all designated existing signs including attachment hardware and sign support posts located as needed and where required by the Engineer.

Work shall include the dismantling, removal, transporting, storing and resetting of existing traffic signs at the locations shown on the plans. The Contractor shall completely remove the sign and post and reset said sign and post at the new location. If existing sign and/or post are not suitable for reuse as determined by the Engineer, the Contractor shall provide a new sign and/or post under Items 832. and/or 847.1 respectively. New attachment hardware shall be furnished as required to replace any missing or unusable existing hardware. Work shall also include the removal and disposal of footings up to a depth of 12 inches below the proposed surface of sidewalks and driveways as well as up to 36 inches below the proposed roadway.

Existing signs and/or posts damaged by the Contractor's operations shall be replaced in-kind by the Contractor at no additional compensation.

Included under this item are warning, regulatory, and route marker signs and miscellaneous directional signs.

The Contractor shall backfill with compacted gravel all holes resulting from the removal of the existing signs and their foundations and restore the area to match existing conditions of adjacent areas.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Traffic Sign Removed and Reset will be measured and paid for at the Contract unit price by the Each traffic sign removed and reset, complete in place, which price shall include all labor, materials, equipment, and incidental costs required to complete the work.

No separate payment will be made for gravel backfill or excavation and disposal of existing footings, if required, but all costs in connection therewith shall be included in the Contract unit price bid.

**ITEM 874.21**

**MUSEUM SIGN REMOVED AND RESET**

**LUMP SUM**

The work to be done under this Item shall conform to Standard Specification Subsection 828 and the following:

The historic Westford Museum sign located at 2 Boston Road shall be removed and reset at the location shown on the Traffic Signs and Pavement Markings sheets in the Contract Drawings with approval from the Engineer and the Town of Westford. The Contractor shall exercise care and make every effort to protect the sign during removal and reinstallation. The Contractor is responsible for stockpiling the sign in a safe and secure location for the duration of construction until the site conditions are suitable for reinstallation. Any damage to any of the museum sign caused by the Contractor's negligence shall be repaired or replaced by the Contractor at no additional cost.

The work shall include excavation of the existing foundations to a minimum depth of 12-inches below surface of the adjacent sidewalk. The sign posts should be installed at least 24 inches below finished grade surface and incased in concrete with a gravel base.

**BASIS OF PAYMENT**

Museum Sign Removed and Reset will be paid for at the contract unit price Lump Sum, which price shall include all labor, materials, and equipment, and incidental costs required to complete the work.

There shall be no additional compensation for the excavation and disposal of the existing foundations, the supplying and replacing of compacted gravel backfill, cement concrete foundations and any other incidental items necessary for the satisfactory completion of this work as specified, but all costs in connection therewith shall be included in the Contract lump sum price bid.

**ITEM 874.22**

**TRAIL SIGN REMOVED AND RESET**

**LUMP SUM**

The work to be done under this Item shall conform to Standard Specification Subsection 828 and the following:

The Peace Trail Cub Scout Pack 95 sign located at Town of Westford owned-land between 66-68 Boston Road and 70 Boston Road shall be removed and reset at the location shown on the Traffic Signs and Pavement Markings sheets in the Contract Drawings with approval from the Engineer and the Town of Westford. The Contractor shall exercise care and make every effort to protect the sign during removal and reinstallation. The Contractor is responsible for stockpiling the sign in a safe and secure location for the duration of construction until the site conditions are suitable for reinstallation. Any damage to any of the trail sign caused by the Contractor's negligence shall be repaired or replaced by the Contractor at no additional cost.

The work shall include excavation of the existing foundations to a minimum depth of 12-inches below surface of the adjacent sidewalk. The sign posts should be installed at least 24 inches below finished grade surface and incased in concrete with a gravel base.

**BASIS OF PAYMENT**

Trail Sign Removed and Reset will be paid for at the contract unit price Lump Sum, which price shall include all labor, materials, and equipment, and incidental costs required to complete the work.

There shall be no additional compensation for the excavation and disposal of the existing foundations, the supplying and replacing of compacted gravel backfill, cement concrete foundations and any other incidental items necessary for the satisfactory completion of this work as specified, but all costs in connection therewith shall be included in the Contract lump sum price bid.

**ITEM 874.41**

**TRAFFIC SIGN REMOVED AND DISCARDED**

**EACH**

The work to be done under this Item shall conform to Standard Specification Subsection 828 and the following:

Work under this item includes the dismantling, removal, and disposal of any existing signs and supports (including their foundations) not to be used under this contract, as directed by the Engineer and/or the Town of Westford. The signs and supports shall become the property of the Contractor and disposed of by the Contractor. The work shall include removal and disposal of the existing signs and supports, excavation of the existing foundations to a minimum depth of 12-inches below surface of sidewalk and driveways and 36-inches within new roadway areas.

The existing signs shall not be removed until the new signs and structures replacing them are ready to be installed or as directed by the Engineer.

**METHOD OF MEASUREMENT**

Item 874.41 will be measured for payment by the Each traffic sign removed and discarded.

**BASIS OF PAYMENT**

Item 874.41 will be paid for at the Contract unit price per each, which price shall include all labor, materials, equipment, excavation, disposal of the existing foundations, supplying and placing of gravel backfill, compaction, the restoration or replacement in kind of disturbed surfaces, and all incidental costs required to complete the work.



**ITEM 988.01**

**SEDIMENT FOREBAY PAVING**

**SQUARE FOOT**

The work under this item shall conform to the relevant provisions of Subsections 501 and 983 of the Standard Specifications and the following:

The purpose of this item is to provide a level protective surface over a compacted gravel borrow foundation and geotextile fabric for separation to facilitate in maintenance of the pretreatment sedimentation forebay.

The work shall include the construction to the line and grade of a level sedimentation forebay protective bottom surface conforming to the minimum size and dimensions shown on the Contract Drawings and the following:

Each piece of granite curb or edging shall have a minimum length of eighteen (18) inches, minimum width of four (4) inches and minimum depth of four (4) inches. Granite curb or edging shall be placed in an offset tile pattern with two (2) inch spacing on all sides. Material may either be new or existing curb or edging designated to be stacked as shown on the plans within the Project limits of work.

Reused curbing shall include removal, temporary storage, protection, cutting, removal and disposal of all foreign matter and installation.

Curb layout pattern shall be pre-approved by the Engineer.

**METHOD OF MEASUREMENT**

Sediment Forebay Paving will be measured for payment by the square Foot of curbing installed, complete in place.

**BASIS OF PAYMENT**

Sediment Forebay Paving will be paid for at the Contract unit price per Square Foot, which price shall include all labor, materials, equipment, and all incidental costs required to complete the work.

Excavation when required to construct the sediment forebay paving will be paid for by the cubic yard under Item 120.1 Unclassified Excavation.

Gravel borrow will be paid for separately by the cubic yard under Item 151.

Geotextile Fabric for Separation will be paid for separately by the square yard under Item 698.3.

**ITEM 992.33**                      **COORDINATION OF TEMPORARY SUPPORT**                      **EACH**  
**FOR UTILITY POLES**

The work under this item shall consist of coordinating with National Grid for temporary holds and support of utility poles.

The Contractor shall coordinate directly with National Grid to procure work order numbers for temporary holds and support of each utility pole at the locations shown on the Plans during installation of drainage infrastructure in proximity to the existing or proposed utility pole location.

National Grid shall be responsible for the temporary support of utility poles during the Contractor's activities.

The Contractor shall be responsible for all coordination and meeting the timetable set forth for temporary utility pole support by National Grid to coincide with the schedule for drainage infrastructure installation.

To initiate National Grid Electric Work Requests:  
<https://ngus.force.com/electric/s/> or 1-800-375-7405, Option #2

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 992.33 will be measured and paid for by the Contract unit price per each utility pole to be temporarily supported, which price shall include all labor, materials, equipment, National Grid work order number generated, and all incidental costs required to complete the work.

No additional compensation or basis for claim shall be awarded due to delays caused by the Contractor's failure to assess need and/or request temporary support in a timely manner.

\*\*\* END OF DOCUMENT \*\*\*

DOCUMENT A00802

# **DETAIL SHEETS**

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THE COMMONWEALTH OF MASSACHUSETTS  
MassDOT - HIGHWAY DIVISION  
TEN PARK PLAZA, BOSTON, MA

**PRELIMINARY ESTIMATE OF QUANTITIES - DETAIL SHEETS**

CITY/TOWN: Westford

YEAR: 2024

STA. 20+00 to 75+50

ROAD: Boston Road

TYPE OF PROJECT: Transportation Improvement

CLASS: Urban Principal Arterial

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Unclassified Excavation	12,500 CY	Gravel for Subbase	150 CY
Class "A" Rock Excavation	570 CY	Gravel for Driveways	220 CY
Class "A" Trench Excavation	30 CY	Gravel for Sidewalks & Ramps	60 CY
Class "B" Rock Excavation	15 CY	Embankment + 15%	575 CY
Class "B" Trench Excavation	2,350 CY	Dense Graded Crushed Stone	275 CY

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**PROPOSED FULL DEPTH RECLAMATION – BOSTON ROAD**

**AREA = 19,100 SY**

SURFACE: 1¾" SUPERPAVE SURFACE COURSE – 12.5 POLYMER (SSC - 12.5 - P) OVER  
1¾" SUPERPAVE INTERMEDIATE COURSE – 12.5 (SIC - 12.5) OVER

BASE: 4½" SUPERPAVE BASE COURSE – 37.5 (SBC – 37.5)

SUBBASE: 4" RECLAIMED PAVEMENT BORROW FOR SUB-BASE (STABILIZED) OVER  
8" RECLAIMED PAVEMENT BORROW FOR SUB-BASE

NOTE: RECLAIM DEPTH SHALL BE 14"±2" OR AS REQUIRED TO MEET LINES AND  
GRADES. EXISTING PAVEMENT SHALL BE MILLED 4" FROM STA 20+27 TO STA  
31+50 PRIOR TO RECLAIMING

**PROPOSED FULL DEPTH PAVEMENT CONSTRUCTION – CROWN ROAD**

**AREA = 700 SY**

SURFACE: 1¾" SUPERPAVE SURFACE COURSE - 12.5 POLYMER (SSC - 12.5-P) OVER  
2½" SUPERPAVE INTERMEDIATE COURSE – 12.5 (SIC – 12.5) OVER

SUBBASE: 12" GRAVEL BORROW, TYPE b OVER  
VARIABLE DEPTH SPECIAL BORROW OVER  
EXISTING SUBBASE MATERIAL

**PROPOSED RESURFACING OVERLAY**

**AREA = 4,285 SY**

SURFACE: 1¾" SUPERPAVE SURFACE COURSE - 12.5 - POLYMER (SSC - 12.5-P) OVER  
1¾" SUPERPAVE INTERMEDIATE COURSE – 12.5 (SIC - 12.5) OVER  
3½" MAX DEPTH FINE PAVEMENT MILLING

SUBBASE: EXISTING SUBBASE MATERIAL

NOTE: VARIABLE DEPTH PAVEMENT FINE MILLING AS REQUIRED TO MEET PROPOSED  
LINES AND GRADES.

**PROPOSED FULL DEPTH PAVEMENT (WIDENING LESS THAN 4' WIDE)**      **AREA = 70 SY**

SURFACE:    1¼" SUPERPAVE SURFACE COURSE – 12.5 POLYMER (SSC - 12.5 - P) OVER  
                 1¼" SUPERPAVE INTERMEDIATE COURSE – 12.5 (SIC - 12.5) OVER

BASE:            6" HIGH EARLY STRENGTH CEMENT CONCRETE BASE COURSE OVER

SUBBASE:    8" GRAVEL BORROW, TYPE b

**PROPOSED PERMANENT PAVEMENT TRENCH PATCH**      **AREA = 255 SY**

SURFACE:    VARIABLE DEPTH SUPERPAVE INTERMEDIATE COURSE – 19.0 (SIC – 19.0)  
(ITEM 451) (COMPACTED IN 3" LIFTS TO MATCH EXISTING PAVEMENT  
THICKNESS)

BASE:            8" GRAVEL BORROW, TYPE b

SUBBASE:    EXISTING MATERIAL SUITABLE FOR RE-USE (SEE VARIOUS TRENCH  
DETAILS)

**PROPOSED TEMPORARY PAVEMENT TRENCH PATCH**      **AREA = 6,800 SY**

SURFACE:    3" HOT MIX ASPHALT (ITEM 472.) OVER

SUBBASE:    EXISTING MATERIAL SUITABLE FOR RE-USE (SEE VARIOUS TRENCH  
DETAILS)

**PROPOSED HMA SIDEWALK & BIKE PATH**      **AREA = 2,320 SY**

SURFACE:    1¼" SUPERPAVE SURFACE COURSE - 9.5 (SSC-9.5) OVER  
                 1¼" SUPERPAVE SURFACE COURSE - 12.5 (SSC-12.5) OVER

BASE:            8" GRAVEL BORROW, TYPE b

**PROPOSED CEMENT CONCRETE SIDEWALK & PEDESTRIAN CURB RAMPS**      **AREA = 855 SY**

SURFACE:    4" CEMENT CONCRETE (4000 PSI, ¾", 610)

BASE:            8" GRAVEL BORROW, TYPE b

**PROPOSED CEMENT CONCRETE SIDEWALK THROUGH DRIVEWAYS**      **AREA = 65 SY**

SURFACE:    6" CEMENT CONCRETE (4000 PSI, ¾", 610)

BASE:            8" GRAVEL BORROW, TYPE b

**PROPOSED HMA DRIVEWAY (RESIDENTIAL) (TO MATCH EXISTING)**      **AREA = 865 SY**

SURFACE:    1½" SUPERPAVE SURFACE COURSE - 9.5 (SSC-9.5) OVER  
                 2½" SUPERPAVE SURFACE COURSE - 12.5 (SSC-12.5) OVER

BASE:            8" SUITABLE EXISTING GRAVEL;  
                 ADD GRAVEL BORROW, TYPE b AS REQUIRED

**PROPOSED HMA DRIVEWAY (COMMERCIAL/MUNICIPAL)**

**AREA = 535 SY**

SURFACE: 1½” SUPERPAVE SURFACE COURSE - 12.5 (SSC-12.5) OVER  
2½” SUPERPAVE SURFACE COURSE - 12.5 (SSC-12.5) OVER

BASE: 8” SUITABLE EXISTING GRAVEL;  
ADD GRAVEL BORROW, TYPE b AS REQUIRED

**PROPOSED GRAVEL DRIVEWAY**

**AREA = 50 SY**

SURFACE: 8” DENSE GRADED CRUSHED STONE (COMPACTED IN 4” (MAX) LIFTS

SUBBASE: SUITABLE EXISTING MATERIAL

**GENERAL PAVEMENT NOTES**

1. ASPHALT EMULSION FOR TACK COAT SHALL BE APPLIED BETWEEN ALL ASPHALT SURFACES AND SAWCUT JOINTS BEFORE PAVING. HMA JOINT ADHESIVE SHALL BE APPLIED TO ALL COLD JOINTS (LONGITUDINAL AND TRANSVERSE) BEFORE PAVING SURFACE COURSE. ASPHALT EMULSION FOR TACK COAT SHALL BE APPLIED IN ACCORDANCE WITH SUBSECTION 450.43. ALL SURFACES SHALL BE CLEAN OF ALL ORGANICS, DEBRIS, AND SAND PRIOR TO PAVING.
2. HMA FOR WALKS AND DRIVEWAYS SHALL BE IN ACCORDANCE WITH SECTION 702.
3. ALL GRAVEL BORROW MEETING SPECIFICATION SHALL BE RETAINED IN PLACE, COMPACTED, AND LEVELED AS REQUIRED.
4. PROPOSED GRAVEL BORROW MAY BE SUBSTITUTED WITH RECLAIMED PAVEMENT BORROW. GRAVEL BORROW SHALL BE IMPORTED AFTER ALL RECLAIMED PAVEMENT BORROW IS EMPLOYED.
5. PROPOSED DENSE GRADED CRUSHED STONE MAY BE SUBSTITUTED WITH ASPHALT STABILIZED RECLAIMED PAVEMENT BORROW.
6. ALL HMA SHALL BE IN ACCORDANCE WITH SECTION 450 HMA PAVEMENT AND SECTION M3 ASPHALTIC MATERIALS.
7. SUB-BASE SHALL BE 12” COMPACTED THICKNESS.
8. ALL ROADWAY EMBANKMENT SHALL BE COMPACTED TO NOT LESS THAN 95% OF MAXIMUM DRY DENSITY.
9. THE ENTIRE SUB-BASE SURAFCE SHALL BE STABILIZED WITH EMULSIFIED LIQUID ASPHALT FOR DENSITY AND DUST CONTROL PRIOR TO PAVING HMA BASE COURSE.
10. ALL UTILITY AND DRAINAGE STRUCTURES SHALL BE LOWERED BENEATH RECLAMATION DEPTH PER SECTION 403.

**ITEM 101. CLEARING AND GRUBBING**

<u>Boston Road</u>	
Station	Offset
27+91 to 28+86	RT
45+46 to 47+61	RT
45+31 to 47+40	LT
47+71 to 48+46	RT
52+00 to 55+48	LT
55+60 to 56+95	LT
66+79 to 67+30	LT

**ITEM 102.1 TREE TRIMMING**

<u>Boston Road</u>	
Station	Offset
24+08 to 25+39	RT
26+70 to 27+18	LT
27+36 to 27+48	LT
27+59 to 27+76	LT
27+92 to 28+15	LT
28+20 to 28+53	LT
28+74 to 28+90	LT
30+52 to 30+92	LT
30+99 to 31+10	LT
31+31 to 31+76	LT
37+21 to 37+32	RT
42+88 to 47+82	RT
54+70 to 56+10	RT

**ITEM 102.511 TREE PROTECTION – ARMORING & PRUNING**

<u>Boston Road</u>	
Station	Offset
22+49	35' RT
23+20	24' RT
24+50	30' LT
25+17	26' RT
25+34	29' RT
25+60	22' RT
26+11	26' RT
26+42	32' LT
27+01	33' LT
27+17	22' RT
28+54	30' LT
28+91	23' LT



**ITEM 102.511** (Continued)

29+44	27' LT
29+48	28' LT
29+64	25' LT
30+30	31' LT
30+45	33' LT
31+80	26' LT
33+28	25' RT
33+33	21' RT
37+80	29' LT
39+78	28' LT
40+13	27' LT
43+69	27' LT
48+29	25' LT
48+91	26' LT
52+15	32' RT
52+31	31' RT
54+38	31' RT
59+24	27' RT
59+76	21' RT

Crown Road

Station	Offset
81+94	23' RT

And as required by the Engineer.

**ITEM 102.513** **TREE PROTECTION – AIR EXCAVATION & ROOT-PRUNING**

Boston Road

Station	Offset
22+49	RT
23+20	RT
27+17	RT

And as required by the Engineer.

**ITEM 102.521** **TREE AND PLANT PROTECTION FENCE**

Boston Road

Station	Offset
20+54 to 22+85	30' to 56' LT

**ITEM 103. TREE REMOVED – DIAMETER UNDER 24 INCHES**Boston Road

Station	Offset
29+64	24' LT
29+97	29' LT
31+80	25' LT
47+37	14' RT
47+80	23' RT
56+18	27' RT
56+51	24' RT
56+88	24' RT
57+05	29' RT
57+28	25' RT
57+39	23' RT
57+51	33' RT
59+79	27' RT
60+19	14' LT
61+31	21' LT
67+30	35' LT
67+53	36' LT

Crown Road

Station	Offset
80+68	21' RT
80+76	17' RT

And as required by the Engineer.

**ITEM 104. TREE REMOVED – DIAMETER 24 INCHES AND OVER**Boston Road

Station	Offset
29+42	23' RT
45+01	33' LT
52+45	23' RT
52+64	15' LT
52+96	15' LT
62+06	18' LT
64+71	22' LT
65+38	33' LT

And as required by the Engineer.

**ITEM 105.**      **STUMP REMOVED**Boston Road

Station	Offset
38+22	30' LT
46+45	21' RT

**ITEM 146.**      **DRAINAGE STRUCTURE REMOVED**Boston Road

Station	Offset	Type
22+08	24' RT	DMH
23+10	15' LT	CB
23+27	21' RT	CB
25+32	17' RT	CB
26+33	15' RT	CB
27+16	15' RT	CB
29+10	17' RT	CB
31+00	17' RT	CB
31+48	15' LT	CB
35+78	20' RT	CB
35+83	14' RT	CB
37+34	17' RT	CB
38+50	14' RT	CB
39+01	18' LT	CB
39+20	13' RT	CB
41+36	17' RT	CB
41+36	15' LT	CB
41+45	13' LT	DMH
47+46	14' RT	CB
48+57	20' LT	CB
49+69	10' RT	CB
50+83	9' RT	CB
53+60	10' LT	CB
54+97	16' RT	CB
55+68	15' RT	CB
65+49	14' RT	CB
66+39	11' RT	CB
69+61	36' RT	CB
72+55	26' LT	CB
74+08	38' RT	CB

Main Street

Station	Offset	Type
12+84	18' LT	CB

**ITEM 201.**      **CATCH BASIN**Boston Road

Station	Offset	Struct. #
21+80	16' RT	83
23+27	16' LT	79
25+29	16' LT	77
26+34	16' LT	73
29+06	16' LT	68
31+00	16' LT	63
33+93	16' LT	59
35+83	16' LT	53
38+50	16' LT	45
38+50	16' RT	46
39+20	16' RT	43
41+36	16' LT	40
43+97	18' LT	37
44+21	19' RT	38
46+50	16' LT	35
46+88	16' RT	33
48+50	16' LT	30
48+52	16' RT	30A
50+40	16' RT	28
50+52	16' LT	27
52+21	16' RT	24A
52+50	17' LT	25
54+44	16' RT	23
54+56	16' LT	22
56+80	16' RT	19
59+39	16' RT	15
59+39	16' LT	16
62+39	16' RT	12
62+39	16' LT	11
65+47	16' RT	9
65+47	27' LT	8
67+19	20' LT	4
67+19	20' RT	5
68+69	17' RT	106
68+69	27' LT	105
70+12	29' RT	103
70+14	27' LT	102
72+55	27' LT	107
74+13	39' RT	108

Main Street

Station	Offset	Struct. #
12+77	21' LT	86

**ITEM 201.1**      **CATCH BASIN WITH DOUBLE GRATE**
Boston Road

Station	Offset	Struct. #
22+19	42' RT	84
23+22	18' RT	81
25+32	16' RT	76
26+33	16' RT	74
27+31	16' RT	71
29+06	22' RT	69
30+03	20' RT	66
31+00	17' RT	64
32+53	16' RT	61
33+94	16' RT	58
34+85	16' RT	56
35+75	19' RT	54
36+52	17' RT	51
41+36	16' RT	41

**ITEM 202.**      **MANHOLE**
Boston Road

Station	Offset	Struct. #
22+28	6' LT	82
23+27	21' LT	80
25+34	6' RT	75
27+33	6' RT	70
56+80	4' RT	18
68+76	6' RT	104
70+70	6' RT	101
70+93	29' RT	100

Main Street

Station	Offset	Struct. #
12+84	18' LT	85

**ITEM 203.12**      **STORMWATER BASIN OUTLET STRUCTURE**

Contingency Item.

To be used as required by the Engineer for the wet detention basin.

**ITEM 203.5**      **SPECIAL MANHOLE - 5 FOOT DIAMETER**Boston Road

Station	Offset	Struct. #
23+31	9' LT	78
26+36	5' RT	72
29+08	6' RT	67
30+03	20' RT	65
31+01	6' RT	62
32+54	6' RT	60
33+95	5' RT	57
34+86	5' RT	55
35+82	5' RT	52
36+53	5' RT	50
37+34	6' RT	47
38+51	5' RT	44
39+21	2' RT	42
41+39	3' RT	39
48+52	0' LT	29
52+53	6' RT	24
55+57	2' RT	20
57+99	4' RT	17
59+40	4' RT	14
61+41	1' RT	13
62+39	6' RT	10
66+55	5' LT	6

**ITEM 203.6**      **SPECIAL MANHOLE - 6 FOOT DIAMETER**Boston Road

Station	Offset	Struct. #
44+09	3' RT	36
45+51	4' RT	34A
50+43	4' RT	26
52+22	3' RT	24B
54+46	8' RT	21
65+48	1' LT	7
66+98	283' LT	2

**ITEM 203.7**      **SPECIAL MANHOLE - 7 FOOT DIAMETER**Boston Road

Station	Offset	Struct. #
46+51	4' RT	34
46+89	5' RT	31
66+97	20' LT	3

**ITEM 204.**      **GUTTER INLET**

Contingency Item.

To be used when proposed CB's conflict with existing utilities or as directed by the Engineer.

**ITEM 206.**      **DROP INLET, TYPE A**

Boston Road

Station	Offset	Struct. #
46+47	19' RT	35B

**ITEM 209.1**      **DROP INLET, TYPE DF**

Boston Road

Station	Offset	Struct. #
37+33	22' RT	49

**ITEM 220.**      **DRAINAGE STRUCTURE ADJUSTED**

Boston Road

Station	Offset	Type
64+46	16' RT	Exist CB
72+50	26' RT	Exist DMH
72+56	37' RT	Exist CB
75+43	31' RT	Exist CB
75+44	26' RT	Exist DMH
75+45	19' RT	Exist DMH

Main Street

Station	Offset	Type
10+91	23' RT	Exist CB
11+81	35' RT	Exist CB

Proposed drainage structures within reclaim limits and as required by the Engineer

**ITEM 220.2**      **DRAINAGE STRUCTURE REBUILT**

Proposed drainage structures within project limits as required by the Engineer.

**ITEM 220.5**      **DRAINAGE STRUCTURE REMODELED**

Boston Road

Station	Offset	Type
64+46	15' RT	CB
66+47	20' RT	DMH
72+50	25' RT	DMH

Main Street

Station	Offset	Type
11+84	24' RT	CB

Proposed drainage structures within reclaim limits and as directed by the Engineer

**ITEM 221.**      **FRAME AND COVER**

To be used for replacement of drainage structure covers within State Highway Layout and as directed by the Engineer.

Boston Road

Station	Offset
50+44	4' RT
52+21	3' RT
52+53	6' RT
54+46	8' RT
55+57	2' RT
56+80	4' RT
57+99	4' RT
59+40	4' RT
61+41	1' RT
62+39	6' RT
65+48	5' RT
66+56	11' LT
66+97	20' LT
68+76	6' RT
70+70	6' RT
70+93	29' RT

**ITEM 222.**      **FRAME AND GRATE – MASSDOT BAR TYPE**

Boston Road

Station	Offset
37+33	22' RT
46+47	19' RT

And as required by the Engineer.



**ITEM 222.1**      **FRAME AND GRATE – MASSDOT CASCADE TYPE**

To be used for replacement of drainage structure grates within State Highway Layout and as directed by the Engineer.

Boston Road

Station	Offset
50+40	16' RT
50+52	16' LT
52+21	16' RT
52+50	17' LT
54+44	16' RT
54+57	16' LT
56+80	16' RT
59+39	16' RT
59+39	16' LT
62+39	16' RT
62+39	16' LT
65+47	14' RT
65+47	26' LT
67+19	16' RT
67+19	27' LT
68+69	17' RT
68+69	27' LT
70+12	29' RT
70+14	27' LT
72+55	27' LT
74+13	39' RT

**ITEM 222.3**      **FRAME AND GRATE (OR COVER) MUNICIPAL STANDARD**

To be used for replacement of drainage structure grates and covers within Town of Westford layout and as directed by the Engineer.

Boston Road

Station	Offset	Type
21+80	16' RT	FRAME & GRATE - CBCI
22+19	42' RT	FRAME & GRATE - CBCI
22+28	6' LT	FRAME & COVER - DMH
23+22	18' RT	FRAME & GRATE - CBCI
23+27	21' LT	FRAME & COVER - DMH
23+27	16' LT	FRAME & GRATE - CB
23+31	9' LT	FRAME & COVER - DMH
25+29	16' LT	FRAME & GRATE - CBCI
25+32	16' RT	FRAME & GRATE – CBCI
25+34	6' RT	FRAME & COVER - DMH
26+33	16' RT	FRAME & GRATE – CB

**ITEM 222.3** (Continued)

26+34	16' LT	FRAME & GRATE - CBCI
26+36	5' RT	FRAME & COVER – DMH
27+16	16' RT	FRAME & GRATE - CBCI

Boston Road

Station	Offset	Type
27+33	6' RT	FRAME & COVER - DMH
29+06	22' RT	FRAME & GRATE - CB
29+08	6' RT	FRAME & COVER - DMH
30+03	20' RT	FRAME & GRATE – CB
30+03	20' RT	FRAME & COVER – DMH
31+00	17' RT	FRAME & GRATE - CB
31+00	16' LT	FRAME & GRATE – CB
31+01	6' RT	FRAME & COVER - DMH
32+53	16' RT	FRAME & GRATE - CB
32+54	6' RT	FRAME & COVER - DMH
33+93	16' LT	FRAME & GRATE - CBCI
33+94	16' RT	FRAME & GRATE - CB
33+95	5' RT	FRAME & COVER - DMH
34+85	16' RT	FRAME & GRATE - CB
34+86	5' RT	FRAME & COVER – DMH
35+75	19' RT	FRAME & GRATE - CB
35+82	5' RT	FRAME & COVER – DMH
35+83	16' LT	FRAME & GRATE - CBCI
36+52	17' RT	FRAME & GRATE - CB
36+53	5' RT	FRAME & COVER - DMH
37+34	6' RT	FRAME & COVER – DMH
38+50	16' LT	FRAME & GRATE - CB
38+50	16' RT	FRAME & GRATE - CB
38+51	5' RT	FRAME & COVER - DMH
39+20	16' RT	FRAME & GRATE - CB
39+21	6' RT	FRAME & COVER - DMH
41+36	16' LT	FRAME & GRATE - CBCI
41+36	16' RT	FRAME & GRATE - CBCI
41+39	6' RT	FRAME & COVER - DMH
43+97	18' LT	FRAME & GRATE – CB
44+09	3' RT	FRAME & COVER – DMH
44+21	19' RT	FRAME & GRATE - CBCI
46+50	16' LT	FRAME & GRATE - CBCI
46+53	LT/RT	FRAME & COVER- DMH
46+88	16' RT	FRAME & GRATE - CBCI
46+88	0' RT	FRAME & COVER - DMH
48+50	16' LT	FRAME & GRATE – CBCI
48+52	3' LT	FRAME & COVER – DMH
48+52	16' RT	FRAME & GRATE – CBCI

**ITEM 222.3** (Continued)

Main Street

Station	Offset	Type
12+77	21' LT	FRAME & GRATE - CBCI
12+84	18' LT	FRAME & COVER – DMH

And as required by the Engineer.

**ITEM 222.31** **FRAME AND GRATE (BEEHIVE)**

Boston Road

Station	Offset
72+54	RT

**ITEM 224.12** **12 INCH HOOD**

To be used as required by the Engineer for 12 inch diameter pipes in catch basins.

**ITEM 224.15** **15 INCH HOOD**

To be used as required by the Engineer for 15 inch diameter pipes in catch basins.

**ITEM 227.4** **MASONRY PLUG**

Boston Road

Station	Offset
21+95	30' RT
22+02	28' RT
22+12	25' RT
23+07	14' LT
30+94	17' RT
31+14	8' RT
31+46	13' LT
37+34	4' LT
39+03	18' LT
41+31	13' LT
41+49	13' LT
43+92	15' LT
47+49	14' RT
49+73	9' RT
50+80	9' RT
50+87	8' RT
51+50	2' RT

**ITEM 227.4** (Continued)

52+34	0.4' LT
53+57	10' LT
53+62	10' LT
54+18	2' RT
54+70	13' RT
54+95	16' RT
55+00	16' RT
55+64	15' RT
55+77	1' RT
66+41	13' RT

**ITEM 238.10**      **10 INCH DUCTILE IRON PIPE**

To be used for drainage pipes when utility conflicts with existing utilities or as directed by the Engineer.

**ITEM 241.30**      **36 INCH REINFORCED CONCRETE PIPE CLASS III**

<u>From Structure</u>	<u>To Structure</u>
Outlet Control Structure	Pipe Outlet

**ITEM 241.36**      **36 INCH REINFORCED CONCRETE PIPE CLASS III**

<u>From Structure</u>	<u>To Structure</u>
3	2
2	1
6	3

**ITEM 242.30**      **30 INCH REINFORCED CONCRETE PIPE FLARED END**

<u>Boston Road</u>	
Station	Offset
68+58	377' LT

**ITEM 242.36**      **36 INCH REINFORCED CONCRETE PIPE FLARED END**

<u>Boston Road</u>	
Station	Offset
68+55	372' LT

**ITEM 252.12**      **12 INCH CORRUGATED PLASTIC PIPE**

Boston Road

From Structure	To Structure
83	82
84	82
82	79
81	80
79	78
76	75
77	75
74	72
73	72
71	70
68	69
69	67
66	65
63	62
64	62
61	60
59	57
56	55
53	52
51	50
45	44
46	44
43	42
41	39
40	39
37	36
35	34
35B	34
33	31
30	29
30A	29
27	26
25	24
24A	24B
23	21
22	21
16	14
12	10
11	10
8	7
9	7
5	3
4	3
106	104

**ITEM 252.12** (Continued)

105	104
104	101
103	101
102	101
100	101

Main Street

From Structure	To Structure
86	85

**ITEM 252.124** **24 INCH CORRUGATED PLASTIC PIPE FLARED END**

<u>From Structure</u>	<u>To Structure</u>
32	31

**ITEM 252.15** **15 INCH CORRUGATED PLASTIC PIPE**

<u>From Structure</u>	<u>To Structure</u>
80	78
58	57
54	52
38	36
19	18
15	14

**ITEM 252.18** **18 INCH CORRUGATED PLASTIC PIPE**

<u>From Structure</u>	<u>To Structure</u>
78	75
75	72
49	47

**ITEM 252.24** **24 INCH CORRUGATED PLASTIC PIPE**

From Structure	To Structure
72	70
70	67
67	65
65	62
62	60
60	57
57	55

**ITEM 252.24** (Continued)

55	52
52	50
50	47
31	32

**ITEM 252.30**     **30 INCH CORRUGATED PLASTIC PIPE**

From Structure	To Structure
47	44
44	42
42	39
39	36
36	34A
34A	34
31	29
29	26
26	24
24B	23
24	21
21	20
20	18
18	17
17	14

**ITEM 252.36**     **36 INCH CORRUGATED PLASTIC PIPE**

From Structure	To Structure
34	31
14	13
13	10
10	7
7	6
6	3
3	2
2	1

**ITEM 258.      STONE FOR PIPE ENDS**

For use at drainage outlets.

Boston Road

<u>Station</u>	<u>Offset</u>
47+01	34' LT
67+09	298' LT
68+58	377' LT
72+54	46' RT

**ITEM 269.08      8 INCH SLOT-PERFORATED CORRUGATED PLASTIC PIPE (SUBDRAIN)**Boston Road

<u>Station</u>
25+32 to 26+33
26+33 to 27+16
27+16 to 29+06
29+06 to 30+03
30+03 to 31+00
31+00 to 32+53
32+53 to 33+94
33+94 to 34+85
34+85 to 35+75
35+75 to 36+51
38+50 to 39+20
39+20 to 41+36

**ITEM 269.10      10 INCH SLOT-PERFORATED CORRUGATED PLASTIC PIPE (SUBDRAIN)**Boston Road

<u>Station</u>
54+43 to 56+80
56+80 to 59+35

**ITEM 269.12      12 INCH SLOT-PERFORATED CORRUGATED PLASTIC PIPE (SUBDRAIN)**Boston Road

<u>Station</u>
36+51 to 38+50
41+36 to 44+21
44+21 to 46+47



**ITEM 269.12** (Continued)

46+88 to 48+52  
 48+52 to 50+40  
 50+40 to 52+21  
 52+21 to 54+44

**ITEM 271.121** **12 INCH AND UNDER PIPE REMOVED AND DISCARDED**Boston Road - Drainage

Station	Offset
23+11 to 23+30	LT
23+28 to 23+31	RT
25+35 to 26+33	RT
31+00 to 31+14	RT
31+49 to 35+83	LT
35+78 to 35+83	LT/RT
35+83 to 39+02	LT
37+34 to 37+34	RT/LT
38+50 to 38+65	RT
39+00 to 39+20	LT/RT
41+31 to 41+43	RT/LT
41+37 to 41+43	LT
46+60 to 46+82	RT/LT
48+57 to 49+68	LT/RT
51+50 to 52+34	RT/LT
54+18 to 54+70	RT
55+68 to 55+77	RT/LT
65+49 to 66+37	RT

Boston Road - Water

Station	Offset
20+42 to 29+25	RT
30+50 to 34+00	RT
35+00 to 51+28	RT/LT

**ITEM 271.181** **18 INCH PIPE REMOVED AND DISCARDED**Boston Road - Drainage

Station	Offset
61+41 to 61+43	LT

**ITEM 302.12      12 INCH DUCTILE IRON WATER PIPE (RUBBER GASKET)**

Boston Road

Station	Offset
20+05 to 72+45	LT/RT

Main Street

Station	Offset
11+71 to 12+17	LT

**ITEM 303.04      4 INCH DUCTILE IRON WATER PIPE (MECHANICAL JOINT)**

Boston Road

Station	Offset
23+39 to 23+45	LT/

**ITEM 303.06      6 INCH DUCTILE IRON WATER PIPE (MECHANICAL JOINT)**

Boston Road

Station	Offset
22+81	LT/RT
28+08	LT/RT
31+98	RT
38+75	RT
42+52	RT
42+52	LT/RT
53+25	RT
56+69	LT/RT
61+98	RT
66+80	RT
71+54	RT

**ITEM 303.08      8 INCH DUCTILE IRON WATER PIPE (MECHANICAL JOINT)**

Boston Road

Station	Offset
42+26	RT
65+94	RT

**ITEM 303.12      12 INCH DUCTILE IRON WATER PIPE (MECHANICAL JOINT)**

To be used where pressure could cause separation on proposed water main.

**ITEM 309.      DUCTILE IRON FITTINGS FOR WATER PIPE**
Boston Road

Station	Offset	Type
20+15	RT	12" 22° Bend
20+27	RT	12" 11° Bend
22+81	RT	12" x 6" TEE
23+46	RT	12" x 8" Cross
23+46	RT	8" X 4" Reducer
23+46	LT	8" 22° Bend
28+07	RT	12" x 6" TEE
31+98	RT	12" x 6" TEE
35+71	RT	12" x 4" TEE
38+75	RT	12" x 6" TEE
42+26	RT	12" x 8" TEE
42+52	RT	12" x 6" TEE
44+40	RT	12" x 6" TEE
47+20	RT	12" x 6" TEE
47+56	RT	12" 45° Bend
47+73	LT	12" 45° Bend
50+93	LT	12" 45° Bend
51+14	RT	12" 45° Bend
53+25	RT	12" x 6" TEE
54+00	RT	12" 22.5° Bend
54+33	RT	12" 22.5° Bend
54+60	RT	12" 22.5° Bend
54+91	RT	12" 22.5° Bend
56+69	RT	12" x 6" TEE
61+98	RT	12" x 6" TEE
65+94	RT	12" x 8" TEE
66+80	RT	12" x 6" TEE
71+54	RT	12" x 6" TEE
71+61	RT	12" 45° Bend
72+37	LT	12" MJ Cap
72+43	RT	12" 45° Bend

Main Street

Station	Offset	Type
12+08	LT	12" x 12" TEE

**ITEM 336.1**      **1 INCH PLASTIC WATER PIPE**Boston Road

Station	Offset
22+02	LT/RT
25+13	LT/RT
25+96	LT/RT
26+36	RT
26+65	RT
26+94	LT/RT
27+43	LT/RT
28+25	LT/RT
28+27	RT
29+18	RT
29+19	LT/RT
30+66	RT
30+87	LT/RT
31+30	RT
32+25	LT/RT
32+46	RT
33+37	LT/RT
33+40	RT
34+05	LT/RT
34+78	RT
36+31	RT
37+09	LT/RT
38+86	RT
39+59	RT
39+70	LT/RT
41+44	RT
43+13	LT/RT
48+15	LT
48+24	LT/RT
49+27	LT/RT
51+18	LT/RT
51+27	RT
53+74	LT/RT
55+80	LT/RT
65+26	LT/RT
68+32	LT/RT

**ITEM 336.2**      **2 INCH PLASTIC WATER PIPE**Boston Road

Station	Offset
42+10	LT

**ITEM 345.1**      **1 INCH TEMPORARY SERVICE PIPE**

To be used for temporary service connections during construction on proposed water main.

**ITEM 345.41**      **4 INCH TEMPORARY WATER BYPASS PIPE**

To be used for temporary water main during construction on proposed water main.

**ITEM 350.06**      **6 INCH GATE AND GATE BOX**

Boston Road

Station	Offset
22+81	RT
26+72	RT
31+98	RT
38+75	RT
42+52	RT
44+40	RT
47+20	RT
53+25	RT
56+69	RT
61+98	RT
66+80	RT
71+54	RT

**ITEM 350.08**      **8 INCH GATE AND GATE BOX**

Boston Road

Station	Offset
65+94	RT

**ITEM 350.12**      **12 INCH GATE AND GATE BOX**

Boston Road

Station	Offset
23+42	RT
23+46	RT
23+46	RT
23+51	RT
31+50	RT
39+50	RT
44+36	RT

**ITEM 350.12** (Continued)

44+46	RT
52+40	RT
60+00	RT
65+88	RT
66+00	RT

Main Street

Station	Offset
12+08	LT
12+15	LT

**ITEM 355.04** **4 INCH GATE AND GATE BOX REMOVED AND STACKED**

Boston Road

Station	Offset
23+46	RT
23+46	LT/RT
23+76	RT

**ITEM 357.06** **6 INCH GATE BOX**

To be used for the replacement of broken gate boxes or gate boxes not able to be adjusted.

**ITEM 358.** **GATE BOX ADJUSTED**

Boston Road

Station	Offset	Type
42+26	RT	WG

Main Street

Station	Offset	Type
11+09	LT	WG
12+60	LT	WG
12+92	LT	WG

And as required by the Engineer.

**ITEM 363.1**      **1 INCH CORPORATION COCK**Boston Road

Station	Offset
22+02	LT/RT
25+13	LT/RT
25+96	LT/RT
26+36	RT
26+65	RT
26+94	LT/RT
27+43	LT/RT
28+25	LT/RT
28+27	RT
29+18	RT
29+19	LT/RT
30+66	RT
30+87	LT/RT
31+30	RT
32+25	LT/RT
32+46	RT
33+37	LT/RT
33+40	RT
34+05	LT/RT
34+78	RT
36+31	RT
37+09	LT/RT
38+86	RT
39+59	RT
39+70	LT/RT
41+44	RT
43+13	LT/RT
48+15	LT
48+24	LT/RT
49+27	LT/RT
51+18	LT/RT
51+27	RT
53+74	LT/RT
55+80	LT/RT
65+26	LT/RT
68+32	LT/RT

**ITEM 363.2**      **2 INCH CORPORATION COCK**Boston Road

Station	Offset
42+10	LT

**ITEM 367.04**      **4 INCH CAST IRON PLUG**

Boston Road  
Station                      Offset  
20+42                      RT  
29+22                      RT  
35+00                      RT

**ITEM 367.08**      **8 INCH CAST IRON PLUG**

Boston Road  
Station                      Offset  
11+74                      LT

**ITEM 371.04**      **4 INCH COUPLING**

Boston Road  
Station                      Offset  
23+45                      RT

**ITEM 371.06**      **6 INCH COUPLING**

Boston Road  
Station                      Offset  
44+40                      LT

**ITEM 371.08**      **8 INCH COUPLING**

Boston Road  
Station                      Offset  
23+39                      LT  
42+26                      RT  
65+93                      RT

**ITEM 371.12**      **12 INCH COUPLING**

Boston Road  
Station                      Offset  
11+72                      LT  
11+79                      LT  
12+02                      LT



**ITEM 376.**      **HYDRANT**Boston Road

Station	Offset
22+82	LT
26+72	RT
31+98	RT
38+75	RT
42+52	RT
47+20	LT
53+25	RT
56+70	LT
61+98	RT
66+81	RT
71+54	RT

**ITEM 376.3**      **HYDRANT – REMOVED AND STACKED**Boston Road

Station	Offset
22+87	LT
31+98	RT
38+76	RT
46+89	LT
54+52	LT
60+96	LT
66+87	LT

**ITEM 376.5**      **HYDRANT – ADJUSTED**Boston Road

Station	Offset
81+38	LT

**ITEM 381.**      **SERVICE BOX**Boston Road

Station	Offset
25+13	LT
25+96	LT
26+36	RT
26+65	RT
26+94	LT
27+43	LT
28+25	LT

**ITEM 381.** (Continued)

28+27	RT
29+18	RT
29+19	LT
30+66	RT
30+87	LT
31+30	RT
32+25	LT
32+46	RT
33+37	LT
33+40	RT
34+05	LT
34+78	RT
36+31	RT
37+09	LT
38+86	RT
39+59	RT
39+70	LT
41+43	RT
42+10	LT
43+13	LT
48+15	LT
48+24	RT
49+27	RT
51+18	LT
51+27	RT
53+74	LT
55+80	LT
65+26	LT
68+32	LT

And as required by the Engineer.

**ITEM 382.** **METER BOX**

<u>Boston Road</u>	
Station	Offset
22+03	LT

**ITEM 382.2** **METER BOX REMOVED AND STACKED**

<u>Boston Road</u>	
Station	Offset
22+03	LT

**ITEM 384.**      **CURB STOP**Boston Road

Station	Offset
25+13	LT
25+96	LT
26+36	RT
26+65	RT
26+94	LT
27+43	LT
28+25	LT
28+27	RT
29+18	RT
29+19	LT
30+66	RT
30+87	LT
31+30	RT
32+25	LT
32+46	RT
33+37	LT
33+40	RT
34+05	LT
34+78	RT
36+31	RT
37+09	LT
38+86	RT
39+59	RT
39+70	LT
41+43	RT
42+10	LT
43+13	LT
48+15	LT
48+24	RT
49+27	RT
51+18	LT
51+27	RT
53+74	LT
55+80	LT
65+26	LT
68+32	LT

And as required by the Engineer.

**ITEM 451.**      **HMA FOR PATCHING**

To be used for mill & overlay areas that are in disrepair and cannot be milled out, and for permanent pavement trench patches.

**ITEM 472.      ASPHALT MIXTURES FOR TEMPORARY WORK**

To be used for temporary patching for access and drainage at driveways, temporary utility patching, and temporary curb ramps.

**ITEM 487.1      IMPRINTED PREFORMED THERMOPLASTIC CROSSWALKS**

To be used for decorative crosswalks adjacent to Westford Town Common.

**ITEM 504.2      GRANITE CURB TYPE VA4 – SPLAYED END**

Boston Road

Station	Offset
65+77	39' RT
66+08	44' RT
71+88	61' LT
72+00	43' LT
72+67	39' LT
72+97	38' LT
73+10	26' LT
74+74	66' RT
74+86	46' RT

Crown Road

Station	Offset
71+88	61' LT

**ITEM 506.      GRANITE CURB TYPE VB– STRAIGHT**

Boston Road

Station	Offset
23+86 to 24+78	RT
24+40 to 24+78	LT
25+14 to 26+31	RT
25+26 to 25+66	LT
25+96 to 27+11	LT
26+62 to 27+35	RT
27+42 to 27+68	LT
27+64 to 27+71	RT
27+98 to 28+75	RT
27+98 to 28+49	LT
28+17 to 28+20	LT
28+80 to 29+53	LT
29+11 to 30+69	RT
29+89 to 30+02	LT

**ITEM 506.** (Continued)

30+35	to	31+02	LT
31+00	to	31+03	RT
31+28	to	31+96	RT
31+35	to	31+78	LT
32+15	to	32+88	LT
32+33	to	33+00	RT
33+33	to	33+54	RT
33+23	to	34+43	LT
33+98	to	35+40	RT
34+77	to	34+02	LT
35+39	to	36+52	LT
36+03	to	38+08	RT
36+87	to	37+74	LT
38+08	to	38+15	LT
38+47	to	39+08	RT
38+52	to	38+94	LT
39+41	to	39+79	RT
39+34	to	41+88	LT
40+22	to	41+43	RT
41+78	to	47+44	RT
42+39	to	43+98	LT
44+99	to	47+54	LT
47+42	to	47+54	LT
47+73	to	50+76	RT
47+93	to	48+87	LT
49+51	to	49+84	LT
50+37	to	55+34	LT
51+23	to	53+70	RT
54+14	to	55+64	RT
55+73	to	62+84	LT
56+12	to	62+83	RT
63+18	to	63+46	LT
64+04	to	66+39	LT
64+16	to	65+19	RT
65+44	to	65+47	RT
72+58	to	74+44	RT
74+75	to	74+78	RT
At Medians	20+44	to 20+44	LT
	20+46	to 20+81	LT
	20+46	to 20+81	LT
	29+11	to 20+57	RT
	29+11	to 20+57	RT
	37+07	to 37+53	LT
	37+07	to 37+53	RT
	43+08	to 44+04	LT

**ITEM 506.** (Continued)

43+08 to 44+04	RT
53+12 to 53+68	LT
53+12 to 53+68	RT

Main Street

Station	Offset
11+26 to 11+86	RT

**ITEM 506.1**      **GRANITE CURB TYPE VB - CURVED**Boston Road

Station	Offset
21+81 to 22+03	RT
22+43 to 22+48	RT
23+15 to 23+25	RT
23+54 to 23+86	RT
23+56 to 23+93	LT
62+83 to 63+02	RT
65+47 to 65+61	RT
66+26 to 66+40	RT
71+86 to 71+88	LT

At Medians	20+51 to 20+58	LT
20+81 to 20+81		LT

Crown Street

Station	Offset
80+22 to 80+25	LT

**ITEM 509.**      **GRANITE TRANSITION CURB FOR PEDESTRIAN CURB RAMPS-STRAIGHT**Boston Road

Station	Offset
20+28 to 20+34	RT
23+36 to 23+36	LT
44+02 to 44+06	LT
65+19 to 65+44	RT
71+69 to 71+83	LT
71+86 to 72+00	LT
72+31 to 72+52	LT
71+31 to 72+51	RT
72+56 to 72+67	LT
72+97 to 73+10	LT

**ITEM 509.** (Continued)Main Street

Station	Offset
12+50 to 12+71	LT

Boston Road - Transition curb at driveways (Left Side)

Station	Offset
24+78 to 24+86	LT
25+20 to 25+26	LT
25+65 to 25+73	LT
25+89 to 25+96	LT
27+11 to 27+19	LT
27+35 to 27+41	LT
27+68 to 27+75	LT
27+92 to 27+98	LT

Boston Road - Transition curb at driveways (Left Side)

Station	Offset
28+49 to 28+58	LT
28+74 to 28+80	LT
29+53 to 29+64	LT
29+83 to 29+89	LT
30+02 to 30+13	LT
30+29 to 30+35	LT
31+02 to 31+13	LT
31+29 to 31+35	LT
31+78 to 31+89	LT
32+08 to 32+15	LT
32+88 to 32+99	LT
33+16 to 33+23	LT
34+43 to 34+54	LT
34+70 to 34+76	LT
35+02 to 35+13	LT
35+33 to 35+39	LT
36+52 to 36+63	LT
36+80 to 36+87	LT
37+74 to 37+85	LT
38+01 to 38+08	LT
38+15 to 38+30	LT
38+46 to 38+52	LT
38+94 to 39+09	LT
39+28 to 39+34	LT
41+88 to 42+04	LT
42+33 to 42+39	LT
47+54 to 47+63	LT
47+54 to 47+63	LT
47+86 to 47+93	LT

**ITEM 509.** (Continued)

48+89 to 48+99	LT
49+44 to 49+51	LT
49+84 to 49+96	LT
50+30 to 50+37	LT
55+34 to 55+48	LT
55+66 to 55+73	LT
62+84 to 62+92	LT
63+11 to 63+18	LT
63+46 to 63+53	LT
63+98 to 63+04	LT
66+79 to 66+88	LT
67+02 to 67+12	LT
68+22 to 68+31	LT
68+61 to 68+68	LT

**Boston Road - Transition curb at driveways (Right Side)**

Station	Offset
24+78 to 25+14	RT
26+31 to 26+62	RT
27+35 to 27+64	RT
27+71 to 27+98	RT
28+75 to 29+11	RT
30+69 to 31+00	RT
31+03 to 31+28	RT
31+96 to 32+33	RT
33+00 to 33+33	RT
33+54 to 33+98	RT
35+40 to 36+04	RT
38+08 to 38+47	RT
39+08 to 39+41	RT
39+79 to 40+22	RT
41+42 to 41+78	RT
47+35 to 47+79	RT
50+76 to 51+23	RT
53+70 to 54+14	RT
55+65 to 56+13	RT
67+58 to 68+04	RT

**Main Street**

Station	Offset
11+00 to 11+07	RT
11+20 to 11+26	RT



**ITEM 509.1**      **GRANITE TRANSITION CURB FOR PEDESTRIAN CURB RAMPS -  
CURVED**Boston Road

Station	Offset
20+13 to 20+23	RT
23+28 to 23+36	LT
44+06 to 44+17	LT
44+76 to 44+99	LT
65+62 to 65+78	RT
66+11 to 66+26	RT
72+62 to 72+66	LT
72+98 to 73+04	LT

**ITEM 514.**      **GRANITE CURB INLET - STRAIGHT**Boston Road

Station	Offset
21+26	16' RT
25+29	16' LT
25+32	16' RT
26+34	16' LT
27+04	16' RT
29+05	22' RT
29+06	16' LT
33+93	16' LT
35+83	18' RT
37+27	19' RT
41+36	16' RT
41+36	16' LT
44+21	19' RT
46+50	16' RT
46+50	16' LT
48+50	16' LT
48+52	16' RT
50+40	16' RT
52+22	16' RT
52+50	16' LT
54+30	16' LT
54+44	16' RT
56+80	16' RT
59+35	16' RT
59+35	16' LT
62+40	16' RT
62+40	16' LT
65+48	16' RT
65+48	27' LT

**ITEM 514.** (Continued)

67+19	15' RT
67+19	26' LT
68+69	17' RT
70+14	27' LT
70+14	24' RT

Main Street

Station	Offset
12+78	20' LT

**ITEM 515.** **GRANITE CURB INLET - CURVED**Boston Road

Station	Offset
23+20	17' RT

**ITEM 516.** **GRANITE CURB CORNER TYPE A**Boston Road

Station	Offset
20+44	3' LT
20+45	7' LT
29+10	2' RT
29+10	4' RT
29+59	2' RT
29+59	4' RT
37+06	2' LT
37+06	2' RT
37+54	2' LT
37+54	2' RT
43+06	0.5' LT
43+06	2' RT
44+05	0.5' LT
44+05	3' RT
53+10	2' RT
53+70	2' RT
53+10	2' LT
53+70	2' LT
72+51	38' RT
72+58	38' RT

**ITEM 580.**      **CURB REMOVED AND RESET**
Boston Road

Station	Offset
20+34 to 21+78	RT
21+78 to 22+10	RT
20+63 to 23+25	LT
22+50 to 23+15	RT
23+56 to 23+58	LT
23+83 to 24+62	LT
65+54 to 66+63	LT
66+93 to 68+28	LT
66+42 to 67+68	RT
67+99 to 72+31	RT
68+63 to 70+91	LT
70+91 to 71+99	LT
71+84 to 72+08	LT
71+86 to 72+40	LT
72+45 to 72+64	LT
72+58 to 74+66	RT
72+66 to 72+66	LT
72+97 to 72+97	LT
73+00 to 73+50	LT
74+84 to 74+90	RT
74+96 to 75+02	R

Hildreth Street – Boston Road Baseline

Station	Offset
22+10 to 22+37	LT
23+24 to 23+25	RT

Main Street

Station	Offset
11+20 to 11+88	RT
12+45 to 12+50	LT
12+71 to 12+87	LT

**ITEM 583.**      **EDGING REMOVED AND RESET**
Blake's Hill Road – Boston Road Baseline

Station	Offset
65+77 to 65+79	RT
66+09 to 66+15	RT

**ITEM 594. CURB REMOVED AND DISCARDED**

For curb not suitable for reuse. Assume that 25% of curb is unsuitable.

**Blake's Hill Road - Boston Road Baseline****Boston Road**

Station	Offset
20+34 to 21+81	RT
20+63 to 23+25	LT
22+48 to 23+15	RT
23+56 to 23+58	LT
23+93 to 24+40	LT
66+40 to 67+58	RT
66+75 to 66+85	LT
67+08 to 68+22	LT
68+04 to 72+31	RT
68+81 to 70+91	LT
71+88 to 72+31	LT
72+52 to 72+56	LT
73+02 to 73+10	LT

**Hildreth Street – Boston Road Baseline**

Station	Offset
22+03 to 22+44	LT
23+24 to 23+25	RT

**Main Street**

Station	Offset
11+26 to 11+80	RT

**ITEM 620.12 GUARDRAIL, TL-2 (SINGLE FACED)****Boston Road**

Station	Offset
55+82 to 62+40	22' LT

**ITEM 620.131 GUARDRAIL, DEEP POST (SINGLE FACED)****Boston Road**

Station	Offset
42+52 to 47+22	21' LT

**ITEM 620.32**      **GUARDRAIL, CURVED, TL-2 (SINGLE FACED)**

Boston Road  
Station                      Offset  
47+22 to 47+40            21' LT

**ITEM 627.1**      **TRAILING ANCHORAGE**

Boston Road  
Station                      Offset  
45+42 to 45+52            21' LT  
47+40 to 47+45            31' LT  
55+72 to 55+82            22' LT

**ITEM 627.82**      **GUARDRAIL TANGENT END TREATMENT, TL-2**

Boston Road  
Station                      Offset  
62+40 to 62+65            22' LT

**ITEM 630.2**      **HIGHWAY GUARD REMOVED AND DISCARDED**

Boston Road  
Station                      Offset  
58+20 to 60+32            10'-13' LT

**ITEM 670.**      **FENCE REMOVED AND RESET**

Boston Road  
Station                      Offset  
39+60 to 40+18            23'-25' LT

**ITEM 685.1**      **STONE MASONRY WALL, DRY**

Boston Road  
Station                      Offset  
48+25 to 48+33            22' LT  
48+87 to 48+95            23' LT

**ITEM 691. BALANCE STONE WALL REMOVED AND REBUILT**Boston Road

Station	Offset
32+10 to 32+98	22'-23' LT
42+54 to 44+19	24'-29' LT

**ITEM 691.1 BALANCE STONE WALL REMOVED AND STACKED**Boston Road

Station	Offset
30+45 to 30+54	22' LT
44+93 to 46+70	26' LT
47+40 to 47+49	18' RT
49+00 to 50+78	11' RT
52+00 to 55+38	22' LT
52+50 to 53+81	27' RT
62+45 to 62+87	22' LT
63+98 to 65+83	14'-32' LT

**ITEM 693.1 GRANITE WALL REMOVED AND RESET**Boston Road

Station	Offset
29+83 to 30+13	22' LT

**ITEM 698.3 GEOTEXTILE FABRIC FOR SEPARATION**

To be used below proposed stone for pipe ends, modified rockfill and below sediment forebay and side slopes.

**ITEM 703.3 CONCRETE BLOCK REMOVED AND STACKED**Boston Road

Station	Offset
63+58	26' LT
63+69	26' LT
63+81	26' LT
63+91	27' LT
66+55	30' LT

**ITEM 703.4**      **CONCRETE POST REMOVED AND STACKED**Boston Road

Station	Offset
66+49	26' LT
66+50	26' LT
66+54	26' LT
66+64	29' LT

**ITEM 706.45**      **GRANITE STEPS REMOVED AND RESET**Boston Road

Station	Offset
28+11	20' RT

**ITEM 706.61**      **GRANITE THRESHOLD REMOVED AND RESET**Boston Road

Station	Offset
27+52	21' LT

**ITEM 706.7**      **COBBLESTONE PAVERS**

To be used for Cobblestone Medians

Boston Road

Station	Offset
20+44 to 20+81	LT
29+10 to 29+59	RT
37+05 to 37+54	LT/RT
43+06 to 44+05	LT/RT
53+10 to 53+70	LT/RT

**ITEM 706.71**      **COBBLESTONE EDGING REMOVED AND RESET**Boston Road

Station	Offset
33+92 to 34+56	22' LT
34+69 to 35+09	22' LT

**ITEM 706.72**      **COBBLESTONE WALK REMOVED AND RESET**Boston Road

Station	Offset
29+04 to 29+07	25' LT

**ITEM 706.73**      **COBBLESTONES REMOVED AND STACKED**Boston Road

Station	Offset
47+86 to 48+00	17'-22' LT

**ITEM 710.3**      **BOUND – LETTERED GRANITE**Boston Road

Station	Offset
51+20	22' LT
51+94	22' LT
52+53	23' LT
53+12	24' LT
53+58	24' LT
53+68	24' LT
53+81	24' LT
58+24	22' LT
58+85	22' LT
59+74	22' LT
62+90	22' LT
64+30	22' LT
65+86	32' LT

**ITEM 710.4**      **BOUND – PLAIN GRANITE**Boston Road

Station	Offset
20+49	44' LT
20+64	28' LT
21+05	23' LT
23+90	30' LT
25+41	23' LT



**ITEM 711.**      **BOUND REMOVED AND RESET**Boston Road

Station	Offset
28+92	23' LT
67+22	33' LT

**ITEM 712.**      **BOUND REMOVED AND STACKED**Boston Road

Station	Offset
64+86	26' LT

**ITEM 715.**      **RURAL MAILBOX REMOVED AND RESET**Boston Road

Station	Offset
25+10	19' RT
26+04	17' LT
26+34	17' RT
27+11	17' LT
27+38	22' RT
27+69	17' LT
28+49	18' LT
28+84	22' RT
29+90	17' LT
30+77	17' RT
30+97	17' LT
31+28	17' RT
31+77	17' LT
32+05	17' RT
32+86	17' LT
33+50	17' RT
34+84	17' LT
35+47	17' LT
35+48	18' RT
36+05	17' RT
36+88	19' LT
38+08	19' LT
38+21	18' RT
38+88	17' LT
39+84	17' RT
41+48	18' RT
42+03	23' LT
42+04	23' LT
47+74	17' RT

**ITEM 715.** (Continued)

47+95	17' LT
49+82	17' LT
50+83	17' RT
50+84	17' RT
54+11	17' RT
55+32	16' LT
64+09	21' LT
68+16	28' LT

Crown Road

Station	Offset
80+59	15' LT
81+24	15' RT
81+41	15' LT

And as required by the Engineer.

**ITEM 773.438** **PINE - WHITE 7-8 FEET**Boston Road

Station	Offset
61+02	RT

**ITEM 776.557** **MAPLE - RED - RED SUNSET 2-2.5 INCH CALIPER**Boston Road

Station	Offset
22+90	RT

**ITEM 778.363** **CHERRY - MT. FUJI 1.5-2 INCH CALIPER**Boston Road

Station	Offset
22+87	RT
23+10	RT
40+86	RT

**ITEM 778.393** **CHERRY - YOSHINO 1.5-2 INCH CALIPER**Boston Road

Station	Offset
23+04	RT

**ITEM 778.423      CRABAPPLE - DONALD WYMAN 1.5-2 INCH CALIPER**

<u>Boston Road</u>	
Station	Offset
36+36	RT
60+80	RT

**ITEM 778.436      CRABAPPLE - PRAIRIEFIRE 1.5-2 INCH CALIPER**

<u>Boston Road</u>	
Station	Offset
36+78	RT

**ITEM 781.263      HAWTHORN - WINTER KING 1.5-2 INCH CALIPER**

<u>Boston Road</u>	
Station	Offset
34+87	RT

**ITEM 782.536      REDBUD - EASTERN 7-8 FEET**

<u>Boston Road</u>	
Station	Offset
28+02	RT
47+37	LT
67+27	RT

**ITEM 783.043      SERVICEBERRY - AUTUMN BRILLIANCE 7-8 FEET**

<u>Boston Road</u>	
Station	Offset
39+70	RT

**ITEM 788.265      AZALEA - SWAMP 2-3 FEET / #5**

<u>Boston Road</u>	
Station	Offset
47+33	LT
47+40	LT
47+42	LT

**ITEM 804.3**      **3 INCH ELECTRICAL CONDUIT TYPE NM - PLASTIC - (UL)**Boston Road

Station	Offset
71+46 to 71+72	45'-59' LT
71+72 to 71+81	62'-69' LT
71+72 to 71+95	30'-59' LT
71+95 to 72+01	30'-33' LT
71+95 to 72+29	29'-30' LT
72+20 to 72+29	29'-61' LT
72+29 to 72+40	29'-33' LT
72+29 to 72+55	29'-30' LT
72+55 to 72+59	30' LT
72+55 to 72+56	30'-33' LT
72+44 to 72+48	41'-44' RT
73+06 to 73+06	32'-37' LT
73+09 to 73+67	29'-31' LT
73+68 to 75+45	31'-32' LT

**ITEM 811.22**      **ELECTRIC HANDHOLE - SD2.022**Boston Road

Station	Offset
72+29	30' LT

**ITEM 811.31**      **PULL BOX 12 X 12 INCHES - SD2.031**Boston Road

Station	Offset
71+72	58' LT
71+95	30' LT
72+56	30' LT
72+21	61' LT
73+68	31' LT

**ITEM 811.35**      **PULL BOX ADJUSTED**Boston Road

Station	Offset
71+48	41' RT
73+09	29' LT
75+48	31' LT

**ITEM 811.351    PULL BOX REMOVED AND STACKED**

<u>Boston Road</u>	
Station	Offset
72+59	29' LT
73+68	29' LT

**ITEM 824.501    LED EMERGENCY VEHICLE SIGN REMOVED AND RESET**

To be used for the relocation of the existing “Fire Station Ahead” sign at STA 58+00 RT.

**ITEM 824.62    RADAR FEEDBACK SIGN ASSEMBLY**

<u>Boston Road</u>	
Station	Offset
33+85	23' LT
34+15	19' RT
47+57	23' LT

**ITEM 829.    ROADSIDE GUIDE SIGN (G) – ALUMINUM PANEL (TYPE B)**

<u>Boston Road</u>		
Sign	Station	Offset
MA-I-13	49+42	18' RT

**ITEM 832.    WARNING-REGULATORY AND ROUTE MARKER - ALUM. PANEL (TYPE A)**

<u>Boston Road</u>		
<u>Sign</u>	<u>Station</u>	<u>Offset</u>
W11-2	20+27	25' RT
	23+28	38' LT
	23+54	50' LT
W16-7PL	20+27	25' RT
	23+54	50' LT
W16-7PR	23+28	38' LT
R3-17	20+69	18' RT
	21+26	22' LT
	72+36	33' LT
	75+09	34' RT
	76+68	36' LT
R3-17aP	76+68	36' LT

**ITEM 832.** (Continued)

R3-17bP	21+26	22' LT
	75+09	34' RT
R8-3a	22+58	23' RT
	23+20	48' RT
D1-3	23+97	19' LT
W2-2L	40+60	19' RT
	67+99	33' LT
W16-8p	40+60	19' RT
	47+16	17' LT
R21-2p	33+85	22' LT
	34+15	19' RT
	47+34	22' LT
	48+95	17' RT
<u>Main Street</u>		
<u>Sign</u>	<u>Station</u>	<u>Offset</u>
MA-W13-4 (30)	33+85	22' LT
	34+15	19' RT
	47+34	22' LT
	48+95	17' RT
W1-4L	46+87	18' RT
	60+92	23' LT
W13-1P (30)	46+87	18' RT
	60+92	23' LT
W2-2R	47+16	17' LT
W4-2R	66+32	31' LT
R5-11	67+65	22' RT
R1-1	66+14	34' RT
	74+70	65' RT
W11-8	69+05	34' LT
W9-1R	70+46	34' LT
R3-8 (333)	71+14	31' RT
R10-11a (M)	71+53	29' LT
R10-6	71+86	62' LT
R10-22	72+30	40' RT
	73+45	31' LT
	75+38	40' RT
W11-1	73+11	40' RT
R3-7R	10+71	32' RT
W11-2	11+23	32' RT
	12+64	17' RT
	12+64	29' LT
	14+07	25' LT
W14-1	11+00	36' LT
W16-9P	11+23	32' RT
	14+07	25' LT

**ITEM 832.** (Continued)

W16-7PR	12+64	29' LT
	12+64	16' RT
W16-7PL	12+64	29' LT
	12+64	16' RT
R1-5	13+05	30' LT
 <u>Crown Road</u>		
<u>Sign</u>	<u>Station</u>	<u>Offset</u>
R1-1	80+26	24' LT

**ITEM 841.81**      **SUPPORTS FOR GUIDE SIGN (D1-3) S5X10 STEEL**

Boston Road

<u>Sign</u>	<u>Station</u>	<u>Offset</u>
D1-3	23+97	19' LT

**ITEM 847.1**      **SIGN SUP (N/GUIDE)+RTE MKR W/1 BRKWAY POST ASSEMBLY – STEEL**

Boston Road

<u>Station</u>	<u>Offset</u>	<u>Type</u>
40+60	19' RT	NEW
46+87	18' RT	NEW
47+16	17' LT	NEW
49+42	18' RT	NEW
60+92	23' LT	NEW
65+40	23' RT	R&R
66+14	34' RT	NEW
66+32	31' LT	NEW
67+65	22' RT	NEW
67+99	33' RT	NEW
69+05	34' LT	NEW
70+46	33' LT	NEW
71+84	46' RT	R&R
71+86	62' LT	NEW
72+30	45' RT	NEW
72+36	33' LT	NEW
73+11	40' RT	NEW
72+30	40' RT	NEW
73+42	31' LT	NEW
75+09	34' RT	NEW
75+38	40' RT	NEW
76+68	36' LT	NEW

**ITEM 847.1** (Continued)Crown Road

Station	Offset	Type
80+26	23' LT	NEW

**ITEM 848.1** **SIGN SUP (N/GUIDE)+RTE MKR W/2 BRKWAY POST ASSEMBLIES**  
**- STEEL**Boston Road

Station	Offset	Type
44+21	26' LT	NEW
66+29	26' RT	NEW
68+95	26' RT	R&R
71+14	31' RT	NEW
71+67	56' LT	R&R
71+99	39' RT	R&R

**ITEM 849.1** **HISTORIC DISTRICT SIGN POST**Boston Road

Station	Offset	Type
20+27	25' RT	NEW
20+69	18' RT	NEW
21+26	22' LT	NEW
21+97	24' RT	R&R
22+41	24' RT	R&R
22+49	23' RT	R&R
22+58	23' RT	NEW
23+20	48' RT	NEW
23+21	23' RT	NEW
23+28	38' LT	NEW
23+28	30' LT	R&R
23+54	50' LT	NEW
23+70	26' RT	R&R
36+23	23' LT	R&R

Main Street

Station	Offset	Type
10+72	33' RT	NEW
11+00	36' LT	R&R
11+23	32' RT	NEW
12+63	29' LT	NEW
12+64	16' RT	NEW
13+05	30' LT	NEW
14+07	25' LT	NEW



**ITEM 853.2**      **TEMPORARY BARRIER (TL-2)**

To be used as directed by the Engineer during construction of embankment between STA 55+75 to STA 62+00

**ITEM 864.04**      **PAVEMENT ARROWS AND LEGENDS REFLECTORIZED WHITE (THERMOPLASTIC)**

Boston Road

<u>Station</u>	<u>Type</u>
71+24	THRU ARROW
71+24	THRU ARROW
71+71	SOUTH
72+09	THRU ARROW
72+09	THRU ARROW
72+61	ONLY
73+00	RIGHT TURN ARROW
73+40	ONLY
73+80	RIGHT TURN ARROW

Main Street

<u>Station</u>	<u>Type</u>
10+75	RIGHT TURN ARROW
11+25	ONLY
11+63	RIGHT TURN ARROW
11+63	THRU ARROW
12+91	LEFT TURN ARROW
12+91	THRU ARROW
13+08	YIELD

**ITEM 864.12**      **RECESSED CONTRAST ROUTE SHIELD (PREFORMED)**

Boston Road

<u>Station</u>	<u>Offset</u>
71+09	25' RT
72+09	25' RT

**ITEM 864.221**      **SYMBOLS FOR BIKE FACILITIES (PF)**

Boston Road

<u>Station</u>	<u>Type</u>
20+70	HELMETED BICYCLIST
22+59	HELMETED BICYCLIST
23+11	HELMETED BICYCLIST
24+08	HELMETED BICYCLIST
24+43	HELMETED BICYCLIST

**ITEM 864.221** (Continued)

25+62	HELMETED BICYCLIST
26+03	HELMETED BICYCLIST
30+48	HELMETED BICYCLIST
30+63	HELMETED BICYCLIST
35+42	HELMETED BICYCLIST
35+43	HELMETED BICYCLIST
40+21	HELMETED BICYCLIST
40+36	HELMETED BICYCLIST
42+76	HELMETED BICYCLIST
42+91	HELMETED BICYCLIST
45+27	HELMETED BICYCLIST
45+38	HELMETED BICYCLIST
50+44	HELMETED BICYCLIST
50+69	HELMETED BICYCLIST
55+38	HELMETED BICYCLIST
55+50	HELMETED BICYCLIST
60+43	HELMETED BICYCLIST
60+43	HELMETED BICYCLIST
60+66	HELMETED BICYCLIST
65+00	HELMETED BICYCLIST
65+28	HELMETED BICYCLIST
66+80	HELMETED BICYCLIST
67+47	HELMETED BICYCLIST
69+33	HELMETED BICYCLIST
69+98	HELMETED BICYCLIST
72+06	HELMETED BICYCLIST
72+13	HELMETED BICYCLIST
73+50	HELMETED BICYCLIST
74+76	HELMETED BICYCLIST
75+00	HELMETED BICYCLIST
72+28	BIKE DETECTOR
73+46	BIKE DETECTOR
75+39	BIKE DETECTOR

**ITEM 864.231** **ARROWS FOR BIKE FACILITIES (PF)**

Boston Road

<u>Station</u>	<u>Type</u>
20+70	BIKE LANE ARROW
22+59	BIKE LANE ARROW
23+11	BIKE LANE ARROW
24+08	BIKE LANE ARROW
24+43	BIKE LANE ARROW
25+62	BIKE LANE ARROW
26+03	BIKE LANE ARROW
30+48	BIKE LANE ARROW

**ITEM 864.231** (Continued)

30+63	BIKE LANE ARROW
35+42	BIKE LANE ARROW
35+43	BIKE LANE ARROW
40+21	BIKE LANE ARROW
40+36	BIKE LANE ARROW
42+76	BIKE LANE ARROW
42+91	BIKE LANE ARROW
45+27	BIKE LANE ARROW
45+38	BIKE LANE ARROW
50+44	BIKE LANE ARROW
50+69	BIKE LANE ARROW
55+38	BIKE LANE ARROW
55+50	BIKE LANE ARROW
60+43	BIKE LANE ARROW
60+43	BIKE LANE ARROW
60+66	BIKE LANE ARROW
65+00	BIKE LANE ARROW
65+28	BIKE LANE ARROW
66+80	BIKE LANE ARROW
67+47	BIKE LANE ARROW
69+33	BIKE LANE ARROW
69+98	BIKE LANE ARROW
72+06	BIKE LANE ARROW
72+13	BIKE LANE ARROW
73+50	BIKE LANE ARROW
74+76	BIKE LANE ARROW
75+00	BIKE LANE ARROW

**ITEM 864.33** **SLOTTED PAVEMENT MARKER TWO-WAY WHITE/RED**Boston Road

<u>Station</u>	<u>Offset</u>
71+97	64' LT
72+12	78' LT
72+24	93' LT
74+73	62' RT

**ITEM 864.34** **SLOTTED PAVEMENT MARKER TWO-WAY YELLOW/RED**Boston Road

<u>Station</u>	<u>Offset</u>
72+02	52' LT
72+22	69' LT
72+36	86' LT
74+82	48' RT

**ITEM 864.41      GREEN COLORIZED PAVEMENT MARKINGS**
Boston Road

21+81 to 22+48	RT
23+15 to 23+86	RT
23+28 to 23+93	LT
44+06 to 44+99	LT
62+82 to 64+16	RT
65+47 to 66+40	RT
70+91 to 71+88	LT
72+62 to 73+02	LT

**ITEM 868.106      6 INCH WET REFLECTIVE RECESSED WHITE LINE  
(THERMOPLASTIC)**
Boston Road

<u>Station</u>	<u>Type</u>
20+31 to 21+81	SWL
20+50 to 23+28	SWL
21+81 to 22+48	DWLEx
22+48 to 23+15	SWL
23+15 to 23+86	DWLEx
23+28 to 23+33	SWL
23+45 to 23+51	SWL
23+28 to 23+93	DWLEx
23+86 to 62+83	SWL
23+93 to 44+06	SWL
44+06 to 44+98	DWLEx
44+98 to 70+91	SWL
62+83 to 64+16	DWLEx
64+16 to 65+47	SWL
64+47 to 66+40	DWLEx
65+88 to 72+38	BWL
66+40 to 72+35	BWL
69+00 to 71+15	DWLEx
70+91 to 71+88	DWLEx
71+15 to 72+35	SWL
71+88 to 72+35	SWL
71+90 to 72+27	SWL
72+50 to 72+62	SWL
72+50 to 74+66	SWL
72+62 to 73+02	DWLEx
73+02 to 74+92	SWL
73+40 to 74+90	BWL
73+40 to 73+86	SWL
73+86 to 75+40	BWL
74+66 to 74+80	DWLEx

**ITEM 868.106** (Continued)

74+70 to 74+80	SWL
74+82 to 74+39	SWL
74+90 to 75+39	SWL
74+92 to 75+41	DWLEx
75+41 to 74+50	SWL

Main Street

<u>Station</u>	<u>Type</u>
10+61 to 11+85	SWL
10+61 to 11+85	SWL
11+35 to 12+56	SWL
12+33 to 12+56	DWLEx
12+68 to 13+10	SWL
12+66 to 13+11	SWL
12+66 to 13+11	SWL
80+30 to 82+57	SWL
80+29 to 82+57	SWL

**ITEM 868.112 12 INCH WET REFLECTIVE RECESSED WHITE LINE (THERMOPLASTIC)**Boston Road

<u>Station</u>	<u>Type</u>
20+19 to 20+39	CW
20+29 to 20+47	CW
20+46 to 20+52	SL
22+25 to 22+38	SL
23+42 to 23+65	SL
23+33 to 23+53	CW
23+37 to 23+56	CW
44+19 to 44+85	CW
65+69 to 66+19	CW
65+94 to 66+12	SL
71+77 to 71+90	CW
71+84 to 71+96	CW
71+87 to 71+99	SL
72+35 to 72+35	SL
72+39 to 72+39	CW
72+47 to 72+47	CW
72+51 to 73+40	DWLEx
72+64 to 72+98	CW
72+67 to 72+97	CW
72+67 to 72+97	SL
73+40 to 73+40	SL
73+40 to 74+82	SWL

**ITEM 868.112** (Continued)

73+63 to 74+08	SWL
74+15 to 74+72	SWL
74+35 to 74+39	SWL
74+45 to 74+53	SWL
74+55 to 74+66	SWL
74+64 to 74+68	SL
74+66 to 74+80	SWL
75+39 to 75+39	SL

Main Street

<u>Station</u>	<u>Type</u>
12+57 to 12+65	CW

Crown Road

<u>Station</u>	<u>Type</u>
80+31 to 80+31	SL

**ITEM 869.106** **6 INCH WET REFLECTIVE RECESSED YELLOW LINE**  
**(THERMOPLASTIC)**

Boston Road

<u>Station</u>	<u>Type</u>
20+38 to 21+81	SYL
22+46 to 21+81	SYL
20+81 to 21+04	DBYL
20+81 to 21+04	DBYL
21+04 to 21+79	DBYL
22+37 to 23+28	DBYL
23+66 to 27+41	DBYL
27+41 to 29+09	DBYL
27+41 to 29+09	DBYL
29+09 to 29+59	SYL
29+09 to 29+59	SYL
29+59 to 31+02	DBYL
29+59 to 31+02	DBYL
31+02 to 36+25	DBYL
36+25 to 37+05	DBYL
36+25 to 37+05	DBYL
37+05 to 37+55	SYL
37+05 to 37+55	SYL
37+55 to 38+35	DBYL
37+55 to 38+35	DBYL
38+35 to 42+03	DBYL
42+03 to 43+06	DBYL
42+03 to 43+06	DBYL
42+06 to 44+07	SYL

**ITEM 869.106** (Continued)

44+97 to 45+32	DBYL
45+32 to 53+40	DBYL
53+40 to 54+20	DBYL
53+40 to 54+20	DBYL
54+20 to 54+80	SYL
54+20 to 54+80	SYL
54+80 to 55+55	DBYL
54+80 to 55+55	DBYL
55+55 to 65+47	DBYL
66+19 to 72+34	DBYL
72+00 to 72+38	SYL
73+40 to 74+37	DBYL
74+37 to 75+46	DBYL
74+72 to 74+80	SYL
74+88 to 74+95	SYL

Main Street

<u>Station</u>	<u>Type</u>
10+61 to 11+88	DBYL
12+67 to 13+11	DBYL

Hildreth Street

<u>Station</u>	<u>Type</u>
22+25 to 22+53	DBYL
23+39 to 23+42	DBYL

Crown Road

<u>Station</u>	<u>Type</u>
80+32 to 81+78	DBYL

**ITEM 869.112 12 INCH WET REFLECTIVE RECESSED YELLOW LINE (THERMOPLASTIC)**Boston Road

<u>Station</u>	<u>Type</u>
27+41 to 29+09	GORE
29+59 to 31+02	GORE
36+38 to 37+05	GORE
37+55 to 28+21	GORE
42+32 to 43+06	GORE
52+37 to 53+10	GORE
53+70 to 54+36	GORE
74+47 to 75+47	GORE

Main Street

<u>Station</u>	<u>Type</u>
11+42 to 11+89	GORE

**ITEM 901.**      **4000 PSI, 1.5 INCH, 565 CEMENT CONCRETE**

To be used for proposed steps.

**ITEM 902.**      **3500 PSI, 1.5 INCH, 520 CEMENT CONCRETE**

To be used for encasing shallow guardrail post in concrete due to conflicts.

**ITEM 903.**      **3000 PSI, 1.5 INCH, 470 CEMENT CONCRETE**

For use as thrust blocks at hydrants and fittings.

**ITEM 901.**      **4000 PSI, 1.5 INCH, 565 CEMENT CONCRETE**

To be used for proposed steps.

**ITEM 902.**      **3500 PSI, 1.5 INCH, 520 CEMENT CONCRETE**

To be used for encasing shallow guardrail post in concrete due to conflicts.

**ITEM 903.**      **3000 PSI, 1.5 INCH, 470 CEMENT CONCRETE**

For use as thrust blocks at hydrants and fittings.

**ITEM 988.01**      **SEDIMENT FOREBAY PAVING**

To be used in the bottom of the proposed sediment forebay at the sediment outlet trap and wet detention basin.



**ITEM 992.33**      **COORDINATION OF TEMPORARY SUPPORT FOR UTILITY POLES**

Boston Road

<u>Station</u>	<u>Offset</u>
25+38	20' RT
26+60	18' RT
31+65	19' RT
33+06	18' RT
34+32	22' RT
35+76	25' RT
36+88	20' RT
38+16	18' RT
39+14	18' RT
40+40	19' RT
41+52	18' RT
42+88	21' RT
44+12	21' RT
45+25	19' RT
46+53	11' RT
47+76	13' RT
50+00	11' RT
51+22	17' RT
52+36	21' RT
53+56	18' RT

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DOCUMENT A00804

**Boston Road Westford, MA**

**TREE AND LANDSCAPE MITIGATION ANALYSIS**

**REPORT**

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# **Boston Road Westford, MA Tree and Landscaping Mitigation Analysis Report**

**For  
TEC, INC.  
TEC PROJECT NO. T0713**

**Prepared By  
James M. MacArthur, Owner & Business Manager**

**05/24/2021**

*James M. MacArthur, Owner & Business Manager*

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## **SITE DESCRIPTION**

The TEC Project No. T0713, Boston Road, Westford, MA is located on Boston Road between Main Street and I-495 South bound ramps. The project's improvements will include roadway widening and pavement reclamation along approximately one mile of Boston Road including the installation of granite curb on both sides and a 5' to 6' sidewalk on the north side. See EXHIBIT A.

## **NARRATIVE**

Professional Environmental Services, LLC is responsible for providing a Tree and Landscaping Mitigation Analysis of construction impact and disposition for all trees within and adjacent to project area and make recommendations, as practicable, for design modification as well as for temporary construction measures to mitigate construction impacts. The analysis will also form the basis for whether trees should be retained, trimmed as needed, or removed due to poor health or proposed construction impacts to the root zone.

During construction, MASS DOT ITEM 102.51 for INDIVIDUAL TREE PROTECTION and ITEM 102.52 TEMPORARY TREE PROTECTION FENCE must be adhered to except under those conditions as listed in TREE AND LANDSCAPE MITIGATION ANALYSIS section under points 1,2, & 3.

## TREE AND LANDSCAPE MITIGATION ANALYSIS

There are 94 trees identified within the Project area that were identified as possibly being impacted by the proposed project. Of the 94 trees, 38 are outside the construction zone and should be wrapped with bright orange plastic snow fencing to make them easily identifiable to all construction workers that are operating machinery within close proximity to the trees. A complete list of trees by location, species diameter breast height, condition class and recommendation is part of this report as EXHIBIT A. This list and a photo file of each tree will be provided as separate files. The trees highlighted in yellow on the Excel File are not numbered due to excessive poison ivy vines on or around the trees. Trees 15 through 18 are located in front of 14 Boston Road and there is a Google Earth photo of these trees. Tree 62 also has a Google Earth Photo of it because it was overlooked in the field. Trees 34 through 53 have a broad view Google Earth photo of them. They are a natural grown forest edge condition and are going to be removed due to the grade change. This is the same situation with trees 70 through 87.

When construction is occurring, the trees critical root zone should be protected. The critical root zone can be easily identified by the outer most edge of the trees canopy which is the trees drip line. The area of one half the distance from the tree trunk to the trees drip line should be protected from construction damage by setting down six inches of wood chips or other soil protective matting to protect the trees critical root zone from construction damage. Minimal activity should occur within this inner critical root zone area. An additional six inches of wood chips or protective matting may be added remaining half of the critical zone to the drip line area if construction equipment will be traversing within this area.

Given the conditions that are required by this project, in most cases the critical root zone will be impeded upon. The following should be adhered to when working within the critical root zone.

1. All trees should be wrapped in protective bright orange snow/landscape fencing attached to wooden 8 foot 2X4's to hold the fencing securely to the tree. On trees where operating machinery is in close proximity to the tree and has a potential for damaging the trees bark, must have additional wood 2X4's sufficient enough to provide added protection from such damage.
2. Where sidewalks and curbing are being removed, added caution must be used to protect the roots of the trees from any potential damage.
3. In areas where raised roots have caused sidewalks to rise and/or crack, prior to replacement of the sidewalk, a layer of stone dust should be laid over the roots to provide a cushion between the exposed roots and the replacement sidewalk material.
4. Where-ever possible special consideration should be given to provide at least 6 inches of clearance from the tree trunk when replacing sidewalks and curbing. Under no condition should the replacement sidewalk or curbing be placed any closer to the tree trunk than under the conditions when they were removed.
5. When placing soil or mulch around the trees, the new soil and mulch should not be placed any closer than 2 inches to the trees trunk at the root collar.

# EXHIBIT A

TEC Boston Road Westford, MA Tree and Landscape Mitigation Analysis Spreadsheet						
TREE	PHYSICAL ADDRESS	SPECIES	HEALTH	DBH	RECOMMENDATION	NOTES
1	corner Hildreth and Boston Road	Crimson King Maple	Good	20.5	Retain	Trunk Protection , care around roots while excavating. Air spade if necessary and root prune.
2	Opposite corner of island at Bostopn Road	Crimson King Maple	Good	20.5	Retain	Trunk Protection , care around roots while excavating. Air spade if necessary and root prune.
3	Front of 1713 Tavern on Boston Road	American Beech	Good	20.5	Retain	Trunk Protection , care around roots while excavating.
4	Boston Road across from Pole 6-1	Colorado Blue Spruce	Good	19.5	Retain	Trunk Protection , care around roots while excavating.
5	Across from 2 Boston Road	White Spruce	Fair	16	Retain	Trunk Protection , care around roots while excavating.
6	Boston Road	Black Cherry	Good	14	Retain	Trunk Protection , care around roots while excavating.
7	Boston Road to the right of pole 7	Red Maple	Good	10	Retain	Trunk Protection , care around roots while excavating.
8	Boston Road to the left of pole 7	Red Maple	Good	16	Retain	Trunk Protection , care around roots while excavating.
9	Boston Road near mail box	Red Maple	Good	16	Retain	Trunk Protection , care around roots while excavating.
10	Boston Road	Red Maple	Good	16	Retain	Trunk Protection , care around roots while excavating.
11	7 & 9 Boston Road	Sycamore	Good	54	Retain	Trunk Protection , care around roots while excavating.
12	Boston Road	Red Maple	Good	16	Retain	Trunk Protection , care around roots while excavating.
13	2 Boston Road	Black Cherry	Good	8	Retain	Trunk Protection , care around roots while excavating.
14	3 Boston Road	Sugar Maple	Good	39	Retain	Trunk Protection , care around roots while excavating.
15	4 Boston Road	Colorado Blue Spruce	Good	13.5	Retain	Trunk Protection , care around roots while excavating.
16	4 Boston Road	Colorado Blue Spruce	Good	9	Retain	Trunk Protection , care around roots while excavating.
17	4 Boston Road	Colorado Blue Spruce	Dead	6	Remove	
18	4 Boston Road	Callery Pear	Good	16	Retain	Trunk Protection , care around roots while excavating.
19	4 Boston Road	Red Maple	Dead	16	Remove	
20	4 Boston Road	Red Maple	Good	16	Retain	Trunk Protection , care around roots while excavating.
21	4 Boston Road	Red Maple	Good	6	Retain	Trunk Protection , care around roots while excavating.
22	18 Boston Road	American Elm	Good	18.5	Retain	Trunk Protection , care around roots while excavating.
23	21 Boston Road	Sugar Maple	Good	21	Retain	Trunk Protection , care around roots while excavating.
24	21 Boston Road	Sugar Maple	Good	13.5	Retain	Trunk Protection , care around roots while excavating.
25	25 Boston Road @ Pole 15	White Ash	Poor	10.5	Remove	butt rot cavity
26	8 Boston Road	Red Maple	Good	19.5	Retain	Trunk Protection , care around roots while excavating.
27	2 Boston Road	Horse Chestnut	Good	50	Retain	Trunk Protection , care around roots while excavating.
28	Crown Road near corner on left side of road	Apple Tree	Good	18	Remove	Grade change will be too deep for root system.
29	Crown Road near corner on right side of road	Colorado Blue Spruce	Fair	10	Remove	Grade change will be too deep for root system.
30	Crown Road near corner on right side of road	Colorado Blue Spruce	Fair	10	Remove	Grade change will be too deep for root system.
31	Crown Road near corner on right side of road	Colorado Blue Spruce	Fair	6	Remove	Grade change will be too deep for root system.
32	Crown Road near corner on right side of road	Colorado Blue Spruce	Fair	6	Remove	Grade change will be too deep for root system.
33	Crown Road near corner on right side of road	Colorado Blue Spruce	Fair	24	Remove	Line of Sight issue
34	Boston Road from corner of Crown to 43 Boston Road	American Elm	Poor		Remove	Line of Sight issue
35	Boston Road from corner of Crown to 43 Boston Road	American Elm	Dead		Remove	Line of Sight issue
36	Boston Road from corner of Crown to 43 Boston Road	Red Maple	Fair		Remove	Line of Sight issue
37	Boston Road from corner of Crown to 43 Boston Road	American Elm	Good		Remove	Line of Sight issue
38	Boston Road from corner of Crown to 43 Boston Road	White Pine	Good		Remove	Line of Sight issue
39	Boston Road from corner of Crown to 43 Boston Road	White Pine	Good		Remove	Line of Sight issue
40	Boston Road from corner of Crown to 43 Boston Road	Red Maple	Good		Remove	Line of Sight issue
41	Boston Road from corner of Crown to 43 Boston Road	White Pine	Good		Remove	Line of Sight issue
42	Boston Road from corner of Crown to 43 Boston Road	Red Maple	Good		Remove	Line of Sight issue
43	Boston Road from corner of Crown to 43 Boston Road	White Pine	Good		Remove	Line of Sight issue
44	Boston Road from corner of Crown to 43 Boston Road	White Pine	Good		Remove	Line of Sight issue
45	Boston Road from corner of Crown to 43 Boston Road	Red Maple	Good		Remove	Line of Sight issue
46	Boston Road from corner of Crown to 43 Boston Road	White Ash	Good		Remove	Line of Sight issue
47	Boston Road from corner of Crown to 43 Boston Road	Red Maple	Good		Remove	Line of Sight issue



TEC Boston Road Westford, MA Tree and Landscape Mitigation Analysis Spreadsheet						
TREE	PHYSICAL ADDRESS	SPECIES	HEALTH	DBH	RECOMMENDATION	NOTES
48	Boston Road from corner of Crown to 43 Boston Road	American Elm	Good		Remove	Line of Sight issue
49	Boston Road from corner of Crown to 43 Boston Road	Red Maple	Good		Remove	Line of Sight issue
50	Boston Road from corner of Crown to 43 Boston Road	White Ash	Dead	3, 121, 51, 2, 4, 3, 51, 5	Remove	Line of Sight issue
51	Boston Road from corner of Crown to 43 Boston Road	White Ash	Poor		Remove	Line of Sight issue
52	Boston Road from corner of Crown to 43 Boston Road	Red Maple	Good		Remove	Line of Sight issue
53	Boston Road from corner of Crown to 43 Boston Road	Red Maple	Good		Remove	Line of Sight issue
54	4 Boston Road	Black Cherry	Good	10	Retain	Sidewalk Grade
55	4 Boston Road	Callery Pear	Good	10	Remove	Sidewalk Grade
56	4 Boston Road	Callery Pear	Good	10	Remove	Sidewalk Grade
57	43 Boston Road	Red Maple	Good	20.5	Remove	Roots need to be cut
58	43 Boston Road	American Elm	Good	14	Remove	Roots need to be cut
59	43 Boston Road	Red Maple	Good	14	Remove	Roots need to be cut
60	43 Boston Road	Red Maple	Good	16	Remove	Roots need to be cut
61	Boston Road behind Pole 27	Red Maple	Good	13	Retain	Trunk Protection , care around roots while excavating.
62	46 Boston Road	Black Cherry	Good	5	Retain	Trunk Protection , care around roots while excavating.
63	46 Boston Road	Callery Pear	Good	6	Remove	Grade change
64	46 Boston Road	Callery Pear	Good	6	Remove	Grade change
65	46 Boston Road	Callery Pear	Good	6	Remove	Grade change
66	46 Boston Road	Callery Pear	Good	6	Remove	Grade change
67	Boston Road	White Pine	Good	14	Retain	Trunk Protection , care around roots while excavating.
68	Boston Road	Red Oak	Good	28	Retain	Trunk Protection , care around roots while excavating.
69	Boston Road	Red Oak	Fair	48	Remove	Grade change
70	Boston Road	Red Maple	Fair	14	Remove	Grade change
71	Boston Road	Red Maple	Fair	16	Remove	Grade change
72	Boston Road	Red Maple	Fair	26	Remove	Grade change
73	49 Boston Road	Hickory	Good	10	Retain	Trunk Protection , care around roots while excavating.
74	Boston Road across from 49	Red Maple	Good	8	Remove	Grade change
75	Boston Road across from 49	Red Maple	Good	8	Remove	Grade change
76	Boston Road across from 49	Sycamore	Good	5	Remove	Grade change
77	across from Pole 32 Boston Road	Red Oak	Good	26	Retain	Trunk Protection , care around roots while excavating.
78	51 Boston Road	White Pine	Fair	14	Remove	Grade change
79	51 Boston Road	Sugar Maple	Fair	12	Remove	Grade change
80	51 Boston Road	Red Maple	Fair	14	Remove	Grade change
81	51 Boston Road	White Oak	Fair	18	Remove	Grade change
82	Boston Road	Red Maple	Good	20	Retain	Trunk Protection , care around roots while excavating.
83	Boston Road	Red Maple	Good	14	Retain	Trunk Protection , care around roots while excavating.
84	Boston Road	Red Maple	Good	12	Retain	Trunk Protection , care around roots while excavating.
85	Boston Road	Red Oak	Good	10	Retain	Trunk Protection , care around roots while excavating.
86	Boston Road across from Pole 35	White Oak	Good	35	Retain	Trunk Protection , care around roots while excavating.
87	Boston Road across from Pole 35	Red Oak	Good	38	Retain	Trunk Protection , care around roots while excavating.
88	Boston Road Pole 37	White Birch	Good	14	Remove	Sidewalk Grade
89	Boston Road Pole 37	Red Oak	Good	28	Remove	Sidewalk Grade
90	Boston Road Pole 39	Red Oak	Good	37	Remove	Sidewalk Grade
91	Boston Road Pole 40	Red Oak	Good	33	Remove	Sidewalk Grade
92	Boston Road	White Spruce	Good	8	Retain	Trunk Protection , care around roots while excavating.
93	Boston Road	White Pine	Good	12	Remove	Sidewalk Grade
94	Boston Road	White Pine	Good	14	Remove	Sidewalk Grade

## REFERENCES

- American Nursery and Landscape Association
- American Society of Landscape Architects
- International Society of Arboriculture
- DIRR'S HARDY TREES AND SHRUBS, AN ILLUSTRATED ENCYCLOPEDIA", Author Michael A. Dirr

## **Assumptions and Limiting Conditions**

1. Any legal description provided to the consultant/appraiser is assumed to be correct. Any titles and ownership to any property are assumed to be good and marketable. No responsibility is assumed for matters legal in character. Any and all property is appraised or evaluated as though free and clear, under responsible ownership and competent management.
2. Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible; however, the consultant/appraiser can neither guarantee nor be responsible for the accuracy of information provided by others.
3. The consultant/appraiser shall not be required to give testimony or attend court by reason of this report unless subsequent contractual arrangements are made, including payment of an additional fee for such services as described in the fee schedule and contract of engagement.
4. Loss or alteration of any part of this report invalidates the entire report.
5. Possession of this report or a copy thereof does not imply right of publication or use for any purpose by any other than the person to whom it is addressed, without the prior expressed written or verbal consent of the consultant/appraiser.
6. Neither all nor any part of the contents of this report, nor copy thereof, shall be conveyed by anyone, including the client, to the public through advertising, public relations, news, sales or other media, without the prior expressed written or verbal consent of the consultant/appraiser particularly as to value conclusions, identity of the consultant/appraiser, or any reference to any professional society or institute or to any initiated designation conferred upon the consultant/appraiser as stated in his qualification.
7. This report and values expressed herein represent the opinion of the consultant/appraiser, and the consultant's/appraiser's fee in no way contingent upon the reporting of specified value, a stipulated results, the occurrence of a subsequent event, nor upon any finding to be reported.
8. Sketches, diagrams, graphs and photographs in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering or architectural reports or surveys.
9. Unless expressed otherwise: (1) information contained in this report covers only those items that were examined and reflects the condition of those items at the time of inspection; and (2) the inspection is limited to visual examination of accessible items without dissection, excavation, probing or coring. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the plans or property in question may not arise in the future.























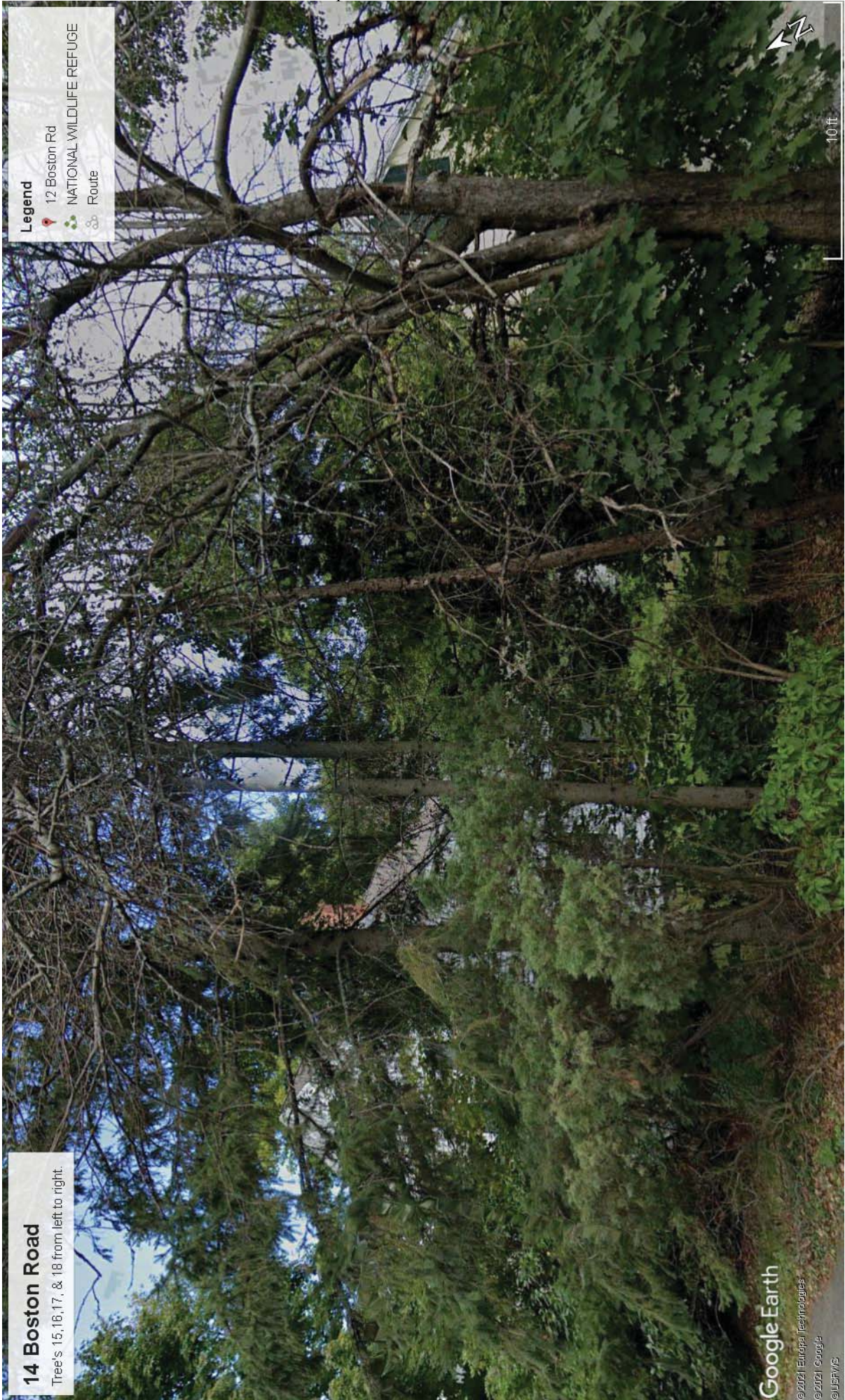












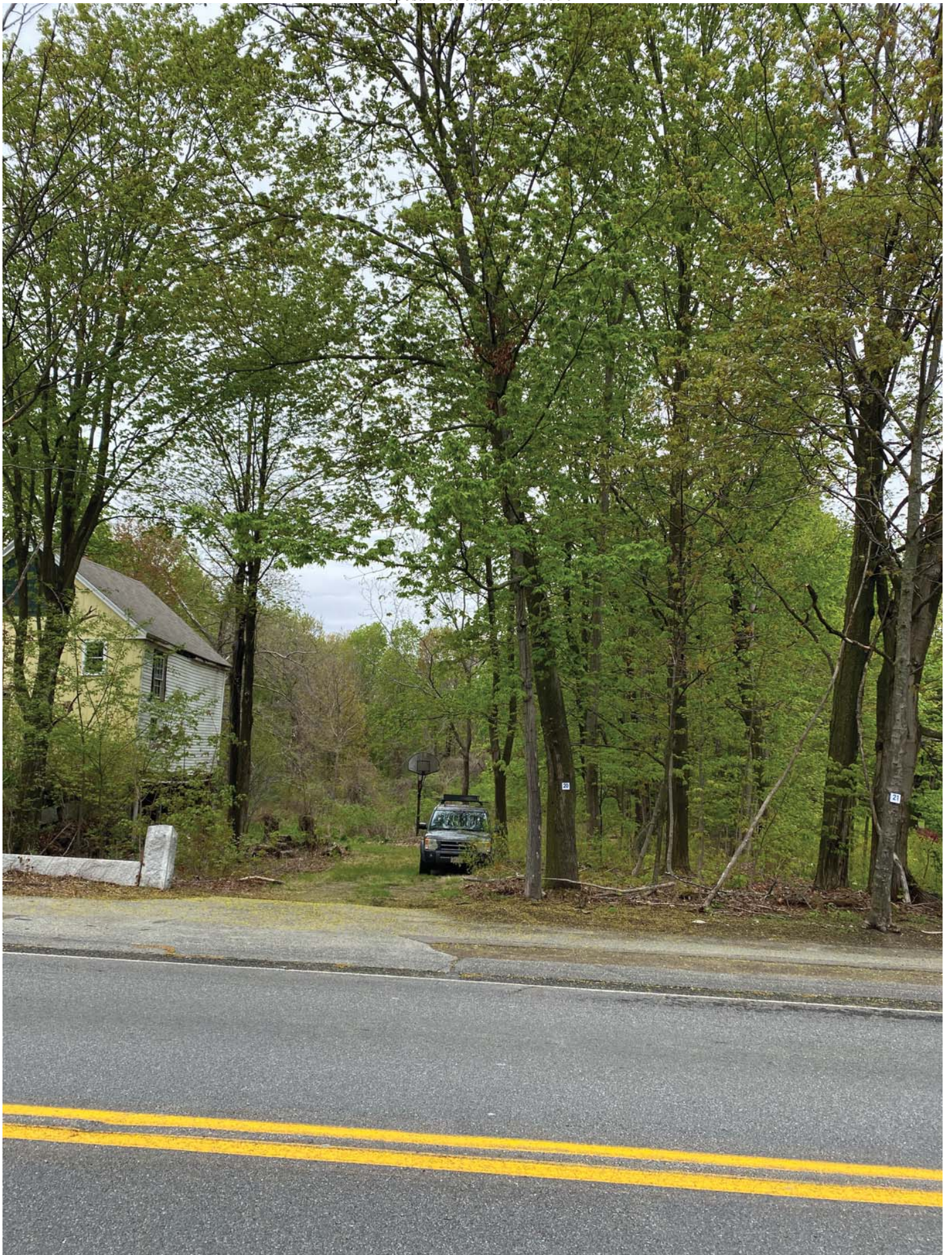
**14 Boston Road**

Trees 15, 16, 17, & 18 from left to right.

Google Earth

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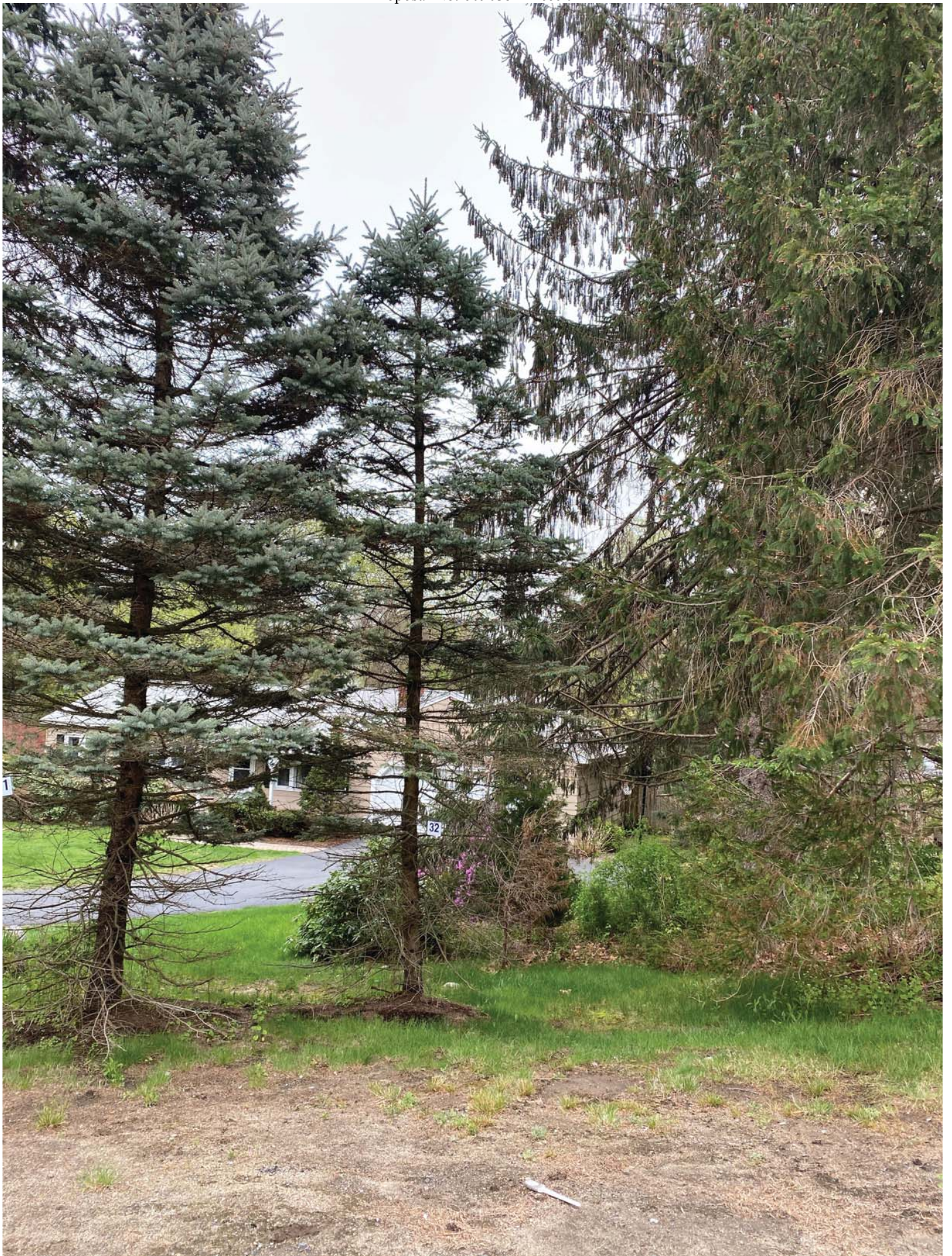


















**Boston Road South of Crown Road**

Trees 34 through 51 from left to right.





















**46 Boston Road**  
 Trees 62 behind Granite post.

**Legend**

-  46 Boston Rd
-  NATIONAL WILDLIFE REFUGE
-  Route

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 @USPSys

6.94 ft









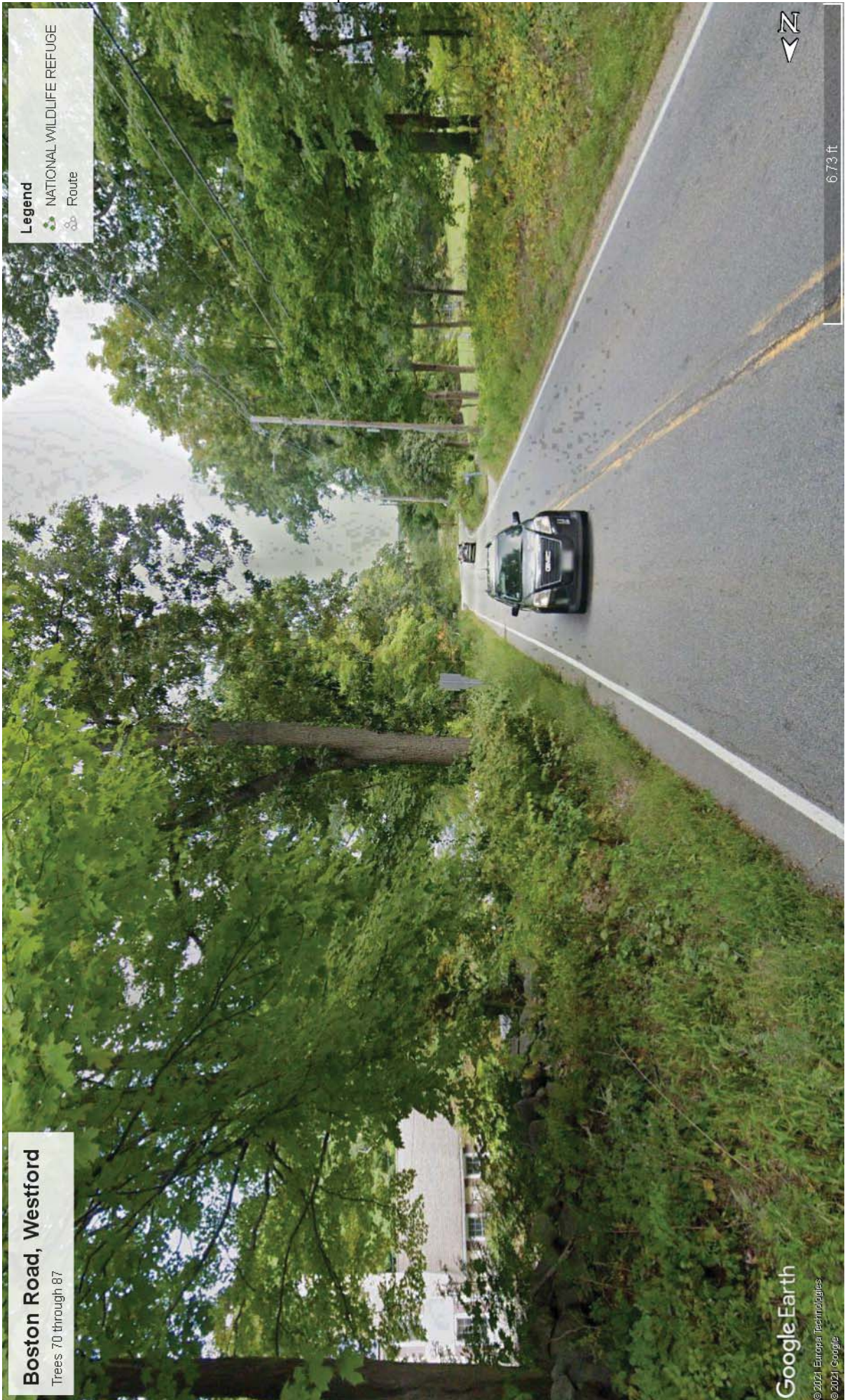












**Boston Road, Westford**

Trees 70 through 87

**Legend**

NATIONAL WILDLIFE REFUGE  
Route

Google Earth

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DOCUMENT A00807

**Westford Water Department**

**MATERIAL AND INSTALLATION SPECIFICATIONS**

**FOR**

**CONSTRUCTING WATER MAINS AND SERVICES**

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## **Westford Water Department**

Warren E. Sweetser, Superintendent

Commissioners:

Leslie A. Thomas

Robert J. Carter

Hugh C. Maguire

Harold A. Fletcher, Sr. (Alternate)

### **MATERIAL AND INSTALLATION SPECIFICATIONS FOR CONSTRUCTING WATER MAINS AND SERVICES**

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Part G  
General Requirements

## SECTION G1 – GENERAL CONCEPT

G1.1 This section of the specifications contains the detail specifications for all major elements which enter into the project and become a permanent part thereof. These specifications are to be used in conjunction with the **Town of Westford Water Department's Rules and Regulations** and intended to be so written that only materials of the best quality and grade will be furnished, that manufacturing procedures for the product be controlled with failure-preventative type processes, and that good workmanship will produce a first class product. The specifications are formulated to provide total performance of each product within the frame of its intended use and as such, every detail requirements of the controlling specification shall be met even though this necessitates selective upgrading of another. The fact that individual specifications may fail to be sufficiently complete in some detail will not relieve the Contractor of full responsibility for providing material of high quality under the total performance concept and protect them adequately until incorporated into the system or structure. Material which does not meet each requirement or does not meet the total performance concept due to an imbalance between individual requirements that make up the material system shall be considered as not fully acceptable, therefore rejectable, and as such may be rejected at the discretion of the utility. Special conditions may arise on any project that are not covered in these specifications or that may require special handling. In case of such special conditions, complete detail as to materials, method of construction, or other procedures shall be submitted to the Westford Water Department for their review and approval.

G1.1.1 Standard construction details are incorporated and made a part of these specifications and shall become a part of the standard requirements for utility line construction. The details are included in the back of these standard specifications.

G1.1.2 Where reference is made to a particular industry specifications (ASTM, etc.), it is hereby understood that reference is made to the latest specifications revision in effect.

### G1.2 DEFINITIONS:

WESTFORD WATER DEPARTMENT- The water production facilities, water distribution system, and operational equipment, and staff of the Water Department under the jurisdiction of the Town Of Westford, Massachusetts, will hereinafter be referred to as "WWD".

SUPERINTENDENT – The chief executive of the Department.

DEVELOPER – Individual, partnership, corporation, or other legal entity such as an improvement district desiring to construct facilities for immediate or contemplated future inclusion in the Westford Water Department.

ENGINEER – Individual registered to practice engineering in the State, that the work is being done.

ASTM- American Society for testing and materials.

AASHTO – American Association of State Highway and Transportation Officials.

ANSI– American National Standard Institute.

SHALL – “Shall” will be interpreted as mandatory.

MAY – “May” will be interpreted as permissive.

STATE STANDARDS – Recommended standards for Water Works and Sewage Works published by Massachusetts Department of Environmental Protection and The American Water Works Association (AWWA).

## **SECTION G2 – JURISDICTION**

### G2.1 Area of Jurisdiction:

These general requirements for utility lines shall be required for the area within the town limits of Westford, Massachusetts, as may be changed from time to time and hose areas outside the town limits which are served by the Westford Water Department or may at some time in the future become a part of the Westford Water Department.

## **SECTION G3 – STANDARDS**

### G3.1 Standards:

#### G3.1.1 Environmental Protection Agency and U.S. Public Health Services:

The governing standards of these agencies will be followed when applicable.

#### G3.1.2 State Health Department, Department of Environmental Protection:

The Water system shall conform to the applicable laws, policies, standards, rules and regulations of the Mass. State Department of Health or the Department Of Environmental Protection.

**G3.1.3 Westford Water Department:**

All water utility construction which is in the service area of the Westford Water Department and Criteria for Design and Construction for Water Supply and Distribution.

G3.2 If a conflict arises between any of these standards, the strongest standard shall prevail.

**SECTION G4 – PLANS AND SPECIFICATIONS****G4.1 Description:**

This section covers the requirements of submission to the Westford Water Department of plans and specifications in order to obtain approval for construction of facilities.

No utility main extension shall be approved for connection to the Water Department system which was constructed prior to approval of construction plans by the Department or which was not constructed in accordance with these requirements as a minimum. At the Engineer's option, the submission of construction plans for approval may be accompanied by a letter statement that materials and workmanship will be in accordance with these standards in lieu of submittal of specifications.

All plans, specifications, and construction procedures shall conform to the standards as established by the Westford Water Department. All plans and specifications shall be completed by a Professional Engineer registered in the State of Massachusetts. Any deviation of work from approved plans must be approved in writing by the Town of Westford Water Department.

**G4.2 Preliminary Report:**

When requested by the Department, the Engineer shall prepare and submit a preliminary engineering report prior to approval of construction plans. The size, scope, and contemplated land use of the proposed development will determine the need for a preliminary report.

G4.2.1 In all subdivisions approved by the Town Of Westford Planning Board, the Developer shall furnish and install, as specified by the Board of Water Commissioners, all water pipes, gates, hydrants, service connections, and necessary fittings to make a complete system and give to the Water Department a Quitclaim deed for the same before water is turned into the system.

G4.2.2 The Water Department establishes the following to insure the safe and reliable operation of the system.

- G4.2.2.1 The developer shall deliver a study of the water system within the subdivision involving analysis of flows, pressures, and other applicable hydraulic data.
- G4.2.2.2 A study of the subdivision impact of the existing water facilities. This work will be performed by a designated Engineer, assigned by the Water Department, using a computer model of the system, at the developer's expense.
- G4.2.2.3 The Board of Water Commissioners will review this report and be aided if necessary by a consultant it may elect to employ. This cost shall be paid by the applicant. The Water Commissioners will make a final decision based on its review of the above as to whether or not to grant permission for the proposed connection.
- G4.2.2.4 A written agreement stating conditions required for the connection, and signed by both parties, will be needed before the developer will be allowed to make the connection.
- G4.2.2.5 A rough grade of new roads in subdivision is required before laying pipe.
- G4.2.2.6 Any water main extension must be extended at minimum to the middle of the new lot or further to have the future water service go on a straight run from the street to the foundation.
- G4.2.2.7 Easements are not approved for water main extensions.
- G4.2.2.8 All water main extensions must follow the Master Plan Guidelines.

G4.3 Construction Plans and Specifications:

G4.3.1 General:

All plans shall be drawn to a scale suitable for adequately showing the facilities proposed except as stipulated herein. All plans of sewer lines shall be drawn to scale with the profile vertical scale exaggerated 4:1 or 40:1 and scale of plan portion shall be 1" = 100' min. All elevations shall be based on MGVD 27. The plans shall depict the entire project and show

all property lines including land ties, existing and proposed utility lines, P.E. stamp, benchmark from which elevations were taken, and other pertinent information. North arrow shall be pointed toward the top or left hand side of the sheet.

#### G4.3.2 Plan Organization:

All plans shall be submitted on 24" x 36" sheets in the following order:

1. Title sheet with approval.
2. Location map, coordination block and index.
3. Right-of-way and easement drawings.
4. Construction plans.
5. Typical details.

#### G4.4 Approval

Three (3) sets of complete plans and three (3) sets of specifications and one design data shall be furnished to the Westford Water Department for approval. Upon approval, one (1) set of plans and specifications will be marked, approved, signed, and returned to the Engineer. If additional copies are required for submission to the Department of Environmental Protection or other agencies, they must be submitted at this time.

#### G4.5 As-Built Drawings:

As-Built Drawings shall be in accordance with the standards established by the Utility and shall show complete details of the installation of the Main and appurtenances as required by the Utility including, but not limited to,

- 1) The location of the Main with respect to property lines,
- 2) The size, make, and location with respect to street corners of all valves and fire hydrants, manholes, and clean outs,
- 3) The limits and location of any and all special encasements or backfill materials including average depth of cover at such location,
- 4) A detailed diagram of all special installations at utility, drainage, and roadway crossings,
- 5) Location of other utilities encountered,
- 6) Flow line and rim elevation for all manholes,
- 7) Certified final estimate for water lines,
- 8) Size and material of main,
- 9) Location and size of easements.

The Applicant shall provide the Water Department with a full size, reduced, and digital copy of the final set of As-built plans within 90 days of completed

installation. The digital copy of approved as-built plans must follow the five requirements listed below:

1. All plans and specifications must be submitted on electronic media (CD or DVD\_ROM using an IBM-PC or compatible file format). Acceptable file formats include: AutoCAD \*.dwg, AutoCAD \*.dxf, ArcView \*.shp, or ArcGIS Geodatabase \*.mdb. The files must be identical to the printed plan and contain all information included on the written plan. Upon project completion a digital submission of the “as-built” plan is required prior to receiving a Certificate of Completion from the Building Department.
2. All digital mapping data must be delivered in the Massachusetts State Plane Coordinate system with a horizontal datum of NAD83 and vertical datum of NGVD88.
3. Each feature type must be organized in the CAD or GIS data structure as a separate layer using logical layer names. For example, there must be separate CAD layers for buildings, roads, parcel lines, and wetlands. Having all these features in a single CAD layer or GIS file will not be accepted.
4. Documentation of the data format must be provided with a description of the CAD layers and list of the types of features placed in each layer. Submission of multiple files must also include a list of the files and their purpose.
5. The data submitted must include documentation on the method used to gather the data, the name of the person(s) responsible for preparing the data, contact information, an estimation of the horizontal and vertical accuracy, and the date of data capture. All media shall be free from any and all defects and viruses, and labeled as to their contents.

## **SECTION G5 – INSPECTION AND LAYOUT**

### **G5.1 Description:**

This section covers the requirement of general inspection and layout for the construction of utility facilities. See section of specification on construction and test for more specific information and material.

### **G5.2 General Supervision:**

- G5.2.1 All utility facilities proposed shall be constructed under the general supervision of a Professional Engineer registered in the Commonwealth of Massachusetts. General supervision shall consist of, but not be limited to, full time inspection on the



construction work to observe the progress and quality of the construction work and to determine if the work is proceeding in accordance with the approved plans and specifications and with the standards set forth by Westford Water Department.

G5.2.2 Any defects, deficiencies or irregularities in the work found by the Engineer or reported by the inspector shall be reported to the Westford Water Department. Such action, as deemed appropriate by the Engineer and Westford Water Department, shall be taken to correct such deficiencies and notification shall be made to the Westford Water Department.

G5.2.3 All work done subject to these requirements shall at all times be subject to the general inspection of the Superintendent of the Westford Water Department, or his assistants.

G5.2.4 The presence of an inspector or representative of the Westford Water Department on the job site will in no way excuse the engineer or contractor from performing the inspection, testing, supervision and reporting called for in these specifications.

G5.3 Construction Layout:

The layout and staking of the construction work shall be completed by trained and qualified survey personnel under the supervision of the Engineer. Such layout and staking shall consist of alignment and grade stakes necessary to establish batter boards or grade lines necessary for use in attaining proper alignment and grade of the facilities.

G5.3.1 No construction in subdivision shall start until lot corners in the subdivision are marked.

**SECTION G6 – RULES AND REGULATIONS**

G6.1 Description:

This section covers such rules and regulations as required by law for the completion of plans, specifications, and construction work on any and all proposed water facilities.

G6.2 Laws, Regulations, and Ordinances:

All Federal, State, County, or City Laws, Regulations, or Ordinances shall be complied with on all water projects.

**G6.3 Permits and Licenses:**

All permits and licenses required by any Federal, State, County, or Local Governing Body shall be obtained in strict accordance with the requirements of the governing agency. When required by the licensing agency, the Westford Water Department may assist in application for permits and licenses, but the cost of any permit, fee, or bond required will be borne by the Developer.

**SECTION G7 - EASEMENTS****G7.1 Description:**

This section covers the requirements of easements for the purpose of maintaining utility lines where the proposed lines will be on private property or where the lines would not be within public rights-of-way.

**G7.2 Width of Easement:**

G7.2.1 Water Line Easements: Where lines are not placed in public rights-of-way, a permanent easement shall be acquired for the Westford Water Department and dedicated for the purpose of maintaining the utility lines. The easement shall have a minimum width of 20' and remain unobstructed.

G7.2.2 Sewer Line Easements: Where sanitary sewer lines are not placed in public rights-of-way, a permanent easement shall be acquired for the Westford Water Department and dedicated for the purpose of maintaining the utility lines. The width of the easement shall be twice the depth of the sewer line plus ten (10) feet, but shall be a minimum of 16' wide.

G7.2.3 Common utility easements will be accepted provided that the easement is wide enough to accommodate the above requirements. Easements of maximum width possible will be provided to allow access.

**G7.3 Filing of Easements:**

Easements shall be properly recorded and filed. A copy of all final recorded easements or subdivision plats as filed shall be furnished the Westford Water Department along with as-built plans. All easements for lines shall be in favor of the Westford Water Department. Easements as shown on a recorded plat shall be considered as public easements and adequate for this purpose.

**SECTION G8 – FINAL INSPECTION AND ACCEPTANCE****G8.1 Description:**

This section covers the requirements for final inspections and acceptance for water and sanitary sewerage facilities upon completion of the project.

**G8.2 Leakage Testing:**

Methods of testing are outlined in Section TW of these standard requirements. All leakage tests shall be conducted in the presence of a representative of the Westford Water Department. Twenty-four hour's notice shall be given to Westford Water Department prior to commencing any tests.

**G8.3 Final Inspection:**

Before utility extensions are accepted for maintenance and service connections to these extensions approved, a final inspection will be made at the written request of the Engineer. A list of material and workmanship defects, if any, will be forwarded to the Engineer. Defects noted and all other known defects must be corrected before acceptance.

**G8.4 Warranty Bond:**

Upon completion of the project and after all defects have been corrected in accordance with the final inspection, a warranty bond in an amount equal to 100% of the construction cost shall be forwarded to the Westford Water Department. The warranty bond shall be for a period of one year from date of acceptance and shall cover all defects in materials and workmanship. The warranty bond shall be binding on the developer.

**G8.5 Acceptance:**

No connection of customer facilities or other utilization of utility mains will be permitted by the Utility until a letter of acceptance is issued. The acceptance letter will not be issued until the following requirements are met:

- (a) Receipt of one copy of approved "As-built" plans.
- (b) Satisfactory correction of all defects.
- (c) Receipt of warranty bond.
- (d) Receipt of all required easements.

G8.6 Inspection Before Expiration of Warranty Bond:

An inspection will be made by the Westford Water Department before the expiration of the warranty bond. A list of any defects in material or workmanship found during this inspection will be forwarded to the Developer's Engineer and a claim filed with the bonding company. As soon as defects found during this inspection are corrected, the Westford Water Department will issue full acceptance of the project for maintenance.

G8.7 Use of Completed Portions:

Portions of the project completed will not be allowed to be put into service without written approval from the Westford Water Department. Approval of the use of portions of the project will be granted only in the best interest of the Utility. Use of completed portions of an incomplete project does not constitute acceptance of the project by the Utility.

**PART DW – DESIGN FOR WATER MAINS**

**SECTION DW1 – GENERAL**

DW1.1 As a minimum, design and layout shall meet the requirement of the standards referred to in G3.

**SECTION DW2 – MATERIALS**

DW2.1 Valves, fire hydrants and water line material shall conform to these types listed in Section MW of these specifications. Materials not specifically authorized in these specifications are forbidden for use in the Westford Water Department (WW) system unless approved in writing otherwise.

**SECTION DW3 – LINE, SIZE, AND PRESSURE**

DW3.1 The nominal working pressure in the system should be between approximately 80 pounds per square inch (PSI) and not less than 20 PSI. All water mains including those designed to provide fire protection shall be sized by a hydraulic analysis based on flow demands and pressure requirements.

DW3.1.1 Minimum Diameter:

The minimum size of water mains providing fire protection and serving fire hydrants shall be 6" diameter for residential areas and 8" diameter for commercial areas. Larger mains will be required if necessary to allow the withdrawal of required fire flow while maintaining the minimum residential pressure of 20 PSI.

DW3.1.2 Minimum Pressure:

The system shall be designed to maintain a minimum pressure of 20 PSI at ground level at all points in the system under all conditions of flow.

DW3.1.3 Flow Requirements:

In sizing the distribution system water mains, the required design flow shall be the sum of the required fire flow and Peak Hour Flow.

DW3.1.4 Minimum Fire Flow:

Dw3.1.4.1 Required Fire Flow (Single Family Dwelling Areas):

Required fire flow for single family dwelling areas shall be in accordance with the following table:

Maximum No. of Dwelling Units	Minimum Fire Flow GPM
50	250
100	500
200	1,000
400	1,500
900	2,000
1,500	2,500

SW3.1.4.2 Required Fire Flow (Other Areas):

Required fire flow for areas other than those occupied by single family dwellings shall be as determined by the Engineer and approved by the Utility for each specific instance.

DW3.1.5 Subdivision Connections:

DW3.1.5.1 Single Connection:

A subdivision to be supplied by a public water system and having a flow requirement as determined herein of not more than 700 gallons per minute may have a single connection to the distribution system.

DW3.1.5.2 Multiple Connection:

A subdivision to be supplied by a public water system and having a flow requirement as determined herein of more than 700 gallons per minute shall have two (2) or more connections to the distribution system. A single connection may be made by using a pipe diameter sufficient to provide two (2) times the required flow as determined by DW3.3 above with provisions for future

connections provided approval of the Utility is obtained.

#### **SECTION DW4 – SYSTEM LAYOUT**

DW4.1 Grid System:

All mains shall be interconnected to form a grid system. Interconnections between eight inch mains shall not be more than 1,200 feet apart unless so authorized by the Utility. When greater separation of interconnecting mains is necessary, larger diameter pipes will be used. If the installations of a “dead-end” main cannot be avoided, its dead-end length shall not exceed 600 feet unless authorized by the Utility.

DW4.2 Dead Ends:

Dead ends shall be minimized by looping the main whenever practical. When a dead end main cannot be eliminated, they shall be provided with a fire hydrant, if flow and pressure are sufficient, or with a blow-off valve to be used for flushing purposes.

#### **SECTION DW5 – LINE LOCATION (GEN.)**

DW5.1 Water mains shall be installed only in dedicated streets, utility easements, or public right-of-way. The main shall be placed a minimum of 5 feet from the edge of the easement or right-of-way and have a minimum cover of 5 feet.

DW5.2 New Water and Sewer Mains – When new water mains and new sanitary sewer mains are installed, they shall have 10 feet of horizontal separation between them. If this cannot be achieved, the sewer line shall be constructed of pressure type pipe.

DW5.3 When it is necessary for water and sewer line to cross each other, the bottom of the water line shall be a minimum of 18 inches above the top of the sewer line; a length of water main pipe shall be centered over the sewer line so that the joints are a maximum distance from the sewer line and by encasing the sewer line with concrete or by constructing it of pressure type pipe for a minimum distance of 9 feet on both sides of the water line.

#### **SECTION DW6 – HYDRANT**

DW6.1 Location – Hydrants shall locate such that no residence or building shall be more than 500 feet from a hydrant, measured along a street or public right-of-way.



DW6.2 Leads: Each fire hydrant shall have a lead with a minimum diameter of 6 inches equipped with an auxiliary gate valve.

**SECTION DW7 – VALVES**

DW7.1 Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves should be located at not more than 500-foot intervals in commercial districts and at not more than one block or 800-foot intervals in other districts.

DW7.2 A minimum of 4 valves shall be installed at a 4 way intersection and 3 valves at a 3 way intersection.

**SECTION DW8 – SERVICE LINES**

DW8.1 The approximate location for service lines should be shown on the drawing submitted for approval with the actual location shown on the “as-built” drawing with station number.

DW8.2 No service line or meter shall be placed in a location that will increase the chance of it receiving damage or impair access for maintenance such as driveways or trees.

DW8.3 If a driveway or sidewalk is installed around existing meters, the Utility Personnel will relocate the meter and/or service line at the expense of the property owner.

**PART MW – MATERIALS FOR WATER MAINS**

**SECTION MW1 – DESCRIPTION****MW1.1      General:**

This part of the specifications shall govern for all materials used in the construction of water distribution facilities under the jurisdiction of the Westford Water Department. Projects that would necessarily involve materials other than those included in this specification shall be subject to the approval of the Water Department. Complete specifications covering all materials not included herein shall be submitted for approval. Any material used other than materials herein specified shall be of the kind and type normally used in the construction of water distribution facilities.

MW1.1.1      All products included in this section shall conform to the requirements of the standard specifications referenced herein.

MW1.1.2      Pipe size shall be as shown on the drawings.

MW1.1.3      All pipe materials and methods of jointing shall be as shown on the Drawings.

**MW1.2      Reference Standards:**

- A. ANSI A21.4/AWWA C104 – Cement Mortar Lining For Ductile Iron Pipe and Gray Iron Pipe and Fittings for Water.
- B. ANSI A21.10/AWWA C110 – Gray Iron and Ductile Iron Fittings, 3” through 48”, for Water and Other Liquids.
- C. ANSI A21.11/AWWA C111 – Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
- D. ANSI A21.51/AWWA C151 – Ductile Iron Pipe.
- E. ANSI B.16 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- F. ASTM A126 – Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- G. ASTM B62 – Composition Bronze or Ounce Metal Castings.
- H. AWWA C502 – Dry Barrel Fire Hydrants.
- I. AWWA C600 – Installation of Cast Iron Water Mains.
- J. AWWA C150 – Thickness Design for Ductile Iron Pipe.
- K. AWWA C504 – Rubber Seated Butterfly Valves.
- L. AWWA C500 – Gate Valves, 3” through 48”.
- M. AWWA C509 – Resilient-Seated Gate Valves.
- N. AWWA C550 – Protective Interior Coatings for Valves and Hydrants.

**SECTION MW2 – DUCTILE IRON WATER MAINS****MW2.1**      Description:

The different kinds of strengths of water pipe outlined in this section shall be used in the construction of water lines unless otherwise specified in Section CW – Construction Methods. The strength of pipe used shall be based upon standard engineering design procedures and manufacturer or trades association recommendation, and the strength proposed shall be shown on the drawings. All pipe used in the construction of water lines shall be “Underwriters Laboratory” (UL) approved. All pipes shall be circular. Only pipe materials listed in this section shall be used for main extensions unless specifically authorized in writing by the Superintendent. All minimums are just suggested minimums and in no way relieve the Engineer from performing the necessary calculations.

**MW2.2**      Ductile Iron Pressure Pipes:

MW2.2.1      Ductile Iron Pipe shall be designed in accordance with AWWA C150 and ANSI A21.51/AWWA C151, Class 52 and shall have push-on joints where specified. Pipe shall be double cement-lined with seal coat inside and out conforming to ANSI A21.4/AWWA C104. Push-on joints and rubber gaskets

MW2.2.2      The pipe manufacturer shall supply the Engineer with certificates of compliance with these specifications and certification that each piece of ductile iron pipe has been tested at the foundry with Ball Impression Test, Ring Bending or other approved test for ductility.

MW2.2.3      Ductile iron pipe may be rejected for failure to meet any of the requirements of this specification.

**SECTION MW3 – SERVICE LINES****MW3.1**      Description:

The service line is the line from the main to the outlet valve at the customer’s meter. It shall consist of the corporation stop at the main, the tubing or pipe, the curb stop and curb box, and a meter with valves on both the inlet and outlet. The specifications for the corporation cock or stop and the curb stop will be found in Section MW4.7.

MW3.1.1 Polyethylene Service line:

Tubing for services shall be polyethylene designed for 200 psi service. Pipe shall be in accordance with AWWA C901 standard for Polyethylene Pressure Pipe, tubing and fittings.

MW3.1.2 For service lines larger than two inches in diameter, any pipe approved in section MW2 for water mains shall be used.

MW3.3.3 Rejection:

PB tubing may be rejected for failure to meet any of the requirements of this specification.

## **SECTION MW4 – FITTINGS**

MW4.1 Description:

The different kinds of strengths of fittings used in water line construction, outlined in this section shall be used in the construction of water lines unless otherwise specified in Section CW – Construction Methods. The strength of the fittings used shall be based upon standard engineering design procedures and manufacturer or trade association recommendation, and the strength proposed shall be shown on the drawings. All fittings used in the construction of water lines shall be “Underwriters Laboratory” (UL) for approved. All materials listed in this section shall be used for main extensions unless specifically authorized in writing by the Superintendent. All minimums are just suggested minimums and in no way relieve the Engineer from performing the necessary calculations.

MW4.2 Fittings for Ductile Iron Pipe:

MW4.2.1 Fittings shall be Cast Iron, 250 psi pressure rating, or Ductile Iron, 350 psi pressure rating, conforming to ANSI A21.10/AWWA C110 with mechanical joints. Compact Ductile Iron Fittings conforming to ANSI A21.53/AWWA C153 will be acceptable. Joints shall be furnished with ductile iron retaining glands. Retaining glands shall be Mega-lugs, series 1100, manufactured by EBBA Iron, or an approved equal. Glands using set screws will not be acceptable. Fittings shall be double cement-lined and seal-coated inside and out in accordance with ANSI A21.4/AWWA C104. Tees for hydrant branches and for stubs for future use shall have mechanical joints on the run

with a plain-end having an integral rotating gland on the branch (Anchor-tees). The gland will anchor mechanical joint pipe or valve ends to the plain end of the pipe.

- MW4.2.2 All Ductile and Cast Iron Pipe and fittings shall be clean, sound, and without defects. The castings shall be smooth and free from pinholes, excess iron, etc. The coatings shall be continuous, smooth and neither brittle nor sticky.

MW4.3 Brass Water Service Fittings:

- MW4.3.1 Ford, McDonald or Mueller fittings required with Pack Joint. Stops and Fittings furnished under these specifications shall be of the size and type specified, with all parts of brass, conforming to Alloy Number 4 A (ASTM Designation B 62) which has a nominal composition of 85% copper and 5% each of tin, lead, and zinc, plus or minus 1%. All stops, cocks, and fittings shall be full size openings, throughout, of the size specified.

All castings shall be smooth, free from burrs, scales, blisters, sand holes, and defects of every nature that would make them unfit for the use for which they are intended.

Nuts shall be smooth cast, with symmetrical, hexagonal wrench flats.

- MW4.3.2 Fittings shall be designed for 200 psi working pressure and brass to brass parts shall be shipped prelubricated with a light, fluid lubricant between key and body.
- MW4.3.3 Valves must be ball type with a full size opening with straight-through flow, Teflon coated, bronze ball with a minimum of .5 mil. thickness coating. The stop must be so constructed that it may be disassembled and the ball removed without special tools.
- MW4.3.4 Corporation stops shall be C.C. or I.P. threads as required. They shall be designed to rotate about the axis of the flow passageway within a circle of rotation small enough to properly clear the inside of any standard tapping machine of appropriate size.

**SECTION MW5 – WATER MAIN VALVES****MW5.1      Resilient Seated Gate Valves:**

- MW5.1.1      Resilient seated gate valves shall be manufactured to meet or exceed the requirements to AWWA C-509 of the latest revision. Valves shall have an unobstructed water way when fully opened equal in diameter to at least ¼” greater than the nominal valve sizes. Valves shall have mechanical joint end.
- MW5.1.2      All internal surfaces shall be coated with epoxy to a minimum thickness of 4 mils. Said coating shall be non-toxic, impart no taste to water and shall conform to AWWA C 550 of latest revision.
- MW5.1.3      Valves shall be provided with two O-ring stem seals. Both O-rings shall be located above the thrust collar. The sealing mechanism shall provide a dual seal with zero leakage at the water working pressure when installed with the line flow in either direction, and shall consist of a cast iron gate having a vulcanized synthetic rubber coating with no rubber metal seams or edges in the water way when in the fully closed position.
- MW5.1.4      All valves shall be seat tested at the rated working pressure in accordance with Section 6 of AWWA C-509. Valve shall be rated at 200 psi working pressure and 400 psi test pressure.
- MW5.1.5      Valves shall open left.

**MW5.2      Butterfly Valves:**

- MW5.2.1      All butterfly valves shall be of the rubber-seated, tight-closing type and shall meet or exceed AWWA Specification C-504-70, with latest revisions. Valves shall be designed for underground service.
- MW5.2.2      Valves shall have mechanical joint ends. Standard M.J. accessories are also to be provided.
- MW5.2.3      Valve shall be equipped with a 2” AWWA operating nut and shall open as specified below.

- MW5.2.4 All valves shall be rated at 200 psi minimum working pressure and hydrostatically tested at 400 psi.
- MW5.2.5 Valves shall have thermosetting epoxy coating on the interior and the vane. The coating shall meet all requirements of AWWA C-550 of the latest revision. All bodies and vains shall be factory coated prior to assembly and tested. All ferrous surfaces of the valve body waterway and vane shall receive an epoxy coating with a minimum dry film thickness of 8 mils. All exterior surfaces shall be coated with asphalt varnish.
- MW5.2.6 Rubber seat shall be a full circle 360 degree seat not penetrated by the valve shaft. Rubber seat shall be mechanically retained in the valve body and shall be capable of being replaced. Seats vulcanized or bonded to the body are not accepted.
- MW5.2.7 All valves shall use full AWWA C-504 Class 150-b valve shaft diameter. Valve shaft shall be one-piece. Shafts shall be made of stainless steel or hi-tensile steel. One piece valve shafts shall extend full size through the entire valve and operator with no neckdown, keyways, or holes.
- MW5.2.8 Valve shaft shall be sealed from waterway by means of stainless steel journals and "triple-seal" rubber packing designed for permanent duty in underground service. Valve disc shall be of the through shaft type made of high strength cast iron ASTM A-48 Class 40.
- MW5.2.9 Valve operator shall be of the worm and gear or traveling-nut type and shall use full AWWA C-504 Class 150-B torque rating throughout entire travel.
- MW5.2.10 Valve operator shall be capable of withstanding an overload input torque of 450 ft.-lbs. at full-open or closed position without damage to the valve operator.
- MW5.2.11 Valves shall open left.
- MW5.3 Tapping Sleeve and Valve:
- MW5.3.1 Tapping sleeve and valve shall be of the mechanical joint type for use on cast/ductile iron pipe with ductile iron outlet



- MW5.3.2 The mechanical joint sleeve shall have longitudinal compound rubber gaskets which shall fit against the rubber end gaskets which shall fit against the rubber end gaskets thus affecting a totally enclosed rubber water-tight seal.
- MW5.3.3 Tapping sleeve shall have a flange with “O” ring seal and drilled to correspond to that of the tapping sleeve to insure proper alignment. The outlet side shall be mechanical joint.
- MW5.3.4 Tapping sleeve shall meet or exceed provisions of AWWA C500 specifications
- MW5.3.5 Tapping sleeve shall be designed for 200 psi working pressure and 400 psi test pressure and shall open left.
- MW5.3.6 Tapping Valve shall be iron body, resilient seated gate valve with 2-inch operating nut.

MW5.4 Valve Boxes:

- MW5.4.1 Valve boxes shall be furnished for all valves. Shop drawings will be required for approval before delivery.
- MW5.4.2 Valve boxes shall be standard cast-iron, asphalt coated, adjustable, sliding type, together with cast-iron covers with the word “Water” plainly cast in relief on the top surface.
- MW5.4.3 The bottom section shall have a minimum I.D. of 5- ¼”. The top section shall have a minimum diameter of 6-⅛”. There shall be a minimum 6” overlap between sections.
- MW5.4.4 The bottom section shall be 48” in length for all butterfly valves and 36” in length for all gate valves. The top section shall be at least 26” in length and have a plain bottom. No three piece combinations shall be acceptable.
- MW5.4.5 Valve boxes shall be completely and thoroughly coated with bitumastic paint.

**MW6 – FIRE HYDRANTS****MW6.1      General:**

- MW6.1.1      Hydrants shall conform to the requirements of AWWA C-502, and be designed for 150 psi working pressure tested to 300 psi hydrostatic. Hydrants shall have 6-inch mechanical joint shoe with retaining gland, 5- $\frac{1}{4}$ -inch valve opening, and 6'0" bury, open left with two 2- $\frac{1}{2}$ -inch hose nozzles and one 4- $\frac{1}{2}$ -inch hose nozzles and one 4-  $\frac{1}{2}$  inch pumper connection, National Standard Threads, operating nut and nozzle cap with non-kink safety chains.
- MW6.1.2      Hydrants shall be the compression type, closing with pressure. They shall be traffic model with safety flange and stem couplings.
- MW6.1.3      Hydrants shall be able to be rotated 360 degrees. They shall have a positive closing, self-cleaning drain valve and drainage area shall be completely bronze or brass lined.
- MW6.1.4      The Water Department has standardized on Mueller M& H, Clow
- MW6.1.5      Hydrants shall be painted yellow to match the Town's standard color.

**SECTION MW7 – METERS****MW7.1      Description:**

This section covers water meters  $\frac{5}{8}$  inch to 2 inches. A special detail will be submitted for approval for meters larger than two inches.

MW7.2      Meters must conform to AWWA Standard C-700, latest edition.

MW7.3      Domestic meters will be a  $\frac{5}{8}$ -  $\frac{3}{4}$ " Neptune T-10 with an encoder register. The bottom shall be of corrosion protector cast iron and will break clean across its diameter when subjected to freezing. The register shall be of the straight reading in cubic feet. The encoder shall have a cable connector consisting of no more than three screw type connectors. The receptacles shall have a cable connector consisting of a three screw terminal to receive a three wire cable connecting the encoder register on the water meter to the receptacle. The remote water meter system and components shall be as manufactured by Neptune Water Meter Company or approved equal and shall be known as the Neptune ARB system or equal.

MW7.4 Larger meters must meet approval of the Water Department.

**MW8 – CONCRETE AND REINFORCING STEEL**

MW8.1 Description:

This section covers materials for concrete and reinforcing steel used in water line construction.

MW8.2 Cement:

MW8.2.1 Cement shall be Portland Cement conforming to AASHTO Designation M85, Type 1. Type III cement high early strength, may be used if approved by the Engineer.

MW8.2.2 When concrete is mixed on the job site, cement shall be delivered in plainly marked paper sacks of not less than 94 pounds net weight.

MW8.3 Water:

Water used in mixing concrete and mortar shall be free from injurious amounts of acids, alkalies, oils, sewage, and vegetable matter. It shall be fit for drinking.

MW8.4 Composition and Strength:

MW8.4.1 Concrete shall be composed of Portland Cement, fine and coarse aggregate, and water proportioned in keeping with the following:

	Class "A"	Class "B"	Class "C"
Minimum sacks of cement per cubic yd	6	5	4
Consistency Range in Slump-in	2-4	2-4	2-4

MW8.4.2 Proportioning of concrete shall be by weight except that water may be measured by volume.

MW8.4.2.1 A one cubic foot sack of Portland Cement will be considered as 94 pounds in weight.

MW8.4.2.2 A gallon of water will be considered as weighing 8.33 pounds.

MW8.4.3 Class “A” concrete made with ordinary Portland Cement shall have a minimum compressive strength at 28 days of 3,000 psi. Class “B” concrete made with ordinary Portland Cement shall have a minimum compressive strength at 28 days of 2,500 psi. If made with high early strength cement, those strengths shall be attained at the age of 7 days. Class “C” concrete shall have 2,000 psi.

Class of concrete shall be shown on the plans in all locations where concrete is required.

**SECTION MW9 – PIPE BEDDING AND BACKFILL**

MW9.1 Description:

This section covers materials used for pipe bedding and backfilling. All water line bedding shall be Class “2” unless otherwise specified herein or shown on the plans. Class “1” bedding may be used for ductile or cast iron pipe only, unless approved by the Utility prior to construction.

MW9.2 Bedding:

MW9.2.1 Class “1” Bedding:

Class “1” bedding materials are materials on the site, earth bedding.

MW9.2.2 Class “2” Bedding:

Class “2” bedding materials shall be composed of gravel materials. Gravel bedding materials shall be pea gravel or washed gravel no larger than ½” diameter. Substitution of alternate bedding materials will be approved only in individual case and only at the specific request of the Engineer.

MW9.2.3 Class “3” and Class “4” Bedding:

Class “3” and Class “4” bedding materials shall be composed of concrete and reinforcing steel and shall meet with the requirements of Section MW9 – Concrete and Reinforcing Steel. All concrete used for Class “3” and Class “4” bedding shall be 2,000 lb. concrete.

**MW9.3      Backfill:**

Backfilling shall be done with good earth, sand or gravel and shall be free from large rocks or hard lumpy material, unless the rocks or lumps are not more than approximately four (4) inches in greatest diameter and are scattered in the soil. No material of a perishable, spongy, or otherwise unsuitable nature shall be used in backfilling.

**SECTION MW10 – METER BOXES****MW10.1      Meter Boxes for 5/8Inch and 1 Inch Meters:**

Meter boxes for 5/8inch and 1 inch meters shall be vitrified clay meeting ASTM specification C700, latest revision. Dimensions of meter box and lid are in the Standard details.

Meter box lids shall be cast iron as per standard details.

**MW10.2      Meter Boxes for Meters Larger than 1 Inch:**

Meter boxes shall be made of concrete blocks, bricks or poured concrete four inches thick or greater. Concrete shall be “Class A” concrete and shall conform to Section MW9, “Concrete and Reinforcing Steel” of these specifications.

Covers for these meter boxes shall be made of steel as per design and plans. The steel shall be strong enough to handle the traffic load (if any).

The walls of the meter boxes shall be coated with a bituminous sealant inside and outside. The steel lids shall be bituminous coated to prevent rust. Lids shall be as per special standard details.

**SECTION MW11 – TRACE WIRE****MW11.1      Trace wire or Magnetic Tape shall be laid with all non-metallic pipe as per standard details.**

Trace shall be fourteen (14) gauge single strand plastic coated copper trace wire.

**PART CW – CONSTRUCTION FOR WATER MAINS**

**SECTION CW1 – GENERAL**

CW1.1 This part of the specification shall govern the construction procedures used in the installation of water line facilities under the jurisdiction of the Utility. Construction procedures other than those outlined in this specification shall meet with the approval of the Utility. Complete specifications covering any unusual or special construction procedure shall be submitted for approval and approval must be received prior to beginning any construction operations.

**SECTION CW2 – EXCAVATION AND BACKFILL**

CW2.1 Description:

This section covers the excavation and backfill of water lines, and appurtenances.

CW2.2 Trench Excavation:

CW2.2.1 The sides of the excavation shall be cut as such a slope that will prevent caving. In areas where soil conditions permit normal excavation of the trench, the sides shall be cut as nearly vertical as possible from the bottom of the trench to a point 12” above the top of the pipe when it is laid to grade. Maximum and minimum widths of the trench shall be as shown in the plans.

CW2.2.2 In caving ground or in wet, saturated, or flowing materials, the sides of the excavation shall be adequately sheeted and braced so as to maintain the excavation free from slides or cave-ins and safe for workmen. Sheeting and shoring shall not be removed until the excavation has been backfilled to a sufficient depth to prevent caving.

CW2.2.3 The trench width from the bottom of the trench to an elevation 12” above the top of the pipe shall not exceed the maximum width as specified in the plans.

CW2.3 Trench Bottom:

The entire length of the water line shall be founded on bedding specified in Section CW3 – Pipe and Bedding and in Section MW10 – Pipe Bedding and Backfill Materials.

CW2.4 Excavation for Fire Hydrants:

Excavation for fire hydrants shall be as specified in Section CW9 – Fire Hydrants.

CW2.5 Disposal of Excavated Materials:

Excavated material shall be piled adjacent to the work to be used for backfilling as required. Excavated materials which are unsuitable for backfilling and excess material shall be disposed of in a manner approved by the Engineer.

CW2.6 Use of Explosives:

In the event the use of explosives is necessary for the efficient prosecution of the work, the Contractor shall notify the Engineer in advance of their use and shall exercise every precaution to prevent damage to adjoining improvements or property by reason of their use. Any damage to private property resulting from the use of explosives shall be the liability of the Contractor. In all cases where the explosives are necessary, a permit from the local government agency shall be obtained prior to their use.

CW2.7 Backfilling:

CW2.7.1 Water Lines:

CW2.7.1.1 Backfilling of water lines shall include the refilling and consolidation of the fill in the excavation up to the surrounding ground surface or road grade at crossings. It is essential that the complete backfill be done in such a manner to minimize voids in the backfill.

CW2.7.1.2 Backfilling up to the point 12” above the top of the pipe shall be done with good earth, sand, or gravel and shall be free from large rocks or hard, lumpy materials. No materials of perishable, spongy or otherwise unsuitable nature shall be used in backfilling.

CW2.7.1.3 Backfill of Rigid Pipe:

Rigid pipe (concrete, cast iron, or asbestos cement) shall be backfilled with select materials of the proper moisture content to obtain a support under the lower ½ of the pipe, compacted to a density of



90% AASHTO T-180 modified or better. The intent is to cradle the pipe so that the fill length of each joint is uniformly supported on firm bedding and the weight of pipe and fill is borne uniformly by the lower ½ of the pipe barrel. Tamping of fill below the spring line of the pipe may be by hand tamps provided the required density is obtained.

Where trenches are not under existing or proposed paved areas, backfill shall proceed with the same select materials hand placed to a point 12" over the top of the pipe. Backfill may then proceed by whatever commonly used construction methods as are consistent with the integrity of the pipeline. Backfill outside the existing or proposed paved areas shall be left slightly over full to allow for settlement.

Where trenches are under existing or proposed paved areas, the entire trench up to a point 2' below existing or proposed subgrade shall be backfilled with select materials and compacted to a density of 90% AASHTO T-180 modified or better. The remaining 2' shall be similarly backfilled, but the minimum compaction shall be 95% AASHTO T-180 modified.

The backfill of materials in trenches under existing or proposed paved areas shall be compacted with mechanical devices manufactured for that purpose from two feet above the top of the pipe to the top of the existing or proposed subgrade.

#### CW2.7.1.4 Backfill of Non-Rigid (Flexible) Pipe:

Backfill of any non-rigid materials not mentioned in CW2.7.1.3 as a rigid material, shall be as specified in Section CW2.7.1.3 except that the entire trench surrounding the pipe barrel to a point 12" above the top of the pipe shall be backfilled with select material compacted to a density of 90% AASHTO T-180 modified or better. All pipe materials approved now or in the future for use in the Utility's system not defined in CW2.7.1.3 as rigid pipe shall be backfilled as specified herein or according to the manufacturer's recommendations or ASTM D2321

whichever requires the greatest degree of compaction.

CW2.7.2 Fire Hydrants:

Backfilling of fire hydrants is specified in Section CW9 – Fire Hydrants.

### **SECTION CW3 – PIPE BEDDING**

CW3.1 Description:

This section covers construction methods for pipe bedding. All pipes shall be laid on either Class “2”, Class “3”, or Class “4” bedding materials as specified in Section MW9 – Pipe Bedding Materials, except that cast or ductile iron pipe conforming to Sections MW2.3 or MW2 of these specifications may be bedded as specified for “type 1” laying conditions in ANSI A21.50, “Thickness Design of Ductile Pipe”, latest revision, unless structural or foundation requirements indicate otherwise.

CW3.2 Class “1” Bedding:

CW3.2.1 Class “1” bedding shall be completed in accordance with details shown on the standard details and with these specifications.

CW3.2.2 The pipe shall be embedded in the bottom of the trench as shown on the standard details, with cuts made for the bells of the pipe.

CW3.3 Class “2” Bedding:

CW3.3.1 Class “2” bedding shall be completed in accordance with details shown on the standard details and with these specifications.

CW3.3.2 Excavation shall be carried to a depth of 0.40’ below the bottom of the pipe. Where excavation is carried below this depth for any reason, the space shall be filled with Class “2” bedding material unless otherwise approved.

CW3.3.3 The pipe and joints shall be embedded in the gravel or sand bedding material to a depth of .10’ of the outside diameter of the pipe or to a minimum depth of 0.2’ as shown on the standard details.

**CW3.4**      Class “3” and Class “4” Bedding:

- CW3.4.1      Class “3” and Class “4” bedding shall be completed in accordance with details shown on the standard details and with these specifications.
- CW3.4.2      Excavation shall be carried to the bottom of the concrete as shown on the standard details. Where excavation is carried to a depth below the bottom of the concrete for any reason, the space may be filled with either Class “2”, Class “3”, or Class “4” bedding material unless otherwise approved.
- CW3.4.3      Where Class “3” or Class “4” bedding is used, the pipe and pipe joints shall be embedded in the concrete as shown on the standard details.
- CW3.4.4      Construction methods of placing concrete and reinforcing steel shall meet with the requirements stipulated above and as outlined in Section CW13 – Concrete and Reinforcing Steel.

**CW3.5**      Service Lines:

The bedding service lines shall meet with the requirements of Class “1” bedding set forth above.

**SECTION CW4 – DEWATERING OF TRENCHES****CW4.1**      Description:

This section covers the dewatering of trenches to the extent that bedding material and water pipe can be placed on dry, firm trench bottom.

**CW4.2**      Wellpointing:

Wellpointing where required to keep the excavation dry and the subgrade stable, shall be installed when the excavation is within a minimum of two (2) feet of the water table, except as hereinafter provided, and shall be in continuous operation until backfill is completed to this level. When construction equipment is to be operated in an area that has been excavated and wellpointing is required to keep trench excavation dry and the subgrade stable, the wellpoint shall be installed when the excavation is within a minimum of five (5) feet of the water table. There shall be sufficient pumping equipment, in good working order, available at all times, to remove any water that accumulates when the pipe line crosses natural drainage channels, the work shall be conducted in such a manner

that unnecessary damage or delays in the prosecution of the work shall be prevented. Provision shall be made for the satisfactory disposal of surface water pumped so as to prevent damage to public or private property.

CW4.3 Trench Dewatering:

Dewatering of trenches other than by wellpointing shall be accomplished by whatever means elected by the Contractor, however, bedding material or pipe may not be placed in wet or unstable trenches. Soil that cannot be properly dewatered shall be excavated and dry material tamped in place to such a depth as may be required to provide a firm trench bottom.

CW4.4 Surface Runoff:

Surface runoff water shall be diverted away from the trenches. Such diversion shall be into existing drainage structures such as storm sewers, ditches or streams. Diversion of surface runoff shall be in such a manner to prevent flooding of streets or private property.

CW4.5 Disposition of Water from Dewatering:

All water removed from the trenches by wellpointing or any other means shall be pumped, piped or drained into existing drainage structures, such as storm sewers, ditches or streams. The disposition of water from dewatering operations shall be accomplished in a manner that will prevent the flooding of public or private property.

## **SECTION CW5 – SHEETING AND SHORING**

CW5.1 Description:

This section covers the sheeting and shoring to protect the safety of workers, provide suitable means for constructing the water line, and to protect public or private property, including existing utilities.

CW5.2 Cave-ins:

Where trench cave-ins are a possibility, adequate sheeting and/or shoring shall be provided so as to maintain the trench free from slides or cave-ins and safe for workmen.

CW5.3 Existing Structures:

Where existing buildings, other utilities, streets, or other structures are in close proximity to the trench, adequate protection shall be provided by the use of sheeting and shoring to protect the structure from possible damage.

In the case of streets or utilities, the Contractor may elect to remove the street or utility provided that the removal and subsequent replacement meets with the approval of the Town of Westford, the utility owner, or whoever has jurisdiction of the structure. In all cases, it shall be the responsibility of the Contractor to protect public and private property and any person or person who might, as a result of the Contractor's work, be injured.

## **SECTION CW6 – PIPE LAYING**

### **CW6.1      Description:**

This section covers the laying of pipe for water lines. All material shall be in accordance with Part MW – Materials for Water Mains of these specifications.

### **CW6.2      Inspection:**

Each joint of pipe shall be inspected carefully before being placed in the trench. Any joint found to be cracked or otherwise so damaged as to impair its usefulness shall be plainly marked in such a manner that the markings will not rub or wash off. Damaged joints shall be removed from the site as soon as feasible.

### **CW6.3      Pipe Laying:**

CW6.3.1      All pipe and fittings shall be installed to the line and grade as detailed on the plans. Subject to the approval of the Engineer, other fittings may be added to or substituted for those shown on the plans, should the need arise during construction. This permissive stipulation in no way shall relieve the Contractor of the responsibility for furnishing and installing all fittings required for a complete and proper installation of main as detailed on the plans.

Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Full responsibility for the diversion of drainage and for dewatering of trenches during construction shall be borne by the Contractor.

All dirt and other foreign matter shall be removed from the inside of pipe and fittings before they are lowered into the

trench. They shall be kept clean during and after laying, care shall be taken to keep dirt out of the jointing space.

Spigot and bells shall be cleaned thoroughly before the application of lubricant and attachment of the gasket shall be in strict accord with the joint.

At the end of each day's work, and when pipe laying is discontinued for an appreciable period, open ends of pipe shall be closed with a cast plug or cap firmly secured in place.

Pipe shall not be placed in the trench without excavating for bells so that the entire barrel of the pipe is uniformly supported on the pipe bedding.

Pipe shall be supported to proper line and grade, and secured against upheaval or floating during the placement of bedding.

All pipe and fittings shall be lowered carefully into the trench in such manner as to prevent damage to pipe, fittings, or linings. Neither pipe nor fittings shall be dropped or dumped into the trench.

Cutting of pipe, where needed, shall be done in a neat and workmanlike manner without damage to pipe or pipe lining.

Unless otherwise directed by the Engineer, pipe shall be laid with bell ends facing in the direction of laying. For lines on an appreciable slope, bells shall, at the direction of the Engineer, face upgrade. Wherever necessary to deflect pipe from a straight line in either the horizontal or vertical plane, to avoid obstructions, or for other allowable reasons, the degree of deflection at any joint shall not be greater than that which will provide adequate gasket space entirely around the spigot end of pipe. The joint opening shall be approximately  $\frac{1}{8}$  inch.

Deflections shall not exceed the maximum recommended by the pipe manufacturer.

All non-metallic pipes shall have trace wire meeting requirements of Section MW12, "Trace Wire" of these specifications as per standard details.

CW6.4      Service Lines:

CW6.4.1      Boring:

Boring may be done by whatever boring machine is designed for said purpose. Where casing is required, the bore shall be large enough to house to casing. Where encasement pipe is not required, the end of the pipe shall be plugged in such a manner as to keep pipe free from dirt and other foreign matter.

CW6.4.2      Polybutylene (PB):

CW6.4.2.1      Open Trench:

Trench bottom shall be free of rocks or sharp objects and should be compacted to prevent settlement. Depth of Service Line should be 5 feet unless otherwise specified on plans or directed by the Engineer. Before installation, pipe should be inspected for cuts, punctures, or excessive abrasion.

CW6.4.2.2      Pipe should be blown out before final connections are made to eliminate any dirt or sand that may have entered the pipe during installation. Pipe shall be pressure tested before being fully backfilled, (partial backfill to hold the pipe in place).

CW6.5      Early Warning Tape:

Early warning tape or wire shall be installed in trench, (18) inches below ground surface for all pipe.

**SECTION CW 7 – FITTINGS**

CW7.1      Description:

This section covers the construction methods for fittings used in water line construction. All materials shall conform to the requirements of Section MW4 – Fittings. Where mechanical joint fittings are to be used, bolts shall be protected from the concrete blocking by either wrapping the fitting with clear plastic or bolts shall be greased.

**CW7.2**      Ductile Iron Pipe:

Fittings for ductile iron pipe shall meet with the requirements of Section MW4.4 – “Fittings for Ductile Iron Pipe” of these specifications.

Fittings shall be installed as per Section CW6 – “Pipe Laying”.

**CW7.3**      Polyvinyl Chloride (PVC) Pressure Pipe:

Fittings for PVC pressure pipe shall meet with requirements of Section MW4.5 – “Fittings for PVC Pressure Pipe” of these specifications.

When using mechanical joint (MJ) fittings with PVC pressure pipe, the bevel on the spigot end of the pipe shall be cut off before being connected to MJ fittings.

When push-on or MJ fittings are being used, fittings shall be blocked against thrust as per standard details.

**SECTION CW8 – TAPS****CW8.1**      Service Taps:**CW8.1.1**      **General:**

Taps and/or tap assemblies of the specified size shall be installed in locations as detailed and indicated on the plans or as specified.

Taps: Taps for transmission of water or air from the main into system service accessories are defined as follows:

- a. Standard internal pipe threaded holes in the wall of water mains; these taps may be either manufactured into the pipe or installed in the field.
- b. Tap installations that are made by clamping a bronze service clamp equipped with a sealed threaded port on the periphery of the main then drilling through the pipe wall to complete each service port.
- c. When a direct tap is made, pipe dope or Teflon tape shall be applied to the threaded part of the corporation stop.
- d. Services will only be provided from dedicated easements, alley ad right-of-ways.
- e. The Westford Water Department shall determine the location of taps.



f. Taps will be located in such a manner to provide the shortest distance and most direct line to the meter.

CW8.1.2 Tapping Asbestos-Cement Pipe:

Asbestos-cement pipe shall be tapped by the use of a tapping saddle made of bronze or stainless steel as in CW8.1.1b above.

CW8.1.3 Tapping Cast Iron Pipe;

Cast iron pipe four (4) inches in diameter and smaller shall be tapped by the use of a tapping saddle made of bronze or stainless steel as in CW8.1.1.b above.

CW8.1.4 Tapping Ductile Iron Pipe:

Ductile Iron Pipe shall be tapped the same as cast iron pipe, Section CW8.1.3 above.

CW8.1.5 Tapping PVC Pipe:

PVC pipe shall be tapped the same as cast iron pipe, Section CW8.1.3 above.

CW8.1.6 Tapping Concrete Pressure Pipe:

Concrete pressure pipe shall be tapped by the use of a bronze or stainless steel tapping saddle as in CW8.1.1.b above. Tap shall be made according to Pipe Manufacturer's specifications. After tap is made, tap shall be covered with mortar conforming to MW13.1 "Mortar" of these specifications.

CW8.2 Main Taps:

CW8.2.1 Wet Taps:

Wet connections shall be used for all connections except where directed by the Engineer. Wet connections shall be made with a tapping sleeve and valve conforming to MW5.3 "Tapping Valves and Sleeves" of these specifications. Either air driven or manual tapping machines may be used. The pipe to be tapped shall be cleaned thoroughly and wire brushed to remove rust and other foreign matter. The tapping sleeve shall be put on

and tightened down securely. The valve shall be put on the sleeve and braced against movement. Then the tap shall be made.

CW8.2.2 Dry Taps:

Dry connections shall only be made when directed by the Engineer and/or when a fitting must be added to an existing line. For dry connections, the existing line must be shut off and drained. This should be done so that down time of the line shall be as short as possible. After line has been drained, the line shall be cut and the fitting put in and blocked. The section o line cut into shall be tested and sterilized as would a new line.

## SECTION CW9 – HYDRANTS

CW9.1 Description:

This section covers construction methods used in setting fire hydrants. All fire hydrants shall conform to Section MW6 – “Fire Hydrants”.

CW9.2 Excavation:

Excavation for fire hydrants shall be neat and shall leave back of trench and bottom of trench undisturbed earth for concrete blocking.

CW9.3 Installation:

Fire hydrants shall be installed as per standard details. A standard six-inch gate valve shall be between the main and hydrant, as per standard details. Six (6) inch Ductile iron water line, meeting requirements MW2.2 – “Ductile Iron Pressure Pipe” of these specifications, or Swival adapters shall be used to install fire hydrants.

CW9.4 Backfill:

Backfill shall be as per standard details. Concrete locking shall be put underneath and behind hydrant. At least seven (7) cubic feet of crushed stone, average  $\frac{3}{4}$  inch diameter, shall be placed around hydrant as per standard details for drainage of hydrant barrel.

**SECTION CW10 – VALVES**CW10.1      Description:

This section covers construction methods used for putting in valves. All valves shall conform to Section MW5- “Valves”.

CW10.2      Bedding:

Valves shall be bedded the same as the pipe the valve is installed on.

CW10.3      Backfill:

## CW10.3.1      Vertical Valves:

Valves shall come with an adjustable cast iron valve box, for vertical valves. Backfill for valves shall be compacted as per CW2.7.

**SECTION CW11 – ENCASEMENT PIPE**CW11.1      Open Cut:

Encasement Pipe installed by open cut shall be bedded as per Section CW3.2 – “Class ‘1’ Bedding” of these specifications. Backfilling shall be as per Section CW2.7 – “Backfill of Rigid Pipe” of these specifications.

Pipe shall be pushed through encasement pipe and installed as per Section CW6 – “Pipe Laying” of these specifications.

CW11.2      Jacking and Boring:

## CW11.2.1      Construction Requirements:

Where encasement or carrier pipe is required to be installed under railroad embankments or under highways, streets or other facilities by jacking or boring, construction shall be made in a manner that will not interfere with the operation of the railroad, highway or other facility, and will not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.

The drilling of pilot holes for the alignment of pipe prior to its installation by jacking, boring, or tunneling will not be a requirement but may be necessary to maintain grade.

The drilling of pilot holes will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract.

The Contractor shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation needed to install the conduit. All damages by excavating and blasting, either to surface or subsurface structures, shall be repaired or replaced by the Contractor at this own cost and expense.

The removal of any obstruction that may be found to conflict with the placing of this pipe will not be measured for payment or paid for as a separate contract pay item. The removal of any such obstruction will be included in such contract pay items as are provided in the proposal and contract.

The Contractor shall dispose of all surplus materials at his own cost and expense at sites approved by the Engineer.

#### CW11.2.2 Construction by Jacking:

If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. This excavation shall not be carried to a greater depth than is required for placing of the guide and jacking timbers and no nearer the roadbed than the minimum distance shown on the plans.

At the other end of the pipe, an approach trench shall be excavated accurately to grade. All open trenches and pits shall be braced and shored in such a manner as will adequately prevent cave-ins or sliding of the walls into the open trench or pit.

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head not less than 6 inches larger than the outside diameter of the pipe, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied at the jack. The jacking head shall be provided with an opening for the removal of excavated material as the jacking proceeds. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides which are straight and securely braced together in such manner to support the section of the pipe and to direct it in the proper line and grade. All timber and other materials used in the construction of the jacking assembly will be of such quality and dimensions that they will withstand all stresses to which they are subjected in such a manner as to insure even pressures on the pipe during jacking operations. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe.

As jacking proceeds, the embankment materials shall be excavated slightly in advance of the pipe in such a manner to avoid making the excavation larger than the outside diameter of the pipe, with the excavated material being removed through the pipe. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall

conform to the contour and grade of the pipe. The excavation for the top half of the pipe shall conform closely to the outside diameter of the pipe and a clearance greater than 2 inches will not be permitted. All voids between the pipe and the earth will be filled with grout. Grout holes may be provided in the pipe or grouting may be made through drill holes from the ground surface if practical. The grouting shall follow immediately upon completion of the jacking operation.

All carrier pipe installed by jacking shall be supported by quarter point cradle of 2000 psi concrete across the jacking pit and to the first joint in the ditch section on each end.

The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but shall not exceed 2 feet in any case. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of 1 inch per 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans.

When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be repaired or removed and replaced by the Contractor at his entire expense.

The pits or trenches excavated to facilitate jacking operations shall be filled immediately after the jacking of the pipe has been completed unless an encasement only has been installed; in which case, the trenches and pits shall be left open until the carrier pipe has been laid through and manholes have been built if required. The pits or trenches will then be backfilled in accordance with the location and conditions as are covered elsewhere in these specifications.

If a carrier pipe is laid through an encasement pipe, the bedding of crushed rock, concrete, grout or granular material, if any, will be considered a part of the unit price of the jacking operation.

#### CW11.2.3 Construction by Boring;

The hole shall be bored mechanically with a suitable boring assembly designed to produce a smooth, straight shaft and so operated that the completed shaft will be at the established line and grade. The size of the bored hole shall be of such diameter to provide ample clearance for bells or other joints. All carrier pipe installed by boring shall be supported by quarter point cradle of 2000 psi concrete across the boring pit and to the first joint in the ditch section on each end.

All voids will be grouted and will be considered a part of the unit price of the boring operation.

In addition to the requirements stated above, the applicable provisions of Section CW11.2.2 – “Construction by Jacking”, in regard to the construction of trench, tolerance in line and grade, method of operation, backfilling, etc., shall govern for construction by boring.

CW11.3      Closing Encasement Pipe:

After Water pipe has been installed in the encasement pipe, the ends of the encasement pipe shall be closed with brick and mortar.

CW11.4      Joints:

When reinforced concrete pipe is used for encasement pipe, joints shall be sealed with mortar.

**SECTION CW12 – METERS AND METER BOXES**

CW12.1      Description:

Services will only be provided from dedicated easements, alleys, and right-of-ways. The Water Department shall determine the location and size of all meters. Meters shall be located in such a manner to provide the shortest length of service line required as long as the main is not overloaded. The meter will not be in a location that will hinder the maintenance or could cause damage to meter or meter box.

CW12.2      Excavation, Bedding and Backfill:

Excavation for Meter boxes shall be done neatly and in a workmanlike manner. The hole excavated for the meter box shall be as small as possible and dug by hand where feasible.

Bedding for meters and boxes shall be a twelve (12) inch layer of crushed stone compacted under the box. Crushed stone shall be an average  $\frac{3}{4}$  inches in diameter.

The top of the meter box shall be set one (1) inch to three (3) inches above the existing grade. Meter box shall not be set in a driveway or other area of traffic. In a traffic area or driveway meter boxes shall be set at grade. Backfill shall be earth excavated from the site and hand tamped around meter box.

**CW12.3**      Meter and fittings:

Meters shall conform to Section MW7 – “Meters” of these specifications and shall be set by the Utility. Fittings shall conform to Section MW4.3.

**SECTION CW13 – CONCRETE AND REINFORCING STEEL****CW13.1**      Description:

This section covers the construction methods for concrete and reinforcing steel. All materials shall conform to the requirements of Section MW8 – “Concrete and Reinforcing Steel”.

**CW13.2**      Ready-Mixed Concrete:

All concrete for poured-in-place manholes and other structural applications shall be ready-mixed concrete. Ready-mixed concrete shall conform to the ASTM Standard D 94 and to applicable portions of these specifications for on-site mixing. The concrete shall be delivered and placed within one hour after all materials, including mixing water, shall have been placed in mixing drum.

**CW13.3**      Reinforcing Steel:

Steel reinforcement shall be free from rust, scale, and from mortar, dirt, or other objectionable coatings. It shall be placed accurately in accordance with details shown on the plans and properly secured in position.

**CW13.4**      Vibration:

All structural concrete must be vibrated as it is placed. The use of form vibrators is not acceptable. Internal vibrators shall be capable of transmitting vibration to the concrete at frequencies not less than 4,500 impulses per minute. Duration of vibration shall be limited to the time necessary to provide satisfactory consolidation without causing segregation. The vibrator shall not be inserted into the lower courses previously vibrated. Vibrators shall be applied in a substantially vertical position and at uniformly spaced point not further apart than the visible effectiveness of the vibrator. Vibration shall be supplemented by such spading and spudding as the Engineer may require. All concrete shall be vibrated except that the concrete in manhole bases and pipe foundations need not be vibrated if other methods produce satisfactory results.

CW13.5      Application of Structural Concrete Other than Manholes:

Utilization of reinforced or unreinforced concrete for structural uses other than poured-in-place manholes shall be subject to individual design and specification of the responsible Engineer to meet the specific needs of the project. Design and specification shall be in keeping with current engineering practice, applicable codes of practice, and subject to the review and approval of the Westford Water Department.

**SECTION CW14 – PAVEMENT REPAIRS**

CW14.1      Description:

This section covers the construction methods to be used in the repair of roads, streets, or other public rights-of-way.

CW14.2      Permanent Repairs:

CW14.2.1      Asphaltic concrete hot mix surface course construction shall meet with the current requirements of the Westford Highway Department Specifications or the Mass Highway Department Specifications for the construction of asphaltic concrete hot mix surface course or as otherwise approved.

CW14.2.2      Concrete pavement repairs shall meet with the current requirements of the Mass Stat Highway Department Specifications or the Westford Highway Department Specifications for the construction of concrete rigid pavements.

CW14.2.3      Gravel surfacing shall meet with the current requirements of the Mass State Highway Department Specifications or the Westford Highway Department Specifications for the construction of crushed stone base courses.

CW14.2.4      All permanent repairs of streets, roads, or other public rights-of-way shall meet with the construction requirements of the governing agency or private owner and shall meet with the requirements of all local Ordinances, Regulations, Permits, or Codes governing the repairs to roads, streets, or other rights-of-way.



**CW14.3      Temporary Surfacing:**

Methods of temporary surfacing shall meet with the requirements of Paragraph CW14.2 or as otherwise approved to adequately maintain traffic and proper drainage.

**SECTION CW15 – CONSTRUCTION WITHIN HIGHWAY RIGHT-OF-WAY****CW15.1      General:**

Where proposed lines are in a highway right-of-way, the work shall not be started until the Contractor has the approval of the Mass Highway Department or Westford Highway Department, received through the Engineer, and, in addition, until the Contractor has notified the Maintenance Foreman for the Highway Department that he is about to commence work. The Contractor shall provide and employ adequate warning signs, barricades, lights, watchmen, etc. to fully protect his workmen and the traveling public. When crossing of highway is permitted in open cut, the Contractor shall prosecute the work in such a manner that one-half of the traveled portion of the road is open to traffic at all times.

Highway crossings shall be bored and cased in accordance with Section CW11 of these specifications. However, in certain cases, where shown on the plans, the Contractor shall make the crossing in open cut.

No changes shall be made in location as shown on the plans with the limits of a highway right-of-way without prior authorization of the Highway Department and the Engineer.

**CW15.2      Backfill:**

The Contractor may, at his option, use Highway Specification Type I or Type II backfill above embedment except on crossings, in which Type I backfill must be used. Type I and Type II backfill are defined as follows:

**a.      Type I Backfill:**

This shall consist of compacted material obtained from suitable soil excavated from the trench or from sources outside the Highway Right-of-Way which is free of rock, lumps, or clods that will not break down under compaction.

Type I Backfill Material shall be placed in the trench in layers not to exceed 4" in depth and compacted, with moisture being added to facilitate compaction.

Compaction shall be done with pneumatic tamps, mechanical tamps actuated by internal combustion and giving equal results to pneumatic tamps, tamping (sheepsfoot) rollers, pneumatic tired roller, or vibratory rollers. Hydro tamp will be allowed, but lift may not exceed 30 inches. Rollers may be used for compaction only if trench is wide enough to

permit use of rollers and provided that use of roller is not believed detrimental to any Highway facility and that type of roller used is acceptable to the Texas Highway Department or Arkansas Highway Department representative. When rollers are employed, a pneumatic or mechanical tamp shall be used along the sides of the trench to compact any backfill that cannot be reached with rollers.

b. Type II Backfill (Granular Material):

Granular backfill material for use in Highway Right-of-Way shall consist of sand or a combination of pit run sand or gravel, and shall be free of organic matter, hard lumps that will not consolidate readily, lumps of clay, and excessive amounts of clay. The Material shall be placed in the trench in uniform layers not to exceed two (2) feet. Each layer shall be dry rodded thoroughly and jetted with water to achieve maximum compaction. Where no pavements or driveways are involved, the top of granular backfill shall be sealed, as directed by the Engineer, with about 12 inches of suitable compacted excavated material to retard entry of water.

c. Where sodding is disturbed by excavation or backfilling operations, such areas shall be replaced by mulch sodding on all slopes of 2% or less. All slopes over 2% shall be replaced by block sodding. The cost of this work and material shall be included in the unit price bid per linear foot of various pipe sizes.

CW15.3 Crossing Highway in Open Cut:

The crossing shall be constructed by trenching across the highway in open cut; opening a trench to the minimum width necessary. Where pavement is concrete or concrete base with other wearing surface and is reinforced, the bars shall be cut on alternate sides of the trench and bent back. Upon laying the line, the pipe shall be covered with granular embedment to a level twelve (12) inches above the top of the pipe; the embedment to be deposited in four-inch layers and each layer thoroughly compacted. The remainder of the trench to the surface of the highway shall be backfilled with Class "B" concrete; the backfill to have a surface level with the top of the road surface pending the placing of concrete pavement (or the base). When ready to replace concrete pavement (or base), the surplus backfill shall be removed and the pavement shall be removed for an additional width of one foot on each side of the trench. The concrete pavement (or concrete base) shall then be replaced using Class "A" concrete. The replaced pavement or base shall be kept wet and barricaded for 48 hours. In the case of asphalt or brick wearing surface on concrete base, the wearing surface shall be installed as soon as the replaced base has set up sufficiently.

Where pavement is flexible base and asphalt surface, the trench shall be backfilled as above. When ready to replace the base and wearing surface, the surplus backfill shall be removed and the base and asphalt surface shall be replaced the same as or equal to the original base and surface.

**SECTION CW16 – CONSTRUCTION WITHIN CITY RIGHT-OF-WAY****CW16.1**      City Streets:

The Mass or Westford Highway Department shall be notified prior to any street cuts. Pavement repairs shall be done according to the requirements of Section CW14 – “Pavement Repairs” of these specifications.

If city streets have to be closed, the appropriate Fire, Police and Street department shall be notified of closing. Proper barricades, warning signs, lights and watchmen shall be employed. Work shall be prosecuted in such a manner that one-half of the traveled portion of the road is open to traffic unless directed by the Engineer.

Right-of-way shall be left in a neat and orderly manner and left in as good or better shape than it was before construction. City right-of-way shall be seeded or sodded according to the requirements of Section CW18 – “Grading, Sodding and Sprigging” of these specifications.

**CW16.2**      Easements:

Easements shall be left in a neat and orderly manner. Easements shall be left in as good or better shape than that before construction. Easements shall be seeded and sodded according to the requirements of Section CW18- “Grading, Sodding, and Sprigging” of these specifications.

**SECTION CW17 – EXISTING STRUCTURES****CW17.1**      General:

No trees or existing structures shall be removed unless directed to do so by the Engineer. All existing structures, improvements, and utilities shall be adequately protected, at the expense of the Contractor, from damage that might otherwise occur due to construction operations. Where construction comes in close proximity to existing structures or utilities, or if it becomes necessary to move services, poles, guy wires, pipe lines, or other obstructions, the Contractor shall notify and cooperate with the utility or structure owner. The utility lines and other existing structures shown on the plans are for information only and are not guaranteed by the City to be complete or accurate as to location and/or depth. The Contractor shall be liable for damage to any utilities resulting from his operation. During construction, all fire hydrants, valve boxes, fire or police call boxes, and other existing utility controls shall be left intact, unobstructed and accessible.

The removal and satisfactory disposal of all existing structures, either above, on the surface, or below the ground, which are to be abandoned or rebuilt and which interfere in any way with the new construction, shall be in accordance with the plans and these specifications.

The adjusting and replacement of all existing structures, either above, on the surface, or below the ground which are designated to be adjusted or replaced, shall be in accordance with the plans and these specifications.

CW17.2 Relocating or Replacing Utilities:

CW17.2.1 Unless noted on the plans that utilities are to be moved by others, any cost of temporarily or permanently relocating utilities shall be borne by the Contractor. The cost of these replacements shall be included in the Contractor's operations, the Contractor shall restore the structure or utility to its original condition and position without extra compensation.

CW17.2.2 Sewer House Services:

All house sewer services damaged during construction shall be replaced by the Contractor at his expense. Sewer service reconnections, including necessary adjustments to a sanitary sewer replacement, will not require the services of a master plumber. It shall be the responsibility of the Contractor to maintain such services throughout the construction process and for a period of one year after the date of final acceptance to the project. Any damage to these service repairs shall be restored by the Contractor at his expense.

CW17.2.3 Water Services:

Whenever water service connections are to be crossed, and the excavation is being done by machinery, it will be permitted, and the Engineer may require, that service lines be removed immediately ahead of excavation. Service lines so removed shall be reset immediately after passage of the excavating machine in order to achieve the least possible interruption of water service to the customer.

CW17.2.4 Interrupted Service:

Cuts or breaks in sewer mains and laterals, or service connections, shall be restored at the earliest practicable moment to give the least possible interruption in service. The Contractor shall be responsible for notifying customers of temporary interruption of service.

CW17.3 Removal and Replacement of Fence:

The Contractor shall do the necessary removing of fencing on the right-of-way, and shall rebuild same after the pipe line is completed. The fences shall be rebuilt of the same character of materials as that which was removed. All posts, wire and other material shall be sound, straight, equal to or better than the materials removed. Fences shall be built to line, posts well set, wires fastened with new staples and well stretched. All new posts used in the fencing shall be buried at least thirty inches (30") in the ground, and shall have a top diameter of not less than three and one-half inches (3 ½"). New corner posts shall have a minimum top diameter of not less than six inches (6"), set three feet (3') in the ground. Gates shall be replaced in a substantial manner, and all corner, gate and end posts well braced. Where fences are removed, the Contractor shall be responsible for the protection of livestock, etc.

CW17.4 Poles, Signs, Guy Wires, Etc.:

All utility poles and guy wires, private sign posts, signs and guy wires and similar private obstructions which are indicated on the plan or existing on the ground shall be removed and replaced by the Contractor at no additional cost to the Town. Any of the above installed after contract bids are submitted and after direction by the Engineer, the Contractor shall remove and replace or have moved to new permanent location by the owner thereof at the expense of the Town. Any such item which the Contractor removes or causes to be moved for his convenience is at his own expense.

The Contractor shall be responsible for all damages to street sign posts and signs within the limits of his operations that remain in place or are removed and replaced. In even the street sign posts and signs are damaged or destroyed by the Contractor's operations, they shall be replaced by the Town at the Contractor's expense.

CW17.5 Other Utilities:

When it is necessary to remove or adjust a storm sewer, a representative of the Highway Department will be notified to decide method and work to be done. The Westford Water Department shall issue the Highway Department a work order to make the necessary adjustments. However, if the Contractor prefers to do the construction in order to facilitate the whole project, the Contractor may do the required construction in a manner satisfactory to the Highway Department, provided he first secures the written permission of the Water Department, and further provided, that he shall initiate and perform such work at the Contractor's own expense other than items that may be provided in the contract for such work.

When it is necessary to remove or adjust another utility, a representative of that utility will be notified to decide method and work to be done. The Contractor shall make satisfactory arrangements with other utilities for the required cutting or adjustments at the Contractor's own expense other than items that may be provided in the contract for such

work. No extra compensation will be paid due to delays caused by removal of public utility structures.

The Contractor will be held liable for any negligent or willful damage to any other utility and shall be expected to pay for the cost of all necessary repairs and any damages resulting to public or private property therefrom.

## **SECTION CW18 – GRADING, SODDING, AND SPRIGGING**

### **CW18.1      Description:**

This section covers methods to be used in replacing grass, preventing erosion and replacing removed trees, shrubs and other plants.

All areas in parks and parkways which have been disturbed during the construction operations and not requiring surfacing or paving, shall be brought to the designated grade with not less than 6” of top soil free of rock 1” and larger as shown on the plans or directed by the Engineer, due consideration being given to shrinkage and settlement.

All sod which does not show signs of living shall be replaced so that when the project is accepted by the Town all areas which require sodding shall have thereon a well started growth.

### **CW18.2      Drainage:**

All areas which have been disturbed during construction shall be left, when final grading is completed, so that the surfaces will drain. All existing drainage pipe systems shall be restored to a condition which will permit proper functioning.

### **CW18.3      Sodding:**

All areas which have been disturbed by the construction operations, unless otherwise noted on the plans, shall be sodded with live grass strips or blocks. When areas have been approved by the Engineer as being in condition to receive the sod, the following procedure shall be followed in placing the sod:

- a. All strips or blocks of sod shall be cut from a dense vigorous growth of grass in a soil which will withstand handling without dropping off or having the roots exposed. Generally, sod taken from a sandy soil will not be accepted and dried out sod will be rejected.
- b. A continuous row of sod not less than five inches wide and two inches thick shall be placed around the boundary of each area. Commencing

from this row, other similar and parallel rows of sod shall be placed not more than two feet apart.

c. Between rows of continuous sod strips there shall be placed two rows of tufts or blocks of sod not less than three inches square and two inches thick, set at eight inch centers so as to break space in adjacent rows.

d. All sod shall be set in trenches or depressions deep enough to permit at least one inch of cover after backfilling and spreading surplus materials over surface. All sod shall be tamped firmly but lightly into place.

CW18.4 Plant Replacement

Plants shall not be removed unless directed by the Engineer. When plants and/or trees are to be removed and replaced, the following steps shall be followed:

1. The hole shall be large enough for the plant being put in it.
2. The plant shall be carefully put in the hole, with care taken not to break or damage roots.
3. The hole shall be filled with good topsoil and tamped firmly but lightly into place.
4. The plant shall be watered.

CW18.5 Erosion Control:

Where the slope of the ground is two (2) percent or more, the ground shall be sodded and whatever means necessary taken to hold the sod in place.

**SECTION CW19 – STERILIZATION**

CW19.1 Description:

This section covers methods for sterilization of water lines and facilities. Before water lines are sterilized they must first be pressure tested according to the requirements of Part TW – “Testing of Water Mains” of these specifications. Water lines also must be flushed to remove dirt and other foreign matter.

**CW19.2**      Flushing:

A service tap must be put on one end of the water line to allow entry of flushing water and sterilization water. The tap shall be done according to the requirements of CW8 – “Service Taps” of these specifications.

Flushing shall be done with clean water from the Town’s system until water leaving the other end of the main is clear.

**CW19.3**      Sterilization:

Chlorine shall be used to sterilize the pipe line by the following method:

The amount of chlorine applied shall be such as to provide a dosage of not less than fifty (50) parts per million. The chlorinating material shall be introduced to the water lines and distribution system in a manner approved by the Engineer. After a contact period of not less than eight (8) hours, the system shall be flushed with clean water until the residual chlorine content is not greater than 0.2 parts per million. All valves in the lines being sterilized shall be opened and closed several times during the contact period.

The cost of furnishing the chlorine, labor, tools, equipment, and tests of chlorine content and bacteriological tests will be at the expense of the Contractor. No water mains shall be placed in service until a satisfactory test report has been received from an approved laboratory.



**PART TW – TESTING OF WATER MAINS**

**SECTION TW1 – GENERAL**

TW1.1 This part of the specifications stipulates test requirements for materials, construction methods, and leakage, pressure and bacteriological tests of the water lines. Testing for materials and construction methods shall be at the Developer's option except as stipulated herein. The Westford Water Department may require tests as outlined in these specifications for materials and construction procedures if, in the opinion of the Water Department, the quality of materials and the construction procedures do not meet the requirements stipulated herein.

In all cases, leakage, pressure and bacteriological tests shall be performed on water lines as specified in these standard specifications.

**SECTION TW2 – HYDROSTATIC TESTING****TW2.1 Asbestos-Cement Water Lines:**

As soon as a continuous section of new water main has been installed the Contractor shall proceed immediately to complete all testing and sterilizing, make all connections, and place those sections in service. The Contractor shall furnish all labor, materials, tools, and equipment necessary to bulkhead and seal off the line for testing, fill it with water, raise the filled line to test pressure and measure the amount of leakage over the test period.

Unless otherwise indicated, the pipeline shall be tested with a hydrostatic pressure of not less than that pressure the pipe is rated at, i.e., class 150, test pressure 150 psi maintained over a continuous period of not less than four (4) hours. After a successful continuous period of four (4) hours has been completed, a test for the determination of amount of leakage shall be run at the same pressure as before for a duration of two (2) hours. If the tests indicate a leakage in excess of a rate equal to ten (10) gallons per inch of internal pipe diameter per mile of pipeline per twenty-four (24) hours, the Contractor will be required to find and eliminate the leak. All known leaks shall be stopped, regardless of this test requirement.

The cost of testing, finding, and repairing the leaks and retesting shall be at the expense of the Contractor. The water required to fill the lines will be furnished by the Owner without charge to the Contractor.

**TW2.2 Cast Iron Pipe:**

As soon as a continuous section of new water main has been installed, the Contractor shall proceed immediately to complete all testing and sterilizing, make all connections, and place those sections in service. The Contractor shall furnish all labor, materials, tools, and equipment necessary to bulkhead and seal off the line for testing, fill it with water, raise the filled line to test pressure and measure the amount of leakage over the test period.

Unless otherwise indicated the pipeline shall be tested with a hydrostatic pressure of not less than that pressure the pipe is rated at (i.e., class 150, test pressure 150 psi) maintained over a continuous period of not less than four (4) hours. After a successful continuous pressure period of four (4) hours has been completed, a test for the determination of amount of leakage shall be run at the same pressure as before for a duration of two (2) hours. If the tests indicate a leakage in excess of a rate equal to ten (10) gallons per inch of internal pipe diameter per mile of pipeline per twenty-four (24) hours, the Contractor will be required to find and eliminate the leak. All known leaks shall be stopped, regardless of this test requirement.

The cost of testing, finding and repairing the leaks and retesting, shall be at the expense of the Contractor. The water required to fill the lines will be furnished by the Owner, without charge to the Contractor.

#### TW2.3 Ductile Iron Pipe:

As soon as a continuous section of new water main has been installed, the Contractor shall proceed immediately to complete all testing and sterilizing, make all connections, and place those sections in service. The Contractor shall furnish all labor, materials, tools, and equipment necessary to bulkhead and seal off the line for testing, fill it with water, raise the filled line to test pressure and measure the amount of leakage over the test period.

Unless otherwise indicated, the pipeline shall be tested with a hydrostatic pressure of not less than two hundred (200) pounds per square inch maintained over a continuous period of not less than four (4) hours. After a successful continuous pressure period of four (4) hours has been completed, a test for the determination of amount of leakage shall be run at the same pressure as before for a duration of two (2) hours. If the tests indicate a leakage in excess of a rate equal to ten (10) gallons per inch of internal pipe diameter per mile of pipeline per twenty-four (24) hours, the Contractor will be required to find and eliminate the leak. All known leaks shall be stopped, regardless of this test requirement.

The cost of testing, finding, and repairing the leaks and retesting, shall be at the expense of the Contractor. The water required to fill the lines will be furnished by the Owner, without charge to the Contractor.

#### TW2.4 PVC Pressure Pipe:

As soon as a continuous section of new water main has been installed, the Contractor shall proceed immediately to complete all testing and sterilizing, make all connections, and place those sections in service. The Contractor shall furnish all labor, materials, tools, and equipment necessary to bulkhead and seal off the line for testing, fill it with water, raise the filled line to test pressure, and measure the amount of leakage over the test period.

Unless otherwise indicated, the pipeline shall be tested with a hydrostatic pressure of not less than that pressure the pipe is rated at (i.e., class 200 test pressure 200 psi) maintained over a continuous period of not less than four (4) hours. After a successful continuous pressure period of four (4) hours has been completed, a test for the determination of amount of leakage shall be run at the same pressure as before for a duration of two (2) hours. If the tests indicate a leakage in excess of a rate equal to ten (10) gallons per inch of internal pipe diameter per mile of pipe line per twenty-four (24) hours, the Contractor will be required to find and eliminate the leak. All known leaks shall be stopped, regardless of the test requirement.

The cost of testing, finding and repairing the leaks and retesting, shall be at the expense of the Contractor. The water required to fill the lines will be furnished by the Owner, without charge to the Contractor.

### **SECTION TW3 – BACKFILL DENSITY TESTS**

#### TW3.1 Description:

This section covers the testing of backfill around water lines, valves, fire hydrants, and other structures to insure proper fill.

#### TW3.2 Requirements:

Backfill density requirements are specified in Part CW – “Construction Methods for Water Mains” of these specifications.

#### TW3.3 Methods of Testing

##### TW3.3.1 Moisture Density Relation:

The moisture density relation of material shall be determined in the laboratory in accordance with AASHTO Designation T-180 modified to use material passing a  $\frac{3}{4}$ ” sieve.

##### TW3.3.2 Field Density:

Field density of backfill density shall be determined in accordance with AASHTO Designation T-147.

### **SECTION TW4 – BACTERIOLOGICAL TEST**

TW4.1 After a section of water main has been sterilized and flushed according to Section CW19 – “Sterilization” of these specifications, the Utility shall be notified to pick up a sample.

A bacteriological test shall be run to determine whether coliform organisms are present. If coliform organisms are found the line will have to be resterilized as per Section CW19 of these specifications.

The Contractor will be notified as to the results of the test. The test requires 48 hours to complete.

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DOCUMENT A00808

# **PROJECT UTILITY CORDINATION FORM**

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# Project Utilities Coordination (PUC) Form

CONTACTS AND GENERAL UTILITY INFORMATION

Revision Date:

2/12/2024  
PRINTED

City/Town: Westford	Project File #: 609035	PUC Completed by: R. Goodale	Utility Pole Set: National Grid
Route/Street: Boston Road	Resident Engineer: TBD	Mass DOT PM: Jonathan Freeman	Scheduled Ad Date: 6/29/2024
			<b>Total Poles Relocated:</b> 23- R&R 8- Upgrade

Consultant:	Contact:	Cell #	Office #	Office #	Email	Cell #	Reimbursement		Notes	Email
							Agreement	Non-Reimbile		
TEC	Jonathan Rockwell		978-794-1792	Scope, Budget, Duration Submitted			Yes	No		
Utility Company	Contact	Office #	Cell #	Office #	Email	Cell #	Yes	No	Notes	Email
National Grid Electric	Sandra Annis	413-582-7424			sandra.annis@nationalgrid.com		X		X	
Town of Westford Fiber	Phil Kumph	978-735-6512			pkumph@waveguidefiber.com		X		X	
Verizon Business/MCI	Stephen Parretti	508-892-3381			stephen.parretti@verizon.com		X		X	
Comcast	Wendy Brown	978-848-5163			Wendy_Brown@comcast.com		X		X	
Verizon	Paul Diamantopoulos	508-323-0282			paul.e.diamantopoulos@verizon.com		X		X	
National Grid Gas	Melissa Owens	781-907-2845			Melissa.Owens@nationalgrid.com		X		X	
Town of Westford Water	Steve Cronin	978-399-2455			scronin@westfordma.gov					
Town of Westford Engineer	Paul Starratt	978-692-5520			pstarratt@westfordma.gov					
Town of Westford IT	Kevin Murphy				kmurphy@westfordma.gov					

**Utility Relocation Notes for MassDOT Contractor**  
 Unless otherwise noted by Contract, the MassDOT Contractor is to provide the District Construction Office with 7 Calendar Days advance notification in order to validate the current progress and provide the required 30 Days advance notice-to-proceed for the first Utility - and each subsequent Utility. These advance notifications are to be identified in the Contractor's Schedules (Pre-Con preparation, Baseline, Subnets, and Updated/Monthly Schedules) as specified in Subsection 8.02 (for DBB Contracts) and/or Section 9 (of DBB Contracts). Note: The durations included below do not include these lead-times. See Additional 'Important Basis notes for Contractor' - on last PUC Form page.

**Additional notes:**  
 Note: The existing underground Verizon Business/MCI cable/fiber that runs the project limits will be relocated into the existing Verizon Duct bank system. This is required to abandon the existing Verizon Business/MCI conduit. This will need to be done prior to any drainage installation or widening. The existing Verizon Business/MCI conduit is concrete encased and in locations located 9-14 inches below top of existing pavement. Once cable is relocated by Verizon Business/MCI the concrete encased conduit, if encountered, can be removed via contract items. Note: There is an existing Verizon owned direct buried copper cable along the Northeast Side of the Boston Road between Crown Road to the limit of work (STA 751-332). This cable has been confirmed as abandoned by Verizon. If the cable interferes with construction activities, the contractor is allowed to remove the cable as necessary.

**Suggested Sequence of Relocation (Based on Consultant proposed construction staging)**  
 The sequence as detailed on the following pages is based on the consultants proposed staging plan. This information was compiled through meetings that included all of the utilities listed below along with the designer and the Town of Westford. The information provided is the best available information prior to project advertisement.

PUC FORM - CONTINUED

Is 'enabling' (prep) work, by the Contractor, necessary prior to the start of the first series of utility relocations:	Yes	No
	X	
Has any of the Utility work been identified to work concurrently	Yes	No
	X	

2/12/2024  
PRINTED



RESPONSIBLE PARTY	DESCRIPTION - Utility Relocation Phases, Tasks and Activities	Estimated Duration (Work Days) by Utilities (Lead time not included)	Concurrent / Exclusive Utility Work				Access Restraint & Limitations of Operations Notes Should an AR be considered for the Contractor?
			Exclusive Utility on site	Concurrent Utilities	Contractor Off-Site operations on-site (while Utility Contractor and Utility are working on-site but NOT in the same vicinity)	Contractor Concurrent	
C	Enabling work by the Contractor - Coordinate with Verizon Business/MCI to initiate relocation. Verizon Business/MCI has been working on the conduit and aerial make ready and should have all the licenses in preparation for force account. Contractor to confirm with Verizon Business/MCI at preconstruction meeting. <u>Note:</u> The existing underground Verizon Business/MCI cable/fiber that runs the project limits will be relocated into the existing Verizon Duct bank system. This is required to abandon the existing Verizon Business/MCI conduit. This will need to be done prior to any drainage installation or widening. The existing Verizon Business/MCI conduit is concrete encased and in locations located 9-14-inches below top of existing pavement. Once cable is relocated by Verizon Business/MCI the concrete encase conduit, if encountered, can be removed via contract items.						
	<b>UTILITY OPERATIONS</b>						
	<b>Verizon Business/MCI</b>						
Task-1	u Install conduit between MCI and Verizon Duct Systems as noted on plans	2	X		X		
	u Install conduit between VZMH 15 and UP 37-3	2	X		X		
	u Install new aerial 1.4f and slack loops from UP 37-3 to UP 48	2	X		X		
	u Install new UG 1.44f and slack loops in Verizon duct	3	X		X		
	u Splice new fiber to splice points	2	X		X		
	u Remove exist fiber	2	X		X		
	<b>Sub-Total</b>	<b>13</b>					
C	Enabling work by the Contractor - At preconstruction meeting schedule a utility walkthrough to discuss pole locations and review tree trimming/removals. Prior to overhead utility relocations contractor will need to perform any necessary clearing & grubbing and tree removal as specified in Contract Documents. Survey will need to stake utility pole locations prior to utility walkthrough. Coordinate water line installation. Initiate work orders with National Grid Electric for secondary electric riser relocations. Overhead street lights are owned by the Town and will be relocated under contract items. At STA 35+75HRT UP 4-15 is being retained but may need to be held in place during installation of the drainage line in close proximity. To be coordinated with NGRID. Contractor to perform slope cutting prior to pole relocation between STA 46+00HRT and STA 51+00+HRT. Contractor to perform slope construction/grading between STA 51+00+HRT and STA 63+00+HRT prior to relocating utility poles. There are locations where utility poles will need to be held during sub-drain and CB installation. Contractor to initiate work order and coordinate with National Grid for these locations. National Grid will be responsible to hold these poles in place.						
	<b>UTILITY OPERATIONS - Overhead</b>						
	<b>National Grid Electric</b>						
Task-2	u Poles/anchors	21	X		X		
	u electric overhead work	41	X		X		
	u outage coordination	10	X		X		
	u transformers/equipment	8	X		X		
	u services	5	X		X		
	<b>Sub-Total</b>	<b>85</b>					
	<b>Town of Westford IT - Fiber</b>						
Task-3	u Delash fiber cable	1	X		X		
	u place new strand on poles	1	X		X		
	u provide hardware for poles	1	X		X		
	u relash Town fiber to new poles	2	X		X		
	<b>Sub-Total</b>	<b>5</b>					
Task-4	<b>Comcast</b>						
	u Transfer coax and strand to new poles	5	X		X		
	u Run new coax as needed to reach new poles	5	X		X		
	u Track slack and transfer fiber to new pole lrens. Include wreck out of old strand and cable	5	X		X		
	<b>Sub-Total</b>	<b>15</b>					
Task-5	<b>Verizon</b>						
	u Verizon to install strand and guying	5	X		X		
	u Verizon to place cables	6	X		X		
	u Verizon to cut over cables and terminals	23	X		X		
	u Verizon to remove and/or transfer cables, terminals and drops	22	X		X		
	u Verizon to remove poles and guying	25	X		X		
	u Verizon contractor to remove conduit risers	2	X		X		

RESPONSIBLE PARTY	DESCRIPTION - Utility Relocation Phases, Tasks and Activities	Estimated Duration (Work Days) by Utilities (Lead time not included)	Concurrent / Exclusive Utility Work				Access Restraint & Limitations of Operations Notes	
			Exclusive Utility on site	Concurrent Utilities	Contractor Off-Site	Contractor Concurrent	Potential Access Restraint (Yes/No)	Reason/Note (optional)
C = Contractor	U = Utility Co.		Utility working with no other utilities in vicinity	Utility working with other utilities on site	No Contractor physical construction operations on-site (While Utility Contractor and Utility are working on-site - but NOT in the same vicinity)	Contractor are working on-site - same vicinity		
	Enabling work by the Contractor - Coordinate gas service relocations with National Grid Gas	83						
	<b>Sub-Total</b>	<b>83</b>						
	<b>UTILITY OPERATIONS - Underground</b>							
Task: 6	<b>National Grid Gas</b>							
	u Relocate 1/2" 60psig PL Service to #45 Boston Road		X		X		No	
	u Excavate and shore	1					No	
	u Trench and install 1/2" 60 psig Plastic Gas Service	1	X		X		No	
	u Connections/Tie ins	1	X		X		No	
	u Stop/hap/purge/cut/cap	1	X		X		No	
	u Backfill	1	X		X		No	
	u Relocate 1/2" 60psig PL Service to #47 Boston Road		X		X		No	
	u Excavate and shore	1					No	
	u Trench and install 1/2" 60 psig Plastic Gas Service	1	X		X		No	
	u Connections/Tie ins	1	X		X		No	
	u Stop/hap/purge/cut/cap	1	X		X		No	
	u Backfill	1	X		X		No	
	<b>Sub-Total</b>	<b>10</b>						

**IMPORTANT BASIS NOTES - FOR CONTRACTOR**

- Unless otherwise specified in the MassDOT Construction Contract, or unless specifically noted within this PUC Form, these durations (herein) are based upon the Contractor providing *unimpeded access* to the Utility company to perform Utility relocations (see Note 5 - Access).
- "Concurrent Utilities" operations noted herein, are to signify those Utility Company operations that can be worked concurrently (e.g. Utility A and Utility B work on-site together) - MassDOT and the Contractor are to prepare NTPs to Utilities accordingly.
- "Potential Access Restraints" noted within this PUC Form are for planning purposes. See MassDOT Contract for Contractual Access Restraints (refer to Subsections 8.02, 8.03, and/or 8.06 for Design Bid Build Contracts and Volume II Section 9 for Design Build Contracts).
- Utility non-work periods - For planning purposes, the durations above contain some non work days (contingency) for New England conditions (precipitation, high temperatures, snow, ice). Gas line work however, typically has a seasonal restriction and can NOT be installed from 15-November to 15-March. Municipally Owned Electric and Gas Utilities are also restricted from proceeding from 15-November to 15-March. The Contractor shall (and the CTD plan) reflect this calendar restriction within the schedule (unless otherwise note).
- Access - Unless otherwise noted in the Contract, and in addition to the 'enabling' notes above, the Contractor must provide safe and unimpeded access (for trucks, lifts, cranes, etc.) to the Utilities, to allow for the proposed relocation(s) - including but not limited to snow removal, clearing and grubbing, guard rail removal, barrier removal, tree removal, and grading.
- For all MassDOT construction contracts issued after January 2014, the new Utility Coordination/documentation specification is required. This is Section 8.14 in Design-Bid-Build Contracts (see Design-Build index reference for applicable section #).
- Prior to starting any and all enabling work for Utilities, the Contractor is to plan in advance with submittals and approved durations.
- \* Potential District Initiated Early Utility Relocation - if noted herein, the District reserves the right to initiate early utility relocation in advance of the Contract NTP. In submitting a bid price and in the development/basis of the Baseline Schedule, the Contractor shall not plan the Work with the potential benefit of any form of 'early utility relocation'. As a requirement of the Baseline submission, unless otherwise noted in this Specification, the earliest that the first Utility company is to receive the 30 days advance notification to mobilize to the site, will be 7 calendar days after the pre-construction meeting and never sooner than 7 days after the Contract NTP.

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DOCUMENT A00810

# **MassDOT Herbicide Use Report**

# MassDOT Herbicide Use Report

Date Submitted:

Use multiple sheets for multiple application techniques or sites as needed.

**Contractor Performing Work:** 
**Project or Contract No:**

**Town/s:** 
**Associated Route:**

**Project Description:**

**Treatment Description:** 
**Area Treated (as applicable)**  
 Acres:  Sq Yds:  Miles:

**Weeds Targeted:** 
**Gallons Formula Used:**

**Application Method:** 
**Date/Time Began:**

**Date/Time End:**

**Product Used:**

Name: _____ EPA Reg. No: _____ % Active Ingredient Dry: _____ Liquid: _____ Formulation (dilution rate): _____	Name: _____ EPA Reg. No: _____ % Active Ingredient Dry: _____ Liquid: _____ Formulation (dilution rate): _____	Name: _____ EPA Reg. No: _____ % Active Ingredient Dry: _____ Liquid: _____ Formulation (dilution rate): _____
---	---	---

**Additional products used (surfactants, etc.) or other information:**

<b>Applicators:</b>	<b>License Numbers:</b>
_____	_____
_____	_____
_____	_____
_____	_____

Upon completion, please submit form to MassDOT District Engineer and Landscape Design Section in Boston office.  
11-16-2017



**WORK  
ZONE  
SAFETY**

*Temporary Traffic Control*

*Typical Details and  
Massachusetts Guidelines  
for MassDOT, Municipalities,  
Utilities, and Contractors*

**SHEET INDEX (1 OF 3)**

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## INTRODUCTION

This guide has been prepared to assist in the planning and installing of temporary traffic controls in maintenance, utility, or short-term construction work areas (work lasting 10 hours or less). This guide serves to assist with the many decisions that must be made for each work site. Special planning for traffic control is necessary on a case by case basis because conditions can vary widely among work locations. **Since this guide cannot cover every situation, representative illustrations covering typical short-term construction, maintenance, and utility operations are presented.**

**All typical traffic control device setups illustrated should be considered as guides.** The traffic control devices that are shown, the arrangement or position of the devices, and the distances prescribed in the tables are based on the Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) and the Massachusetts Amendments to the MUTCD (MA Amendments), but these illustrations only present minimum standards. The provision of safe work zones for all roadway users and roadway workers affected by these activities is paramount. Traffic controls may be expanded or improved upon whenever deemed necessary. Traffic movement through the work site all traffic control devices shall be periodically observed and inspected at all locations.

If necessary, Part 6 of the MUTCD and the MA Amendments, Chapter 17 (Work Zone Management) of MassDOT's Project Development & Design Guide, and the "Traffic Engineering and Safety Section" of the MassDOT web site: (<https://www.massdot.state.ma.us/highway/Departments/TrafficandSafetyEngineering.aspx>), as well as MassDOT District offices can provide additional guidance, information, and suggestions for work zone setups.

## RESPONSIBILITIES FOR TRAFFIC CONTROL

Short-term construction, maintenance, and utility work on or near the roadway creates a potentially hazardous situation, typically requiring the use of temporary traffic controls. These controls are important to protect both work crews and the road users. It is the responsibility of each maintenance foreman to establish and maintain safe and effective controls.

Usually the supervisor, working with the crew, plans the traffic control procedures for proposed work sites. The foreman is responsible for re-requesting, storing, and maintaining all traffic control devices necessary for their crews.

The foreman is responsible for placing the devices according to these guidelines. They must inspect each installation and observe traffic flow through the area. The foreman is generally authorized to make adjustments to the original installations that, in their judgment, are necessary to improve the control of traffic and establish greater safety.

All necessary traffic control devices must be installed before work begins and properly maintained during the work period. They must also be removed as soon as they are no longer relevant to the roadway conditions.

PAGE 2

In situations such as night time road or lane closures, detours, or other unusual conditions on state highways, the District Traffic Maintenance Engineer (DTME) should be advised. If the DTME is absent, the section foreman shall follow the instructions of the District Maintenance Engineer.

### **TRAFFIC CONTROL DEVICES**

Traffic control devices regulate the movement of road users, warn of unexpected or unusual roadway conditions, and inform them how to maneuver safely through or around the work area. All signs, channelizing devices, barricades, and other miscellaneous traffic control devices should work together to guide traffic safely and efficiently. Common temporary traffic control devices are outlined and described below.

#### **Signs**

Temporary traffic control zone (TTCZ) signs are the primary means of providing information and directions to roadway users. All signs must be retroreflective per MassDOT's latest standard.

Warning signs call attention to unexpected conditions and to situations that might not be readily apparent to road users on or adjacent to a roadway. Warning signs alert road users to conditions that might call for a reduction of speed or an action in the interest of safety and efficient traffic operations. Nearly all warning signs for construction and work areas have black legends and borders on a fluorescent orange background.

Regulatory signs shall be used to inform road users of selected traffic laws or regulations and indicate the applicability of the legal requirements. Regulatory signs typically have black legends and borders on a white background.

#### **Channelizing Devices**

When used properly, traffic cones, reflectorized plastic drums, and barricades guide traffic through the work area along an appropriate travel path. It takes roadway users a certain distance along the roadway to safely move away from the upcoming active work site. These transition distances are based on the following taper length (L) formulas:

$L = WS^2/60$  for speeds of 40 mph or less; or

$L = WS$  for speeds of 45 mph or more; where

- $L$  = minimum length of taper in feet,
- $S$  = posted speed limit or typical travel speed in miles per hour prior to the work, and
- $W$  = width of lane closure in feet.

The spacing of channelizing devices (in feet) is approximately equal to the existing speed of traffic (in mph).

#### **Warning Lights**

Rotating beacons and other flashing lights mounted on work vehicles, signs, or channelizing devices help alert roadway users to the work area. They may also be used to warn roadway users of hazards within the work area. The first 10 drums in any taper shall be equipped with sequential flashing lights.

### **Arrow Boards**

Arrow boards are a special type of sign that are highly visible work zone warning devices. They are particularly effective on highways, where both speed and volume are high. Arrow boards in the non-directional, CAUTION, mode (four corner flashing) may be used to indicate that a shoulder is closed. Arrow boards in the arrow mode shall only be used when a travel lane is dropped on a multi-lane road and one lane of traffic must merge with another. All arrow boards should be located at the beginning of each lane or shoulder closure taper without extending outside of it. Arrow boards shall flash at a rate of 25 to 40 flashes per minute. Arrow boards shall not be used to indicate a lane shift.

### **BASIC REQUIREMENTS**

In every work situation, the temporary traffic control setup must: Give roadway users sufficient advance warning of the work area; advise roadway users of the proper actions to take and travel paths to follow; and provide protection to roadway users, workers, and the work area. These three general requirements can be met as outlined below.

#### **Provide Advance Warning**

Warning devices along the approaches to a work area alert roadway Users to changes to road and operating conditions. Roadway users are usually alerted to these dangers via a sign or series of signs installed in the same order as the roadway user generally would expect to see them on long-term construction projects.

The initial project limit sign is usually a general warning such as "ROAD WORK 1500 FT". Other operational warning signs then provide the roadway user with more specific information about the situation. A minimum of three advance warning signs (the initial project limit sign and two operational warning signs) is recommended when work is located on the traveled way. Warning lights and flags can be used to attract attention to the signs. A highly visible work area helps reinforce the advance warnings.

#### **Advise and Direct Travelers**

Operational warning signs provide information to the road-way user such as the type of work being performed, special conditions to watch for, or actions to take. These include signs such as, SHOULDER WORK, RIGHT LANE CLOSED, DETOUR 500 FT, ROAD CLOSED to THRU TRAFFIC, POLICE OFFICER AHEAD, etc. All of these signs must be located far enough in advance of the work area that the roadway user has sufficient time to react to them appropriately. For projects in Urban Areas, see detail: Typical Device Spacing for minimum sign spacing.

#### **Protect Travelers, Workers, and the Work Area**

The primary protection of any work area is its own visibility. Traffic cones, reflectorized plastic drums, portable breakaway barricades, etc. are used to make the work area visible and separate workers from traffic.

PAGE 4

Other devices, such as flashing lights, flags, delineators, temporary lighting, and portable changeable message signs (PCMS) can be used to provide additional emphasis and visibility.

Workers must protect themselves by being alert to their work situation, wearing safety vests and hard hats, and by facing traffic whenever possible.

Work vehicles can also add protection when they are equipped with truck mounted attenuators, rotating beacons, flashing lights, flashing arrow boards, etc. and are parked between workers and oncoming traffic. However, workers should not position themselves between two closely parked vehicles. No private personal vehicles are allowed within the work site.

### PLANNING GUIDELINES

Decisions regarding selection of work area traffic control devices require a knowledge and understanding of the specifics of each work zone. As there may be vast differences between situations, three main variables need to be considered prior to determining the need for, or the selection of, traffic control devices: 1) location of work, 2) type of roadway, and 3) speed of traffic.

Compiling information about these variables will help with planning a safe work area control. Each of these variables is explained below.

#### Location of Work

The choice of traffic controls needed for a short-term construction, maintenance, or utility operation depends upon the work zone's location. As a general rule, the closer the active work site is to the roadway, the more control devices are needed. Work can take place:

- Away from the shoulder or edge of pavement. No special devices are needed if work is confined to an area 15 or more feet from the edge of the shoulder. A general warning sign, such as ROAD WORK AHEAD, should be used if workers and equipment must occasionally move closer to the roadway.
- On or near the shoulder/ edge of pavement. This area should be signed as if work were on the road itself, since it is part of the roadway users' recovery area. Advance warning and operational signs are needed, as well as channelization devices to direct traffic and keep the work area visible to roadway users.
- On the median of a divided highway. Work in this location may require traffic control in both directions of traffic. Advance warning and channelization devices should be used if the median is narrow.
- On the roadway. This condition requires detailed protection for workers and sufficient warning to roadway users. Advance warning must provide a general message that work is taking place as well as information about specific hazards and specific actions the roadway user must take.

### TYPE OF ROADWAY

The characteristics of the roadway also have an important influence on the selection of work area traffic control. The roadway, itself, may present special hazards. You should plan for maximum protection, using the worst hazard present as your guide to signing the work area. Some general considerations are described below for road conditions.

**One-way roads:** A one-way road requires signage on both sides of the road if it carries two or more lanes in one direction, ensuring roadway users in all lanes are alerted and informed.

#### Two-way roads:

- **Undivided:** Two-way, undivided roads will usually require controls for both directions of traffic. When the active work site is well off the roadway, controls for the opposite lane may be eliminated.
- **Divided:** Work on divided multi-lane roadways can often be handled as work along a one-way road (i.e. signs are provided along both sides of the roadway along the direction affected). If the work is in the median, both directions of traffic must be controlled, and both approaches should be double signed (i.e. have all 3 advance warning signs on both sides of each direction).

### EFFECTS OF SPEED ON WORK ZONES

Speed is an important consideration in the use of work area traffic control devices. As a general rule, the greater the speed of traffic approaching a work area, the greater the size, number, and spacing of control devices.

**Size.** The standard size for most warning signs is 36 x 36 inches on conventional roadways and 48 x 48 inches on freeways and expressways. Signs larger than the standard 36 x 36 inches may be desirable on high-speed conventional roads.

**Position.** Install signs far enough in advance of the work area so the roadway users have time to react to them (see charts associated with diagrams for spacing).

### OTHER FACTORS

**Sight Obstructions.** To ensure safety, work areas must be visible. Assess the placement of the temporary traffic control devices by driving through the area, and determine if the devices can be easily seen and provide sufficient time for roadway users to react in a safe manner. Extra precaution should be enacted in areas where horizontal or vertical curves may obstruct a roadway user's clear view of road activities ahead.

**Police/Flaggers.** It should be noted that the MUTCD does not require police/flaggers for stationary setups. If police/flaggers are used, a police/flagger ahead sign should be used in advance of any point where the police/flagger is stationed to control road users.

## PROCEDURES FOR WORK AREA TRAFFIC CONTROL

### 1. PLAN YOUR WORK

**Inspect** location of work area and its surroundings.

#### **Analyze:**

- Location of work in relation to the traveled way, intersecting road-ways, driveways, and sight distances;
- Type of roadway and traffic involved; and
- Volume and speed of traffic.

**Meet and discuss** the work and necessary traffic control with the crew.

**Study** representative illustrations in this guide to develop a temporary traffic control plan (TTCP).

#### **Other Considerations:**

- Base your traffic control plan on the premise that all roadway users are unfamiliar with the area.
- The closer the work area location is to traffic, the more controls are needed.
- Plan for maximum protection.
- Select and inspect the temporary control devices needed (including all warning signs), if they are not in good condition, REPLACE THEM!
- Then collect and transport them to the work site.
- Determine their proper placement.
- Install signs and other traffic control devices prior to allowing personnel or equipment onto the roadway.
- Make sure signs are reflective, accurate, clean, and meet specifications. Completely cover any existing permanent signs that will conflict with the messages of the new work area control signs.

### 2. INSTALLING/REMOVING TEMP. TRAFFIC CONTROL DEVICES

Care must be exercised when installing and removing temporary traffic control (TTC) devices. The traffic control needed to perform the operation safely is dictated by the location on the roadway the operation will occur: in a shoulder or a lane, in the left lane or right, etc. In all cases, installing TTC begins and ends as a mobile operation.

A shadow vehicle with a truck mounted attenuator (TMA) shall be used to protect workers installing and removing TTC devices on all roadways with a posted speed limit of 45 MPH or greater as directed by the engineer. TTC devices shall not be installed or removed from a shadow vehicle with a TMA. TTC devices shall be installed or removed from a work operation vehicle only and a shadow vehicle with a TMA shall be used to protect the workers installing or removing the devices.



## **PROCEDURES FOR WORK AREA TRAFFIC CONTROL (CONT.)**

### **3. INSTALL TRAFFIC CONTROL DEVICES AT WORK SITE FOR LOWER SPEED ( $\leq$ 40 MPH) ROADWAYS:**

- 1) All devices shall be installed in order with the flow of traffic.
- 2) Where one direction of traffic is being affected, the first sign installed should be the sign farthest from the work site, and on the same side as the work.
- 3) Where two directions of traffic are affected, install signs for opposing traffic first, starting with the sign farthest from the work area. When signs for opposing traffic have been installed, install signs on the same side as the work area, again beginning with the sign farthest from the active work site.
- 4) Once signs are in place, other traffic control devices shall be installed in the same manner as the signs.

### **FOR HIGHER SPEED ( $\geq$ 45 MPH) ROADWAYS:**

- 1) All devices shall be installed in order with the flow of traffic.
- 2) Install all advance warning signs, beginning with the ROAD WORK XXX (W20-1) sign and ending with the END ROAD WORK/DOUBLE FINES END (MA-R2-10E) sign.
- 3) Install all signs beginning with the opposite side which will be closed (for a right lane closure; first, install all signs on the left side (shoulder) and then install all signs on the right side (shoulder). No signs shall be erected on the roadway unless delineated by traffic control devices.
- 4) If required, install shoulder taper as the mobile operation advances.
- 5) Install arrow board on the shoulder prior to the merging taper or as close to the beginning of the merging taper as possible.
- 6) Install channelizing devices to form a merging taper. Use of a shadow vehicle with a TMA during installation is required on roads with speed limits of 45 MPH or greater or as directed by the Engineer.
- 7) Install traffic control devices along the buffer space at the appropriate spacing.
- 8) Continue placing devices along the work space at the appropriate spacing.
- 9) Install devices for the termination area as necessary.
- 10) Place the shadow vehicle with a TMA in advance of the first work crew or hazard approached by motorists. Multiple shadow vehicles may be required based on the number of lane and shoulder closures implemented.

### **4. INSPECT WORK AREA SIGNING AND CONTROL DEVICES**

- 1) Assess the placement of the temporary traffic control devices by driving through the work area. All approaches to the work zone should be checked.
- 2) Ensure roadway users will have sufficient time to read signs and react in a safe manner.

### PROCEDURES FOR WORK AREA TRAFFIC CONTROL (CONT.)

- 3) Check visibility of entire work area. If approaching roadway users can't see the work area well, or if they can't see ahead to traffic that may already be queued on the approach because of the work, additional traffic control devices should be deployed.
- 4) Check to ensure the proper temporary traffic control devices are positioned to protect workers from traffic (where possible).
- 5) Ensure all workers wear safety vests, hard hats, and all other necessary safety equipment. All worker safety gear should be in good condition. All reflective gear should be clean and highly visible in the dark.
- 6) Record in the log book the number and location of all signs and devices.

#### Considerations:

- Work area signs should never be blocked from view or obscured by vegetation, existing signs, or other obstructions.
- Flags, flashing lights, and edge line traffic cones can be used to improve visibility.

### 5. REMOVE TRAFFIC CONTROL DEVICES AT WORK SITE

**All workers and equipment should be clear from work site BEFORE removing signs and other devices.**

#### FOR LOWER SPEED ( $\leq 40$ MPH) ROADWAYS:

- 1) Remove signs and other devices within the delineated area when work is complete.
- 2) Remove other traffic control devices in the reverse order in which they were installed
- 3) Remove signs in the reverse order in which they were installed (i.e. sign closest to the work area to be removed first).
- 4) When the operation is complete, uncover any existing permanent signs covered in Step 2.
- 5) Record in the log book the time at which the signs were removed.

#### FOR HIGHER SPEED ( $\geq 45$ MPH) ROADWAYS:

All TTC devices for a stationary lane closure on a multi-lane roadway, except advance warning signs, should be removed against the flow of traffic in the following sequence:

- 1) Remove the channelizing devices starting from the end of the activity area working back to the widest part of the merging taper.
- 2) A shadow vehicle with TMA shall be positioned to protect workers removing devices and work backwards as the setup is removed from the roadway.

### PROCEDURES FOR WORK AREA TRAFFIC CONTROL (CONT.)

- 3) Place the removal vehicle on the shoulder, and remove the channelizing devices from the merging taper by hand onto the work vehicle.
- 4) Remove the arrow board once traffic is clear and it is safe to do so.
- 5) Circle back and moving with the flow of traffic, remove the advance warning signs starting with the opposite side from previous lane closure first.
- 6) At no time shall workers run across the multilane roadway to remove signs on both sides of the road simultaneously.
- 7) Record in the log book the time at which the signs were removed

### RAMP FACILITIES

At all times it is necessary to control the on and off-ramp traffic during the installation and breakdown of traffic control devices. Use of temporary traffic slow-downs or rolling roadblocks is recommended to allow for the safety of workers handing temporary traffic control devices on ramp facilities. A shadow vehicle with a TMA shall be used to protect the workers installing or removing the devices. At no time shall the work operation vehicle be used as the shadow vehicle with the TMA.

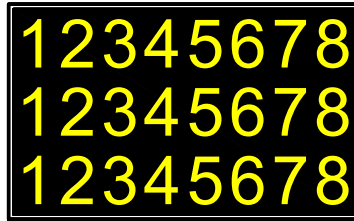
### USE OF THIS GUIDE

Illustrations showing minimum standards for short-term construction, maintenance, and utility operations are arranged in this guide by type of operation. The users of this guide should compare all illustrated examples and examine their differences. After gathering information about the work zones using the general guidelines as outlined, proceed as follows:

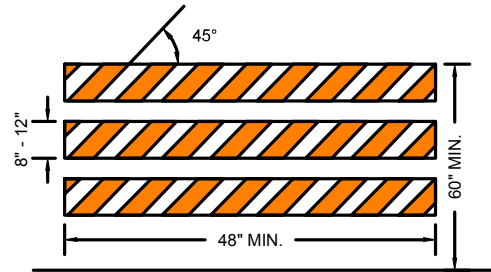
- 1) Turn to the Index. Consider the type of operations and the type of roadway upon which work will occur.
- 2) Select the figure that most closely matches the conditions where you plan to work. Remember that all diagrams represent minimum standards.
- 3) Read the title of the illustration to ensure that it is appropriate to your location. Study the layout of traffic control devices and read all notes.
- 4) Consult the appropriate tables, as directed on each illustration to determine taper length and proper spacing of signs. Notice that distances change when speeds change. Also note that these are guidelines, only, and they must be adapted to your specific work area.
- 5) Use the **“PROCEDURES FOR WORK AREA TRAFFIC CONTROL”** for assistance in completing all necessary steps to provide effective and safe work area traffic control.



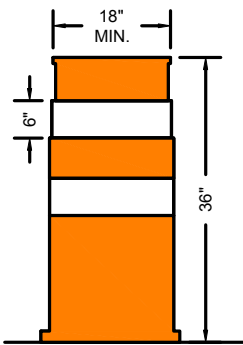
**SIGN**



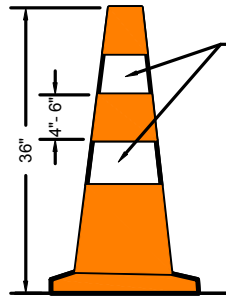
**PORTABLE CHANGEABLE MESSAGE SIGN (PCMS)**



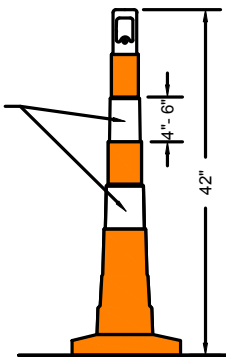
**TYPE III BARRICADE**



**DRUM**

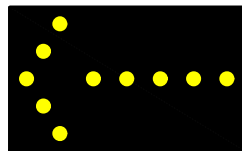


RETROFLECTIVE BANDS

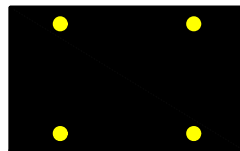


**CONES**

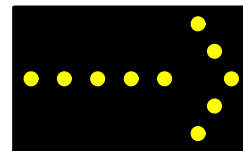
Cones may be used for all daytime operations. For night work, drums should be used to form the taper(s) and cones can be used along the tangent section of the work setup.



LEFT

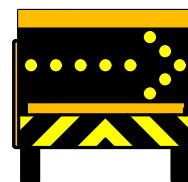


CAUTION



RIGHT

**ARROW BOARD (WITH MODE)**



**TRUCK MOUNTED ATTENUATORS**

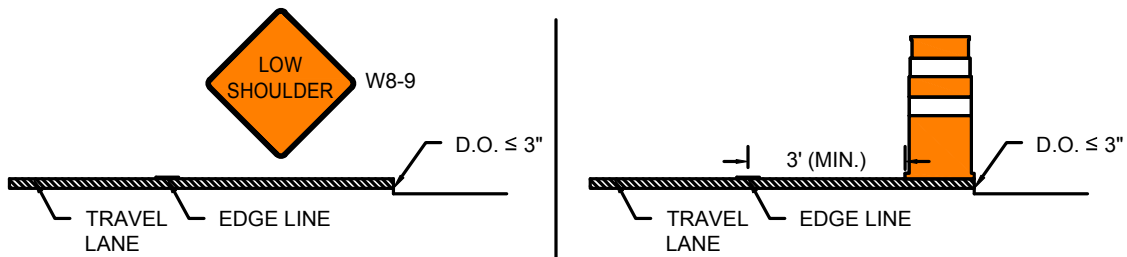
Truck Mounted Attenuators (TMA) shall be positioned between the start of the work area and the end of the designated buffer zone. The TMAs are to be positioned in each temporarily closed lane. This includes shoulders ( $\geq 8$  feet) whether combined with a travel lane closure or being closed alone. These TMA conditions are required on roadways with speeds of 45 MPH or greater. TMAs can be used on other roadways at the discretion of the engineer. TMAs shall be used for the deployment and removal of all traffic control devices, including all advance warning signs.

### SHORT-TERM PAVEMENT EDGE DROP-OFFS

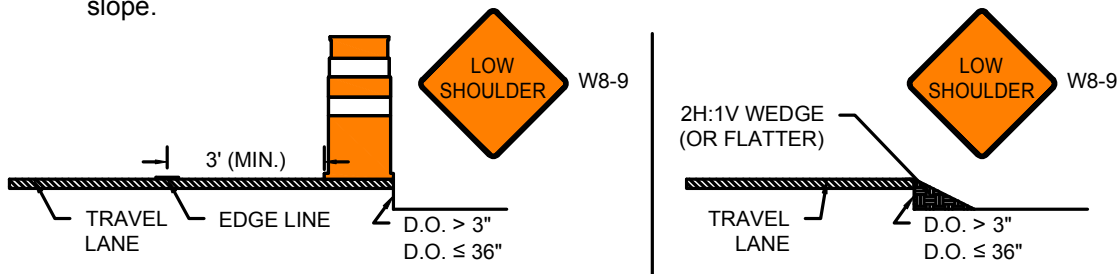
*Note that this guidance is adopted from the Roadside Design Guide, 4th Edition.*

Pavement drop-offs may occur during paving, excavation, and other construction activities. Drop-offs create hazards for vehicles if not properly mitigated. The following applies for all roads with speed limits greater than 30 mph; for roads with speed limits of 30 mph or less, treatments for pavement edge drop-offs are at the discretion of the Engineer. Drop-offs between adjacent, open travel lanes should not exceed 2", and any drop-off in excess of 3" should not be left unattended without one of these mitigation measures applied.

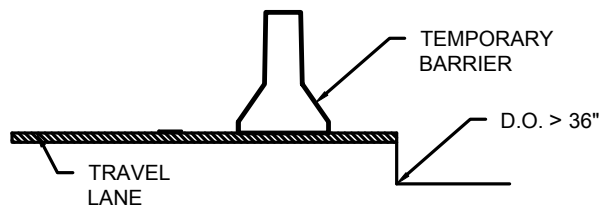
- Shoulder drop-offs 3" or less adjacent to a shoulder or active travel lane should be mitigated by:
  - ✓ A W8-9 (LOW SHOULDER) sign in advance of and at regular intervals throughout the treatment; or
  - ✓ The placement of drums on the traffic side of the drop-off.



- Shoulder drop-offs greater than 3" but less than or equal to 36" should be mitigated by:
  - ✓ A W8-9 (LOW SHOULDER) sign in advance of and at regular intervals throughout the treatment and the placement of drums on the traffic side off the drop-off, offset at least 3' from the travel lane; or
  - ✓ A W8-9 (LOW SHOULDER) sign in advance of and at regular intervals throughout the treatment and the placement of a temporary wedge of material along the face of the drop-off. The wedge should consist of stable material placed on a 2H:1V or flatter slope.



- Shoulder drop-offs greater than 36" must be protected by temporary barrier.





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Work Zone Safety  
Standard Details  
and Drawings

TYPICAL DEVICE SPACING

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		TRAVEL LANE CLOSURE LENGTH (L) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	500 / 500 / 500	320	305	20	55
45-55	500 / 1000 / 1000	660	495	40	40
60-65	1000 / 1600 / 2600	780	645	40	50










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

MINIMUM SPACING OF ADVANCE WARNING SIGNS FOR URBAN ROADWAYS	
ROAD TYPE	DISTANCE BETWEEN SIGNS
URBAN (LOW SPEED)	100 FT
URBAN (HIGH SPEED)	350 FT

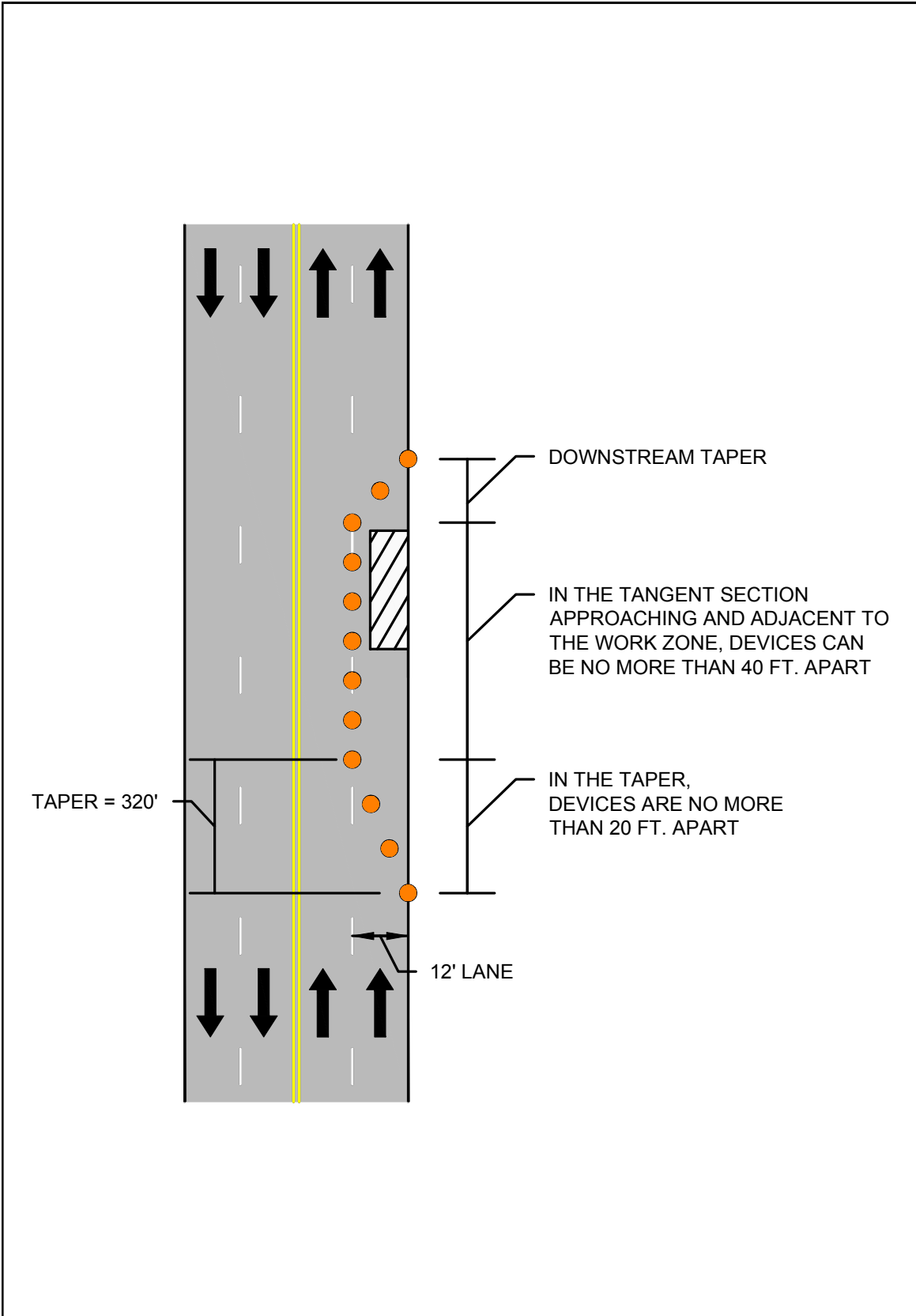
NOTES


1. 40 FT = 10 FT PAVEMENT MARKING + 30 FT SKIP

LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>PAGE 14</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FLAGGING GUIDANCE</p>
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### Guidance for Flagging Operations

**NOTE:**

A flagger shall always be aware of their surroundings and have a good escape route. A flagger shall never be positioned directly beside or against construction equipment. When a flagger is required to direct traffic in an area where the escape route is partially blocked by a traversable obstruction such as a guardrail, the flagger shall be physically capable of traversing that obstruction. Prior to commencing a project, the supervisor in charge shall review the project, including guardrail areas, for safe flagging stations. The supervisor in charge shall clearly communicate with the flagger(s), indicating any locations where they cannot safely perform their duties.

Each flagger shall be equipped with the following high visibility clothing, signaling, and safety devices:

- 1) A white protective hard hat with a minimum level of reflectivity per the requirements of ANSI, Type I, Class E&G;
- 2) A clean, unfaded, untorn lime/yellow reflective safety vest and pants meeting the requirements of ANSI 107 Class 3 with the words "Traffic Control" on the front and rear panels in minimum two (2) inch (50 millimeter) high letters;
- 3) A 24 inch "STOP/SLOW" traffic paddle conforming to the requirements of Part 6E.03 of the Manual on Uniform Traffic Control Devices (MUTCD), a weighted, reflectorized red flag, flagger station advance warning signage, and two-way radios capable of providing clear communication within the work zone between flaggers, the Contractor, and the Engineer. The traffic paddle shall be mounted on a pole of sufficient length to be seven feet above the ground as measured from the bottom of the paddle;
- 4) A working flashlight with a minimum of 15,000 candlepower and a six inch red attachable wand, a whistle with a working lanyard, and a First Aid kit that complies with the requirements of ANSI Z308.1; and
- 5) An industrial/safety type portable air horn that complies with the requirements of the U.S. Coast Guard.



A "STOP/SLOW" paddle should be the primary hand-signaling device. It shall have an octagonal shape on a rigid handle. Flag use should be limited to emergency situations.

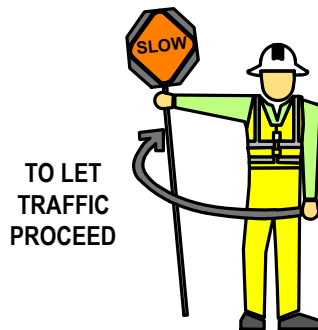


**Properly Trained Flaggers**

- Give clear messages to drivers.
- Allow distance for drivers to react.
- Coordinate with other flaggers.
- Use standard signaling methods.

**Properly Equipped Flaggers**

- Use approved stop/slow paddles.
- Use approved safety apparel.
- Use retroreflective equipment.
- Use hand held radios, as needed.
- All flaggers shall wear safety apparel that meets ANSI Class 3 requirements. The combination of vest and pants is required.



**Proper Flagging Stations**

- Good approach sight distance.
- Highly visible to traffic.
- Stand alone away from other machinery and people.
- Stand on right edge of pavement or shoulder- proceed to centerline only when first vehicle has come to stop.
- Have a good escape route.



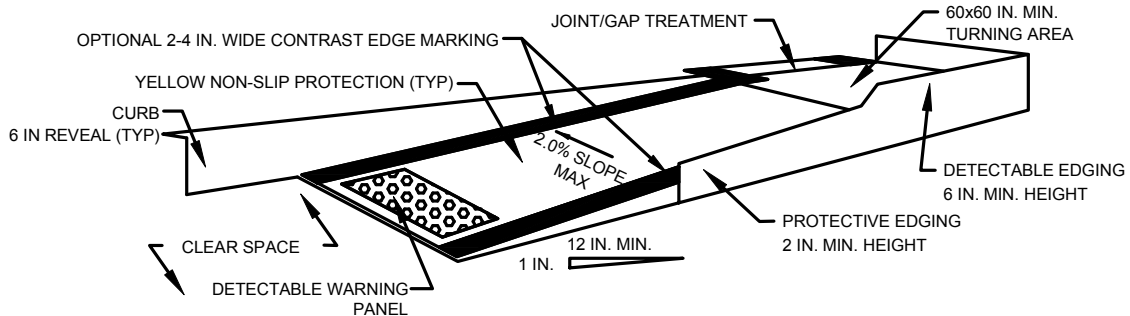
**Proper Advance Warning Signs**

- Always use warning signs.
- Allow for reaction distance from signs.
- Remove signs if no longer necessary or not flagging.
- Use free hand in up-and-down motion to help slow traffic.

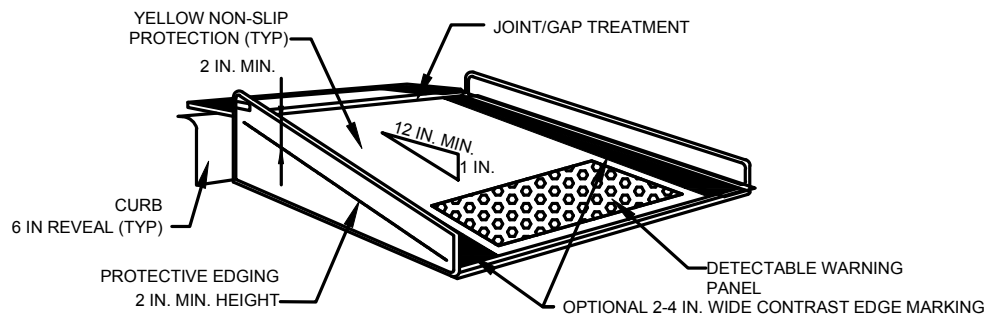




FIGURE 4  
TYPICAL PEDESTRIAN DEVICES  
(1 OF 2)  
NOT TO SCALE



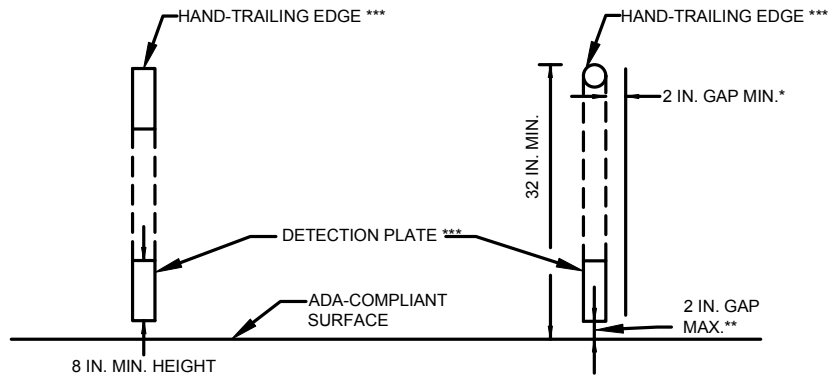
**TEMPORARY CURB RAMP-PARALLEL TO CURB**



**TEMPORARY CURB RAMP-PERPENDICULAR TO CURB**

**NOTES:**

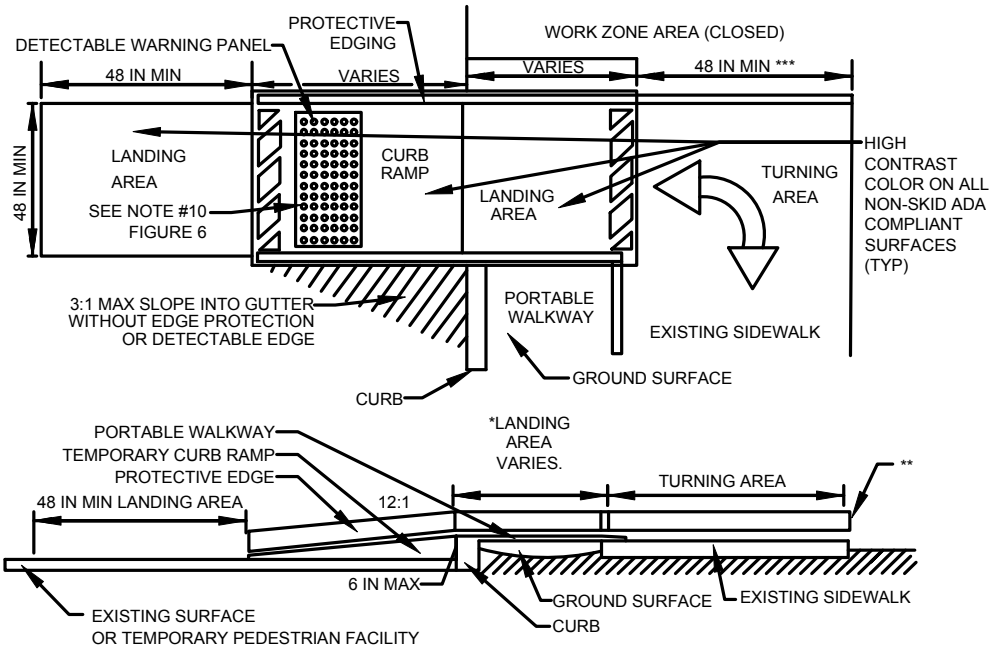
1. CURB RAMPS SHALL BE 60 IN. MINIMUM WIDTH WITH A FIRM, STABLE, AND NON-SLIP SURFACE.
2. PROTECTIVE EDGING WITH A 2 IN. MINIMUM HEIGHT SHALL BE INSTALLED WHEN THE CURB RAMP OR LANDING PLATFORM HAS A VERTICAL DROP OF 6 IN. OR GREATER OR HAS A SIDE APRON SLOP STEEPER THAN 1:3 (33%). PROTECTIVE EDGING SHOULD BE CONSIDERED WHEN THE CURB RAMPS OR LANDING PLATFORMS HAVE A VERTICAL DROP OF 3 IN. OR MORE.
3. PROTECTABLE EDGING WITH 6 IN. MINIMUM HEIGHT AND CONTRASTING COLOR SHALL BE INSTALLED ON ALL CURB RAMP LANDINGS WHERE THE WALKWAY CHANGES DIRECTION (TURNS).
4. THE CURB RAMP WALKWAY AND LANDING AREA SURFACE SHALL BE OF A SOLID CONTINUOUS CONTRASTING COLOR ABUTTING UP TO THE EXISTING SIDEWALK.
5. CURB RAMPS AND LANDINGS SHOULD HAVE A 1:50 (2%) MAX CROSS-SLOPE.
6. CLEAR SPACE OF 48x48 IN. MINIMUM SHALL BE PROVIDED ABOVE AND BELOW THE CURB RAMP.
7. WATER FLOW IN THE GUTTER SYSTEM SHALL HAVE MINIMAL RESTRICTION.
8. LATERAL JOINTS OR GAPS BETWEEN SURFACES SHALL BE LESS THAN 0.5 IN. WIDTH.
9. CHANGES BETWEEN SURFACE HEIGHTS SHOULD NOT EXCEED 0.5 IN. LATERAL EDGES SHOULD BE VERTICAL UP TO 0.25 IN. HIGH, AND BEVELED AT 1:2 BETWEEN 0.25 IN. AND 0.5 IN. HEIGHT.
10. IF A TEMPORARY PEDESTRIAN RAMP LEADS TO A CROSSWALK, THEN A DETECTABLE WARNING PAD MUST BE ADHERED TO THE BASE OF THE RAMP. IF IT LEADS TO A PROTECTED PEDESTRIAN BYPASS THAT DOES NOT CONFLICT WITH VEHICULAR TRAFFIC, THEN A PAD SHALL NOT BE INSTALLED ON THE RAMP.



**CROSS SECTION VIEW**


**PEDESTRIAN CHANNELIZING DEVICE**

- \* THERE SHALL BE A 2 INCH GAP BETWEEN THE HAND-TRAILING EDGE AND ITS SUPPORT.
- \*\* A MAXIMUM 2 INCH GAP BETWEEN THE BOTTOM OF THE BOTTOM RAIL AND THE SURFACE MAY BE USED TO PROVIDE DRAINAGE.
- \*\*\* THE HAND-TRAILING EDGE AND DETECTION PLATE SHALL BE CONTINUOUS THROUGHOUT THE LENGTH OF THE PATH SUCH THAT A PEDESTRIAN USER WITH A LONG CANE CAN FOLLOW IT.



**TEMPORARY CURB RAMP**

- \* LANDING AREA USED TO OVERLAP NON-ADA COMPLIANT SURFACES.
- \*\* DETECTABLE EDGE REMOVED IF A CONTINUOUS SIDEWALK.
- \*\*\* 60 IN. IF AN OBSTRUCTION IS AT BACK OF SIDEWALK.

 <p>PAGE 17</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 5 TYPICAL PEDESTRIAN DEVICES (2 OF 2) NOT TO SCALE</p>
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Work Zone Safety  
Standard Details  
and Drawings

STATIONARY OPERATIONS  
TWO LANE UNDIVIDED ROADWAY  
HALF OF ROADWAY CLOSED  
WORK NEAR CURVE










POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		TRAVEL LANE CLOSURE LENGTH (L) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	500 / 500 / 500	50	100	20	30
45-55	500 / 1000 / 1000	100	150	40	20

\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

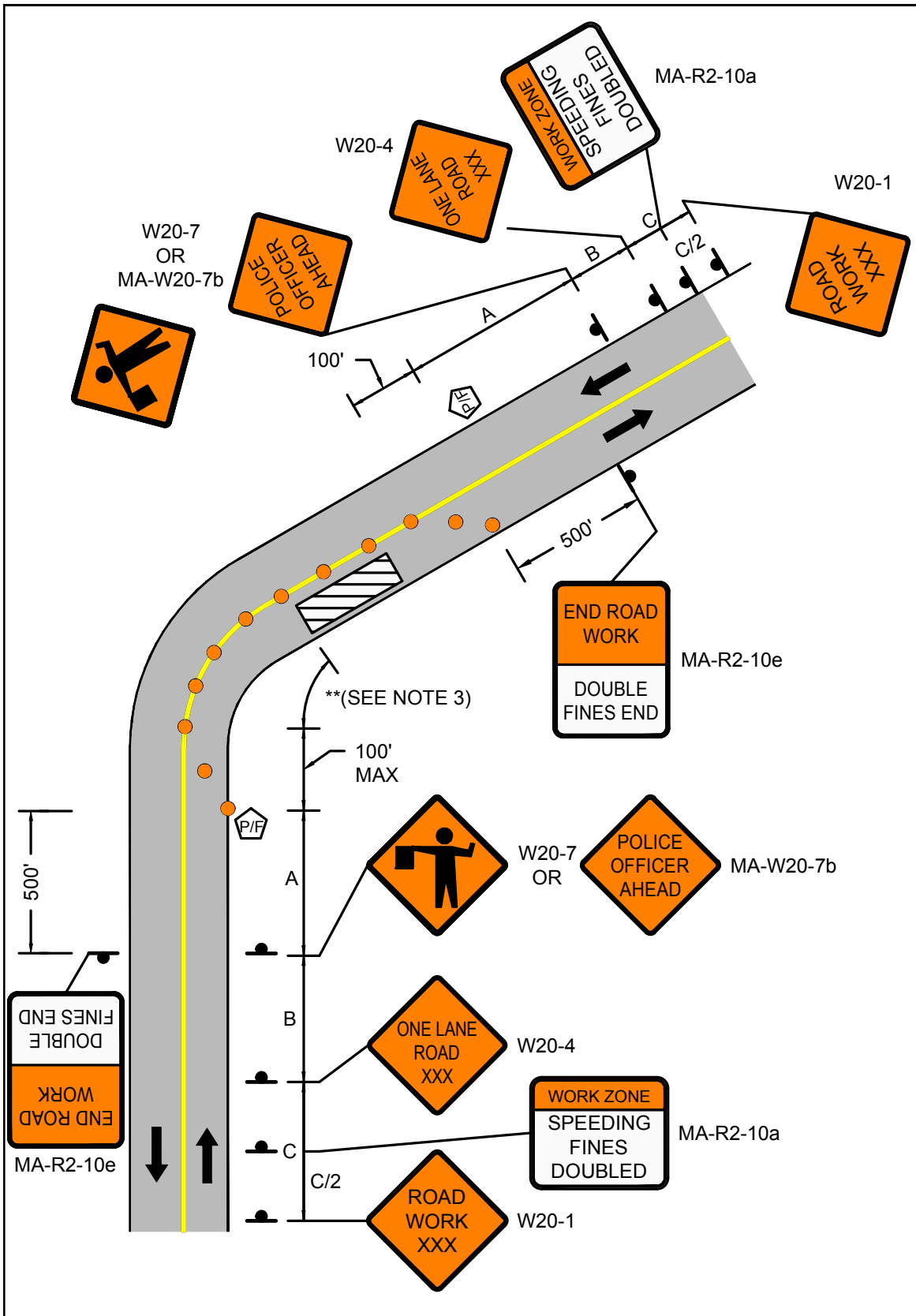
**NOTES**


1. IF POLICE DETAIL/UNIFORMED FLAGGER SUPPORT IS REQUIRED, PROVIDE TWO UNITS.
2. MA-R2-10a LOCATED AT C/2.
3. \*\* = EXTEND ENOUGH SO TAPER IS BEFORE CURVE

**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>PAGE 19</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 6 STATIONARY OPERATIONS TWO LANE UNDIVIDED ROADWAY HALF OF ROADWAY CLOSED WORK NEAR CURVE</p>
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Work Zone Safety  
Standard Details  
and Drawings

STATIONARY OPERATIONS  
TWO LANE UNDIVIDED ROADWAY  
HALF OF ROADWAY CLOSED

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		TRAVEL LANE CLOSURE LENGTH (L) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	500 / 500 / 500	50	100	20	30
45-55	500 / 1000 / 1000	100	150	40	20










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED REGULATORY OR WORK ZONE SPEED	SEPARATION BETWEEN RUMBLE STRIPS
36-mph to 55-mph	15-feet
35-mph and under	10-feet

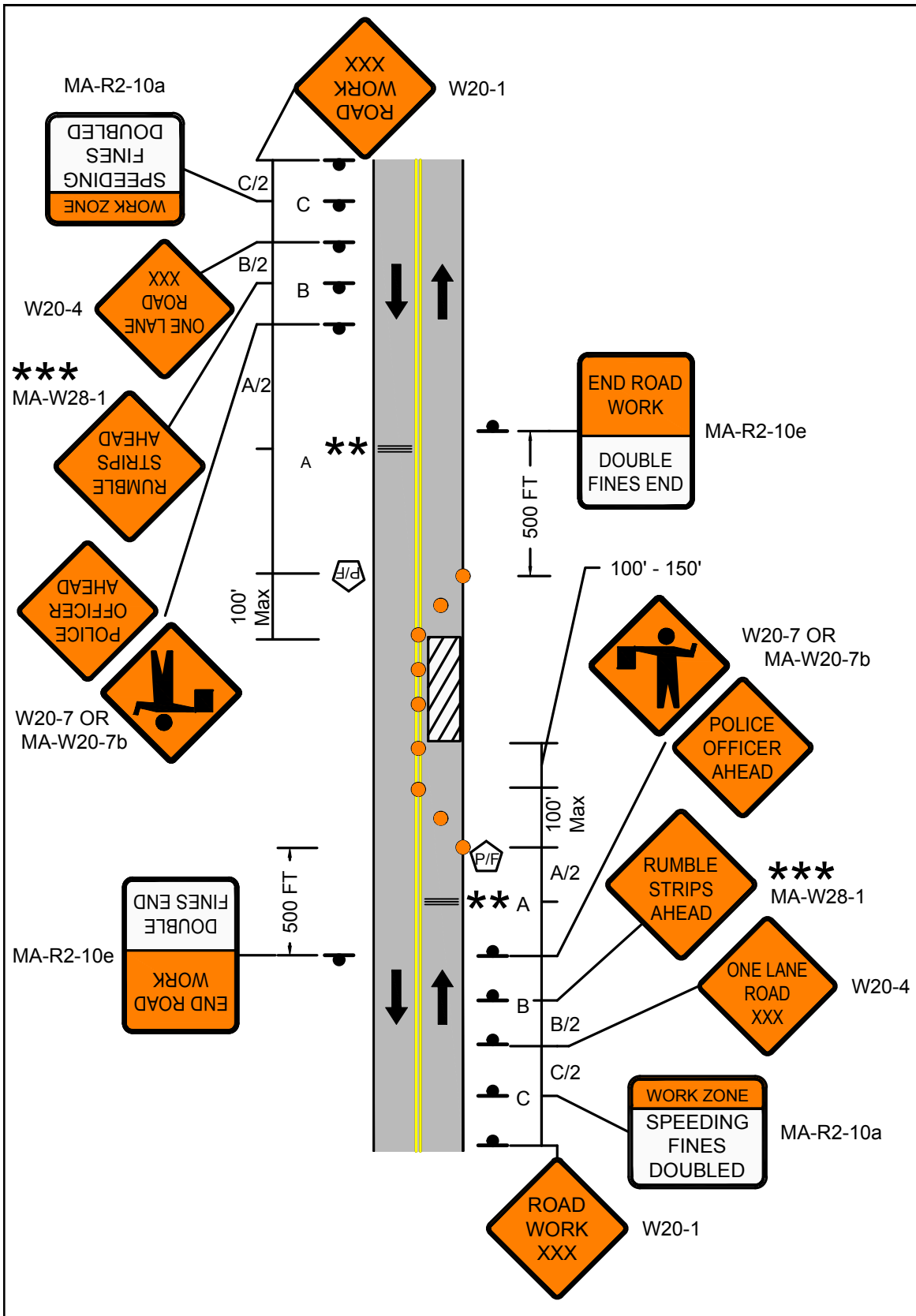
NOTES


1. IF POLICE DETAIL/UNIFORMED FLAGGER SUPPORT IS REQUIRED, PROVIDE TWO UNITS.
2. MA-R2-10a LOCATED AT C/2.
3. \*\* OPTIONAL AT THE ENGINEER'S DISCRETION.
4. \*\*\* SHALL BE DEPLOYED IF RUMBLE STRIPS ARE PRESENT.

LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>PAGE 21</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 7 STATIONARY OPERATIONS TWO LANE UNDIVIDED ROADWAY HALF OF ROADWAY CLOSED</p>
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Work Zone Safety  
Standard Details  
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STATIONARY OPERATIONS  
TWO LANE UNDIVIDED ROADWAY  
SHOULDER CLOSED










POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		SHOULDER TAPER LENGTH (L/3) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	500 / 500 / 500	110	305	20	45
45-55	500 / 1000 / 1000	220	495	40	30
60-65	1000 / 1600 / 2600	260	645	40	35

\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

NOTES

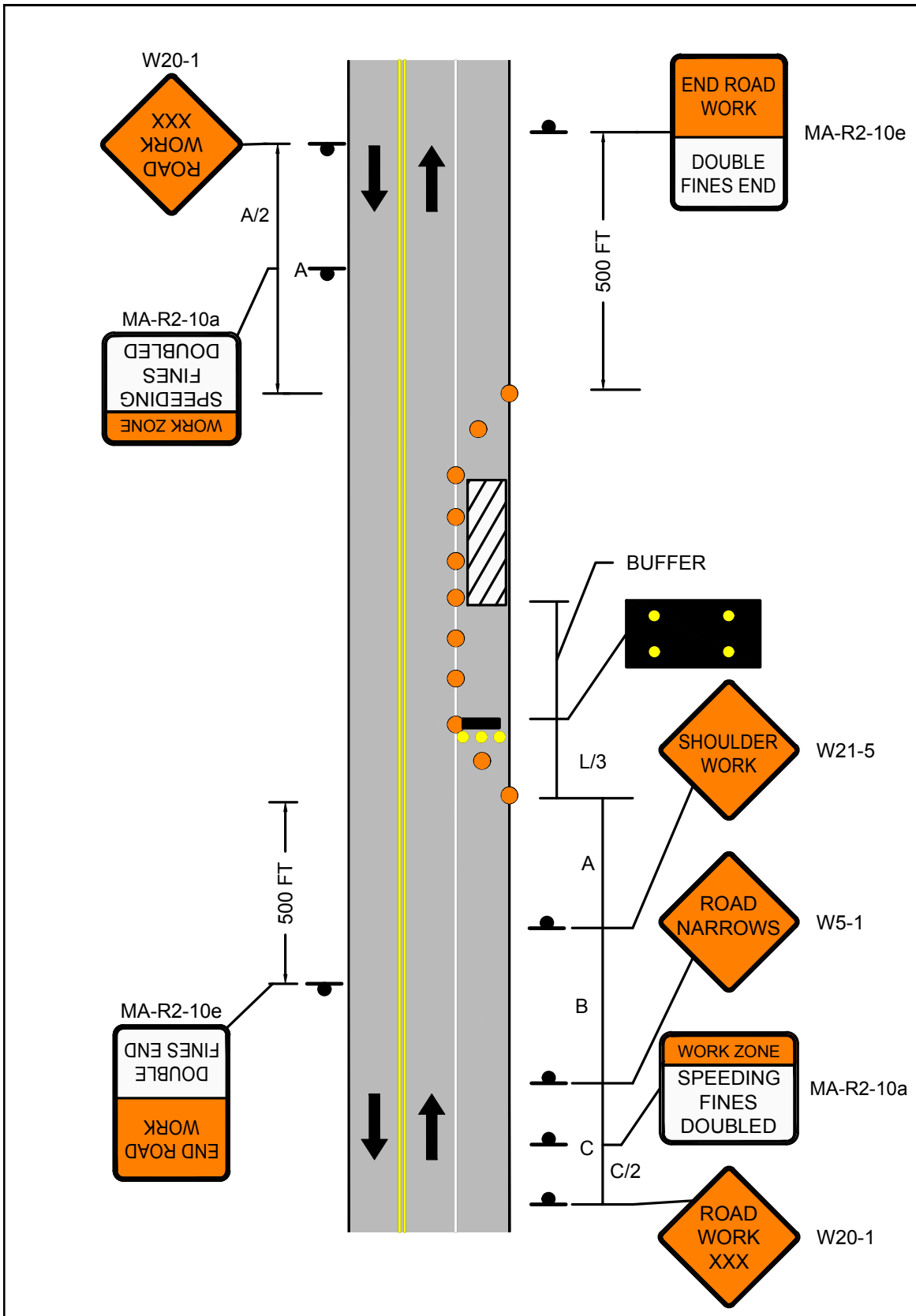
1. MA-R2-10a at C/2 and A/2.


LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE





 <p>PAGE 23</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 8 STATIONARY OPERATIONS TWO LANE UNDIVIDED ROADWAY SHOULDER CLOSED</p>
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STATIONARY OPERATIONS  
TWO LANE UNDIVIDED ROADWAY  
WITH TRAVERSABLE SHOULDER  
HALF OF ROADWAY CLOSED  
MAINTAIN TWO-WAY TRAFFIC

POSTED SPEED LIMIT (MPH)	CHANNELIZATION DEVICES (DRUMS OR CONES)				
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE SHIFT LENGTH (L/2) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	160	305	20	125
45-55	220	330	495	40	100
60-65	260	390	645	40	115










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

**NOTES**

1. MA-R2-10a LOCATED AT C/2.

**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE

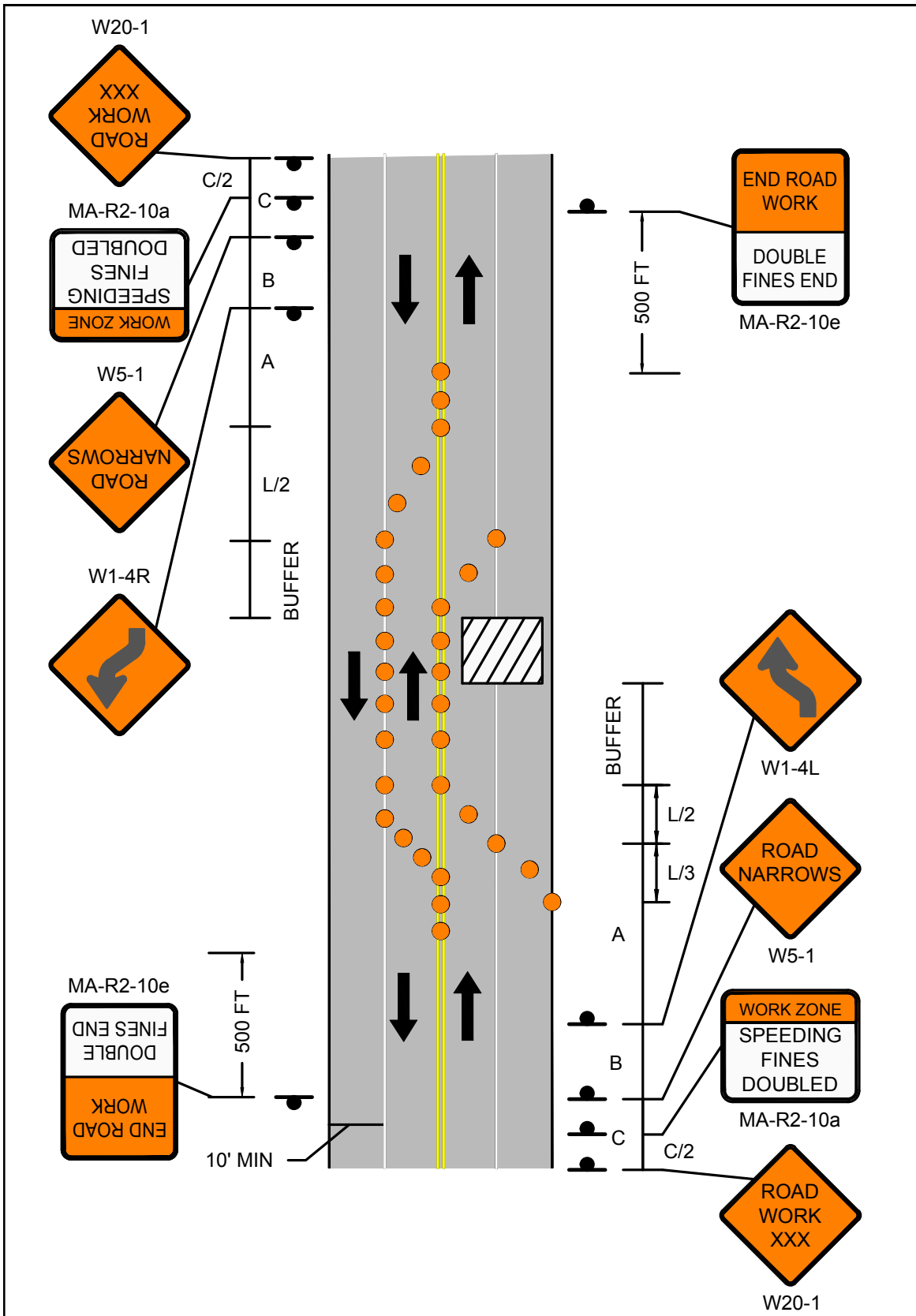


FIGURE 9  
 STATIONARY OPERATIONS  
 TWO LANE UNDIVIDED ROADWAY  
 WITH TRAVERSABLE SHOULDER  
 HALF OF ROADWAY CLOSED  
 MAINTAIN TWO-WAY TRAFFIC





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STATIONARY OPERATIONS  
FOUR LANE UNDIVIDED ROADWAY  
RIGHT LANE CLOSED

POSTED SPEED LIMIT (MPH)	CHANNELATION DEVICES (DRUMS OR CONES)				
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE CLOSURE LENGTH (L) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	320	305	20	60
45-55	220	660	495	40	50
60-65	260	780	645	40	55










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

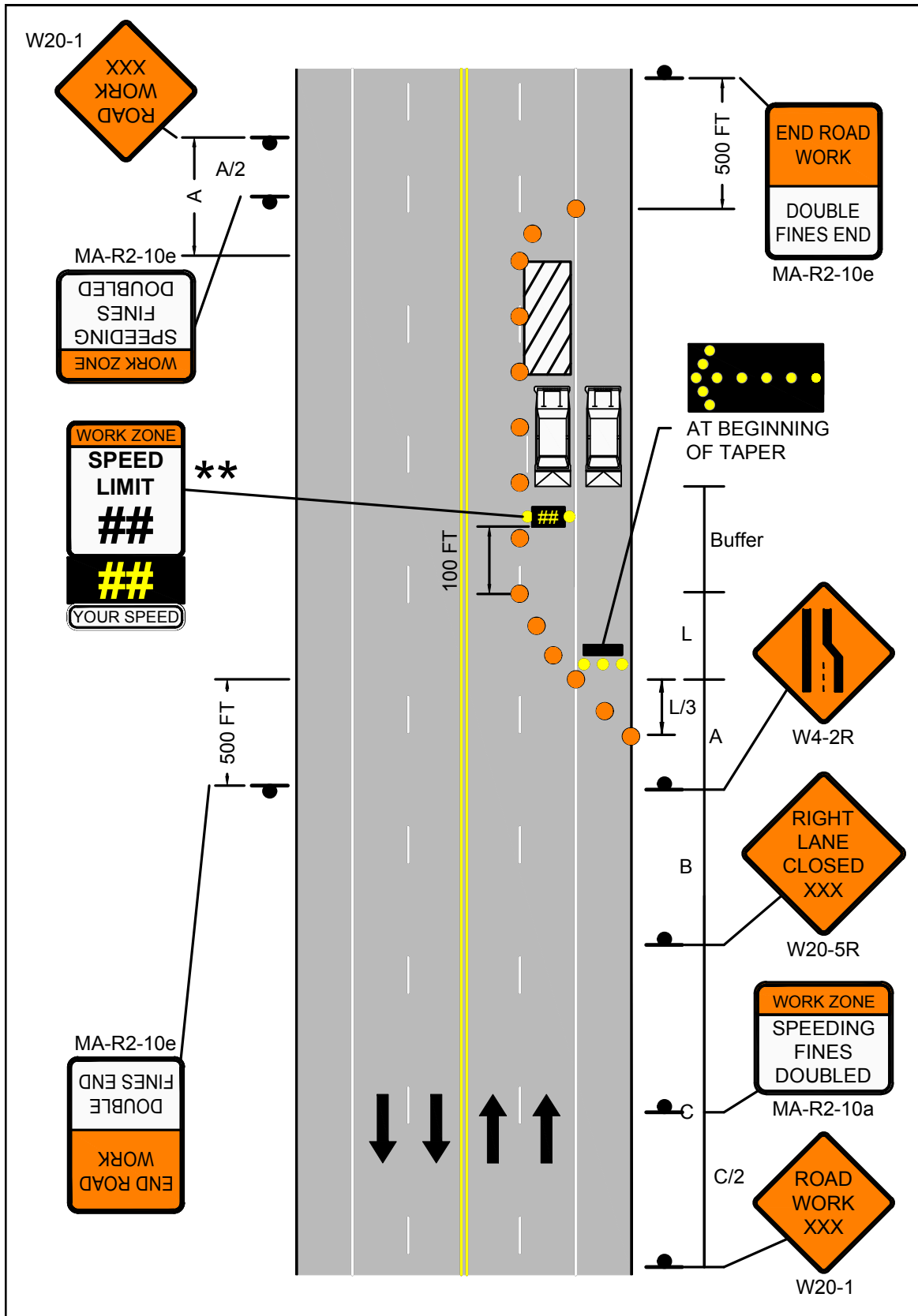
**NOTES**


1. MA-R2-10a LOCATED AT A/2 AND C/2.
2. \*\*OPTIONAL AT THE ENGINEER'S DISCRETION.

**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>PAGE 27</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 10 STATIONARY OPERATIONS FOUR LANE UNDIVIDED ROADWAY RIGHT LANE CLOSED</p>
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Work Zone Safety  
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STATIONARY OPERATIONS  
FOUR LANE UNDIVIDED ROADWAY  
LEFT LANE CLOSED










POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		TRAVEL LANE CLOSURE LENGTH (L) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	500 / 500 / 500	320	305	20	105
45-55	500 / 1000 / 1000	660	495	40	80
60-65	1000 / 1600 / 2600	780	645	40	100

\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

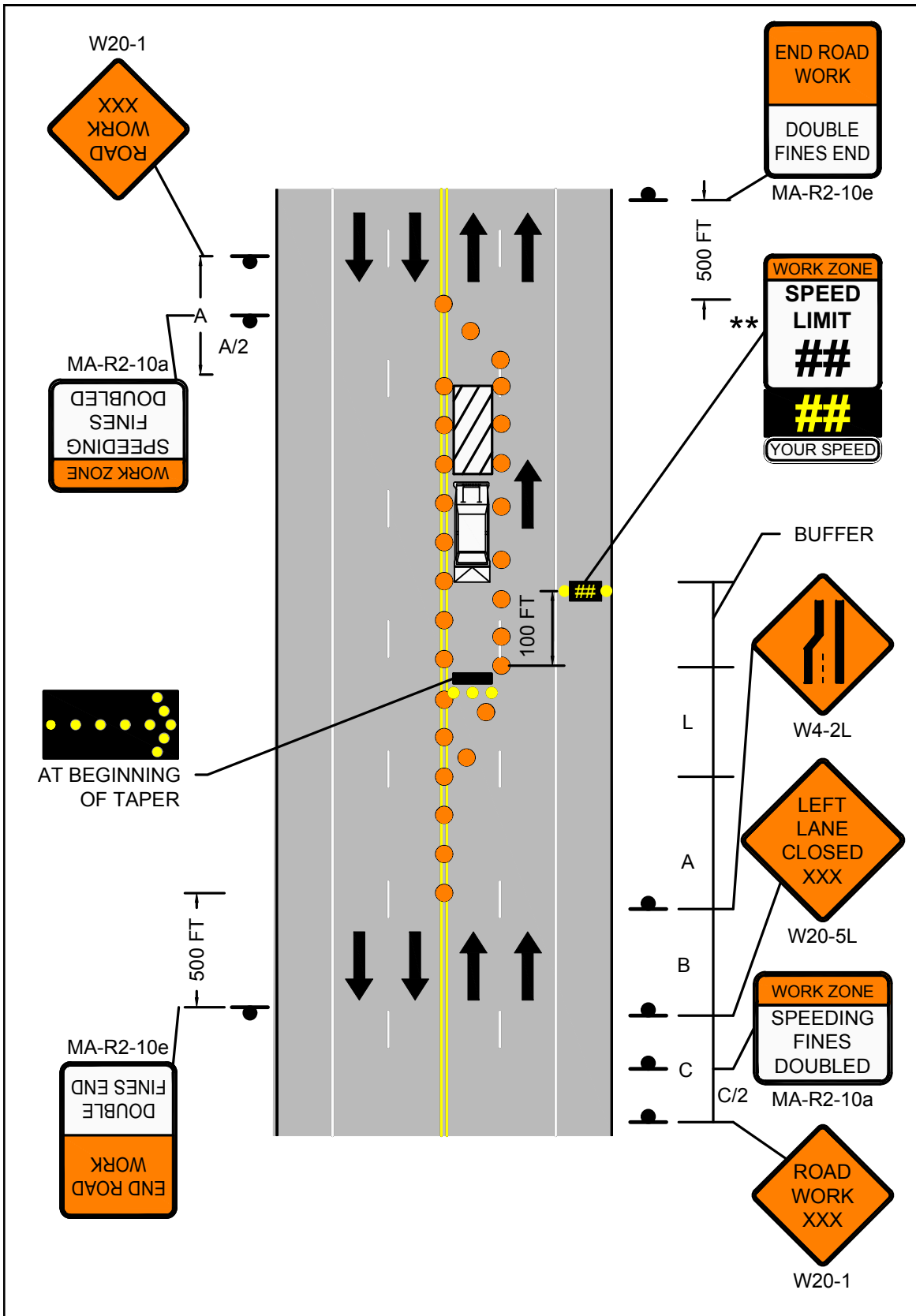
NOTES


1. MA-R2-10a LOCATED AT A/2 AND C/2.
2. \*\*OPTIONAL AT THE ENGINEER'S DISCRETION. 2' OFFSET FROM EDGE OF TRAVEL LANE TO RADAR SPEED FEEDBACK BOARD IS REQUIRED. BOARD MAY BE MOVED FULLY OR PARTIALLY OFF PAVED SHOULDER, IF REQUIRED.

LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>Massachusetts Department of Transportation Highway Division</p> <p>PAGE 30</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>STATIONARY OPERATIONS FOUR LANE UNDIVIDED ROADWAY HALF OF ROADWAY CLOSED</p>
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POSTED SPEED LIMIT (MPH)	CHANNELIZATION DEVICES (DRUMS OR CONES)					
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE CLOSURE LENGTH (L) (FT)	TRAVEL LANE SHIFT LENGTH (L/2) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	320	160	305	20	140
45-55	220	660	330	495	40	120
60-65	260	780	390	645	40	140










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

**NOTES**

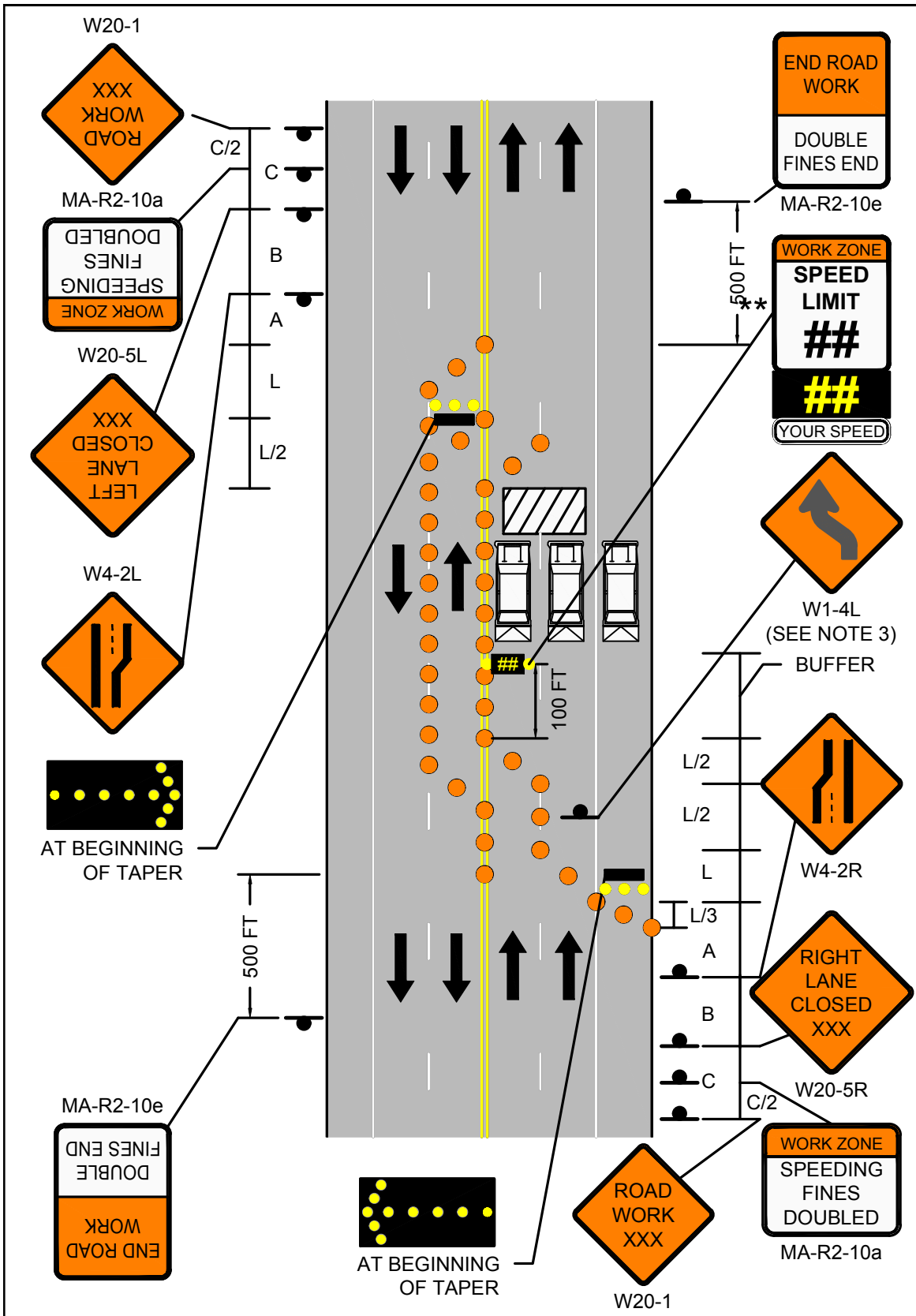
1. MA-R2-10a LOCATED AT C/2.
2. \*\*OPTIONAL AT THE ENGINEER'S DISCRETION.
3. W1-4L SHALL BE PLACED AT THE MIDDLE OF THE TANGENT.


**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE





 <p>PAGE 31</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 12 STATIONARY OPERATIONS FOUR LANE UNDIVIDED ROADWAY HALF OF ROADWAY CLOSED</p>
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Work Zone Safety  
Standard Details  
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STATIONARY OPERATIONS  
MULTILANE DIVIDED ROADWAY  
RIGHT LANE CLOSED

POSTED SPEED LIMIT (MPH)	CHANNELIZATION DEVICES (DRUMS OR CONES)				
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE CLOSURE LENGTH (L) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	320	305	20	60
45-55	220	660	495	40	50
60-65	260	780	645	40	55










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

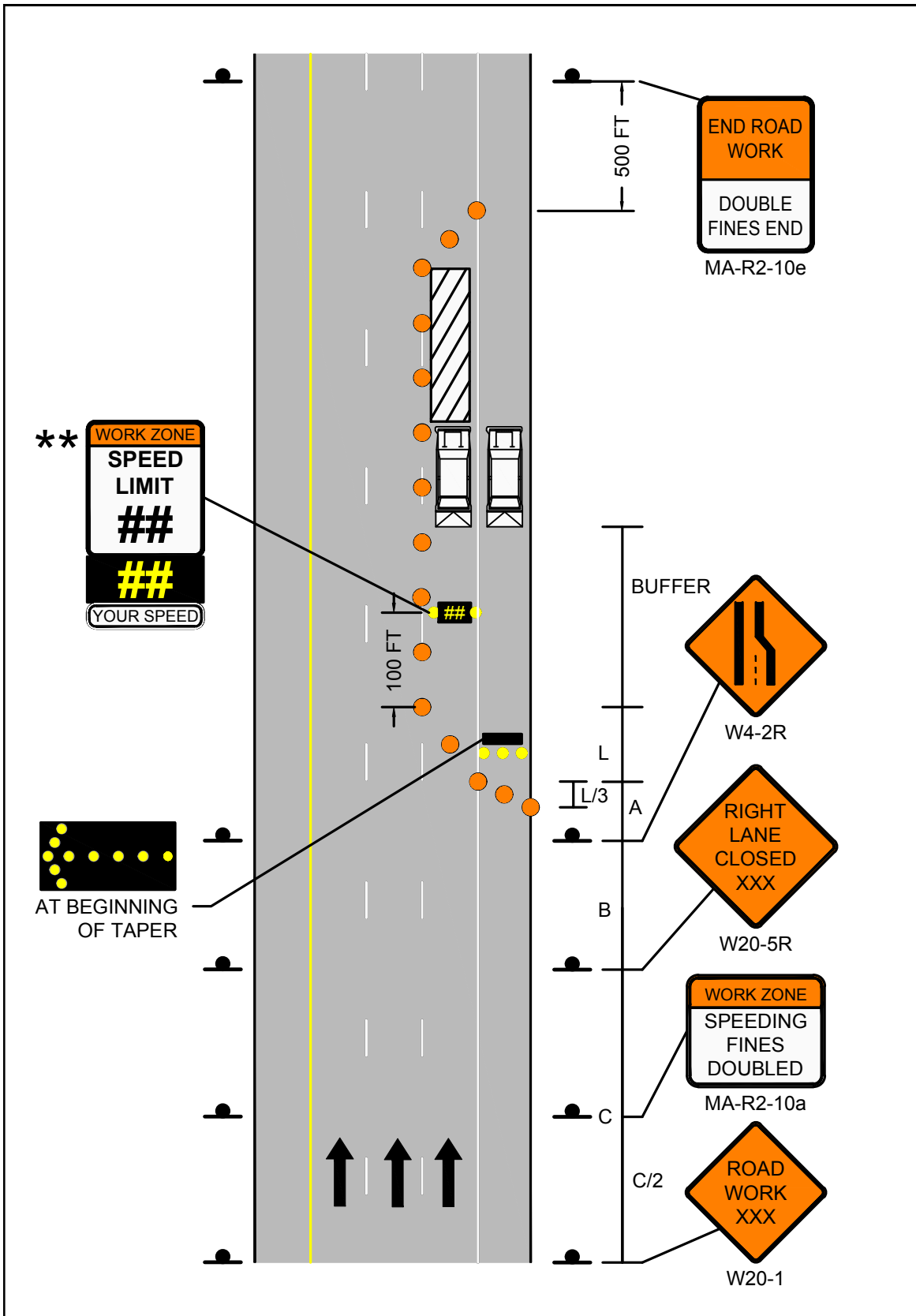
**NOTES**

1. MA-R2-10a LOCATED AT C/2.
2. \*\*OPTIONAL AT THE ENGINEER'S DISCRETION.

**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE





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Work Zone Safety  
Standard Details  
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STATIONARY OPERATIONS  
MULTILANE DIVIDED ROADWAY  
LEFT LANE CLOSED

POSTED SPEED LIMIT (MPH)	CHANNELIZATION DEVICES (DRUMS OR CONES)				
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE CLOSURE LENGTH (L) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	320	305	20	60
45-55	220	660	495	40	50
60-65	260	780	645	40	55










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

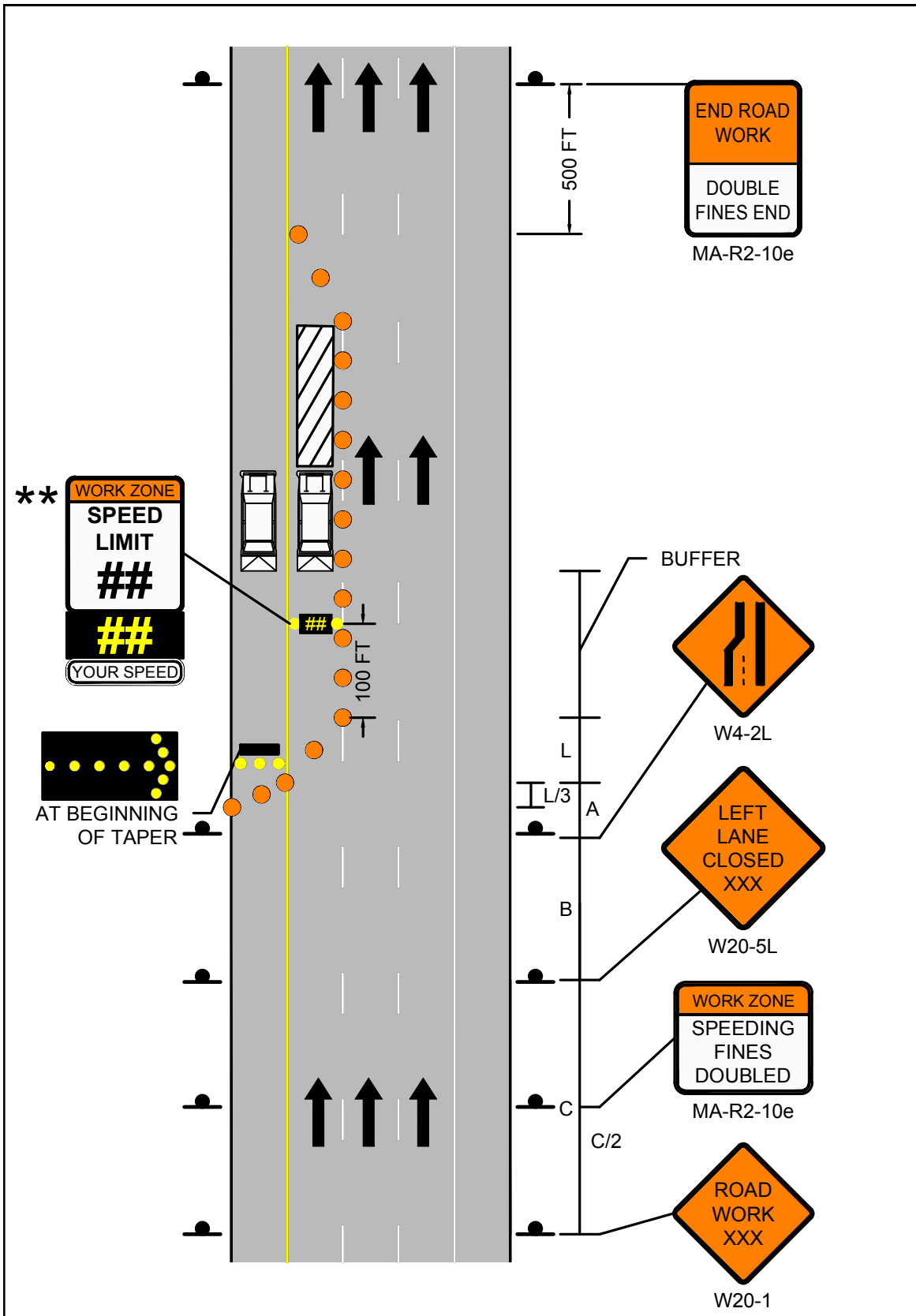
**NOTES**

1. MA-R2-10a LOCATED AT C/2.
2. \*\*OPTIONAL AT THE ENGINEER'S DISCRETION.

**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE





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STATIONARY OPERATIONS  
MULTILANE DIVIDED ROADWAY  
CENTER LANE OR RIGHT/CENTER  
LANES CLOSED

POSTED SPEED LIMIT (MPH)	CHANNELIZATION DEVICES (DRUMS OR CONES)					
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE CLOSURE LENGTH (L) (FT)	TANGENT LENGTH BETWEEN TAPERS T (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	320	640	305	20	110
45-55	220	660	1320	495	40	100
60-65	260	780	1560	645	40	115










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

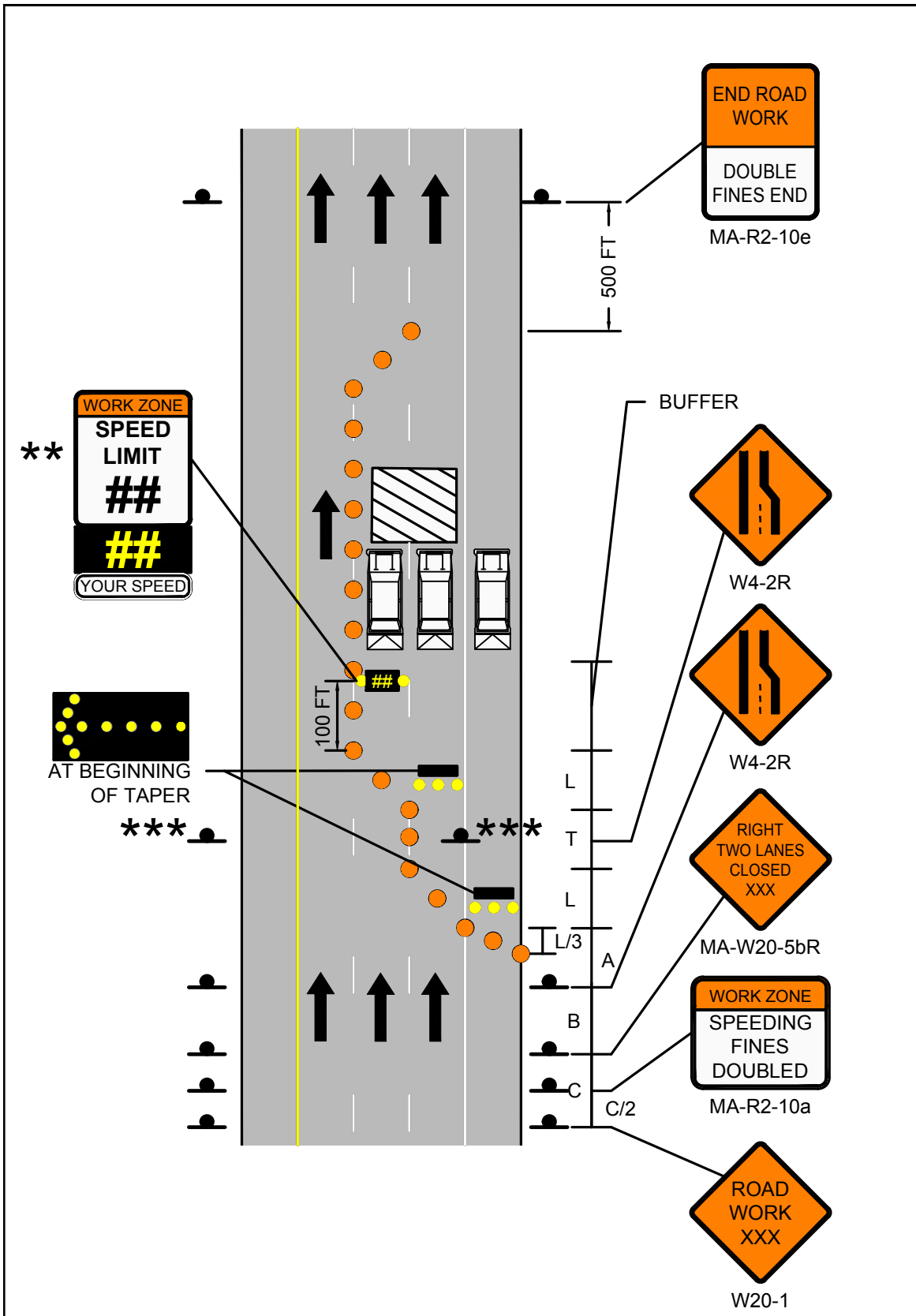
**NOTES**


1. MA-R2-10a LOCATED AT C/2.
2. \*\*\*OPTIONAL AT THE ENGINEER'S DISCRETION.
3. \*\*\*THIS SET OF SIGNS SHALL BE LOCATED AT T/2.


**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>PAGE 37</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 15 STATIONARY OPERATIONS MULTILANE DIVIDED ROADWAY CENTER LANE OR RIGHT/CENTER LANES CLOSED</p>
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 <p>Massachusetts Department of Transportation Highway Division</p> <p>PAGE 38</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>STATIONARY OPERATIONS MULTILANE DIVIDED ROADWAY CENTER LANE OR LEFT/CENTER LANES CLOSED</p>
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POSTED SPEED LIMIT (MPH)	CHANNELIZATION DEVICES (DRUMS OR CONES)					
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE CLOSURE LENGTH (L) (FT)	TANGENT LENGTH BETWEEN TAPERS T (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	320	640	305	20	110
45-55	220	660	1320	495	40	100
60-65	260	780	1560	645	40	115










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

**NOTES**

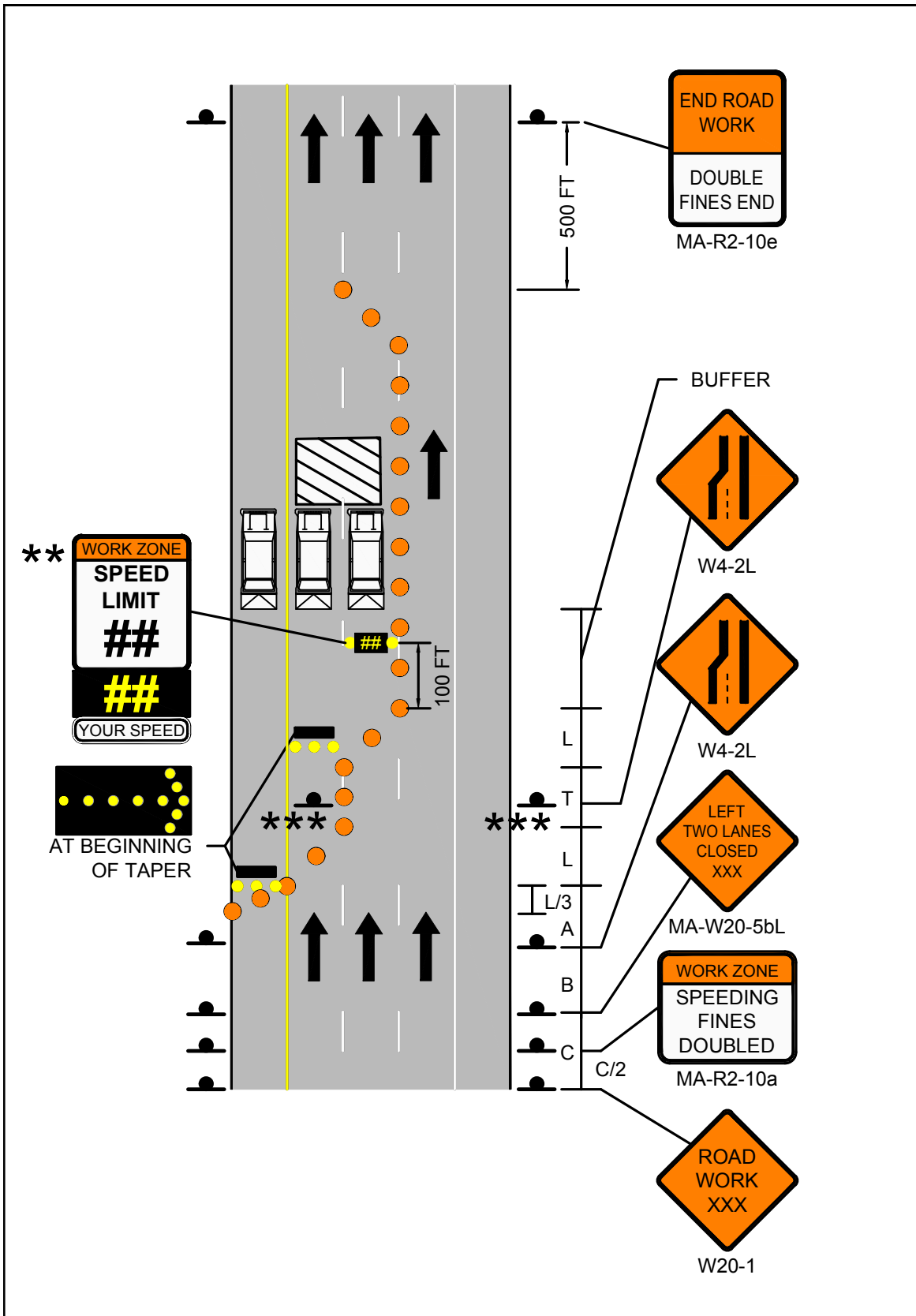
1. MA-R2-10a LOCATED AT C/2.
2. \*\*\*OPTIONAL AT THE ENGINEER'S DISCRETION.
3. \*\*\*THIS SET OF SIGNS SHALL BE LOCATED AT T/2.


**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE





 <p>PAGE 39</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 16 STATIONARY OPERATIONS MULTILANE DIVIDED ROADWAY CENTER LANE OR LEFT/CENTER LANES CLOSED</p>
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Work Zone Safety  
Standard Details  
and Drawings

STATIONARY OPERATIONS  
MULTILANE DIVIDED ROADWAY  
RIGHT SIDE OF OFF RAMP CLOSED










POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		TRAVEL LANE SHIFT LENGTH (L/2) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	500 / 500 / 500	160	305	20	45
45-55	500 / 1000 / 1000	330	495	40	35

\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

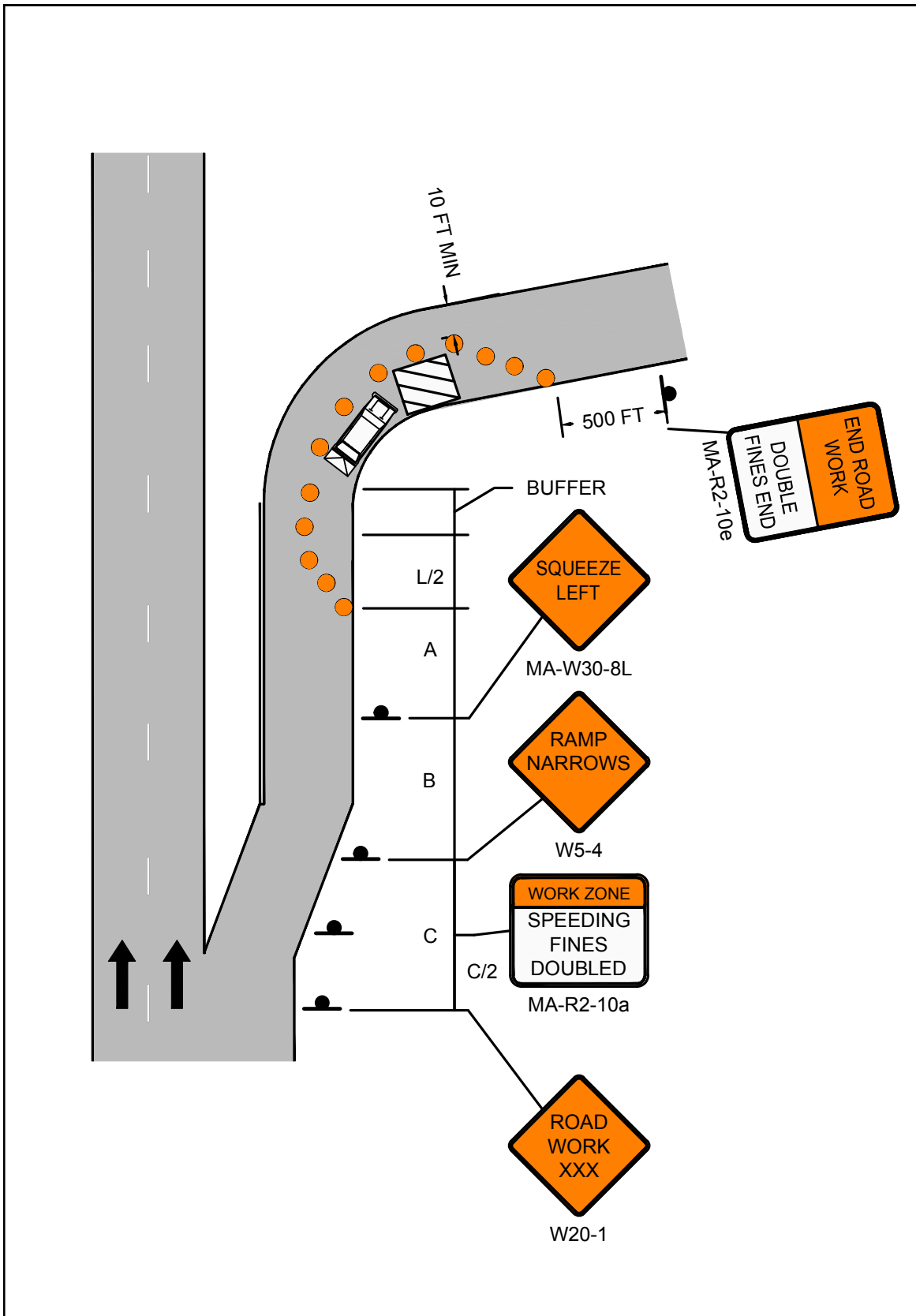
NOTES


1. MA-R2-10a LOCATED AT C/2.

LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>Massachusetts Department of Transportation Highway Division</p> <p>PAGE 41</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 17 STATIONARY OPERATIONS MULTILANE DIVIDED ROADWAY RIGHT SIDE OF OFF RAMP CLOSED</p>
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Work Zone Safety  
Standard Details  
and Drawings

STATIONARY OPERATIONS  
MULTILANE DIVIDED ROADWAY  
LEFT SIDE OF OFF RAMP CLOSED










POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		TRAVEL LANE SHIFT LENGTH (L/2) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	500 / 500 / 500	160	305	20	45
45-55	500 / 1000 / 1000	330	495	40	35

\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

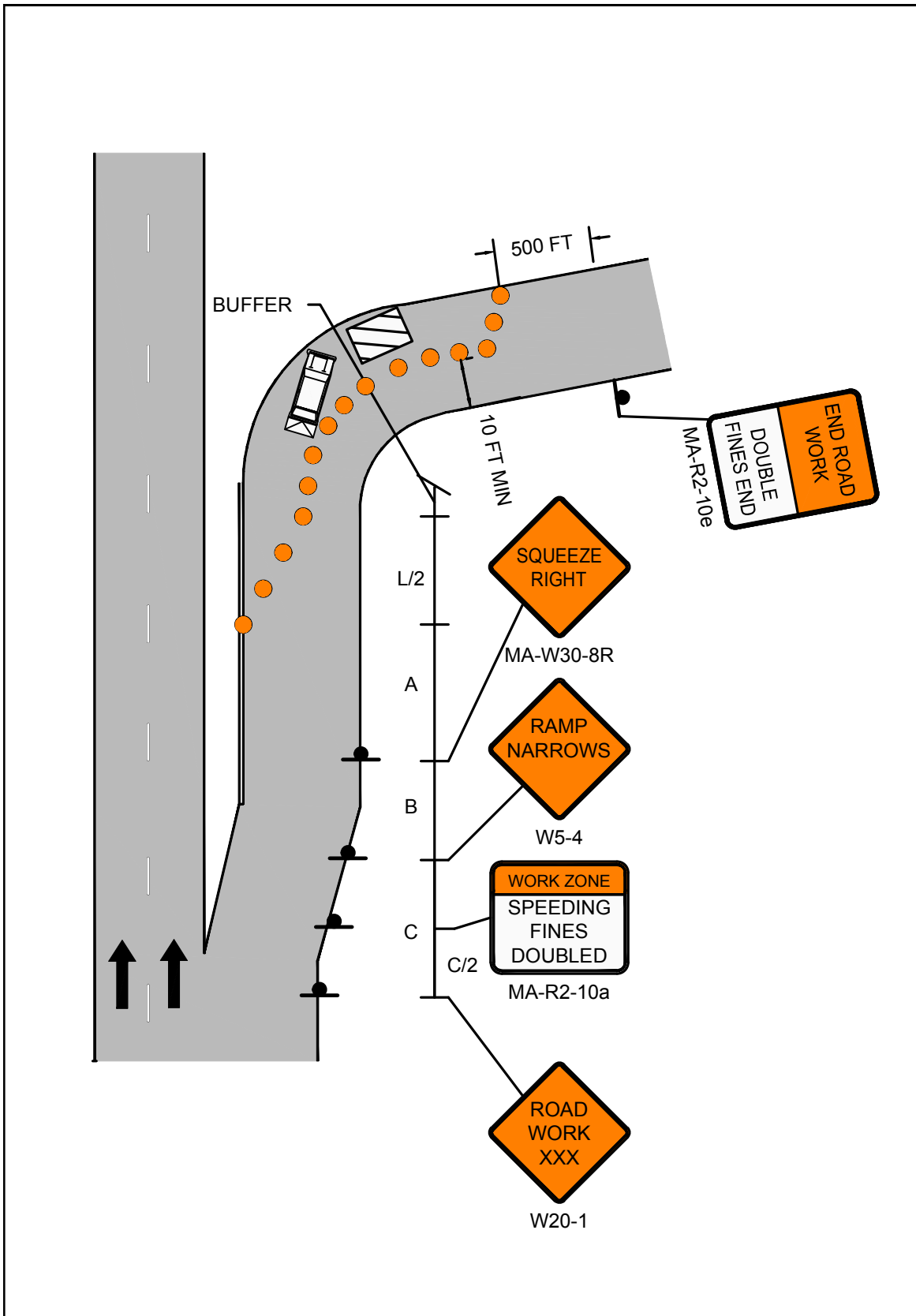
NOTES


1. MA-R2-10a LOCATED AT C/2.

LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 18 STATIONARY OPERATIONS MULTILANE DIVIDED ROADWAY LEFT SIDE OF OFF RAMP CLOSED PAGE 43</p>
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Work Zone Safety  
Standard Details  
and Drawings

STATIONARY OPERATIONS  
MULTILANE DIVIDED ROADWAY  
ROADWORK BEYOND ON RAMP

POSTED SPEED LIMIT (MPH)	CHANNELIZATION DEVICES (DRUMS OR CONES)				
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE CLOSURE LENGTH (L) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	320	305	20	175
45-55	220	660	495	40	135
60-65	260	780	645	40	155










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

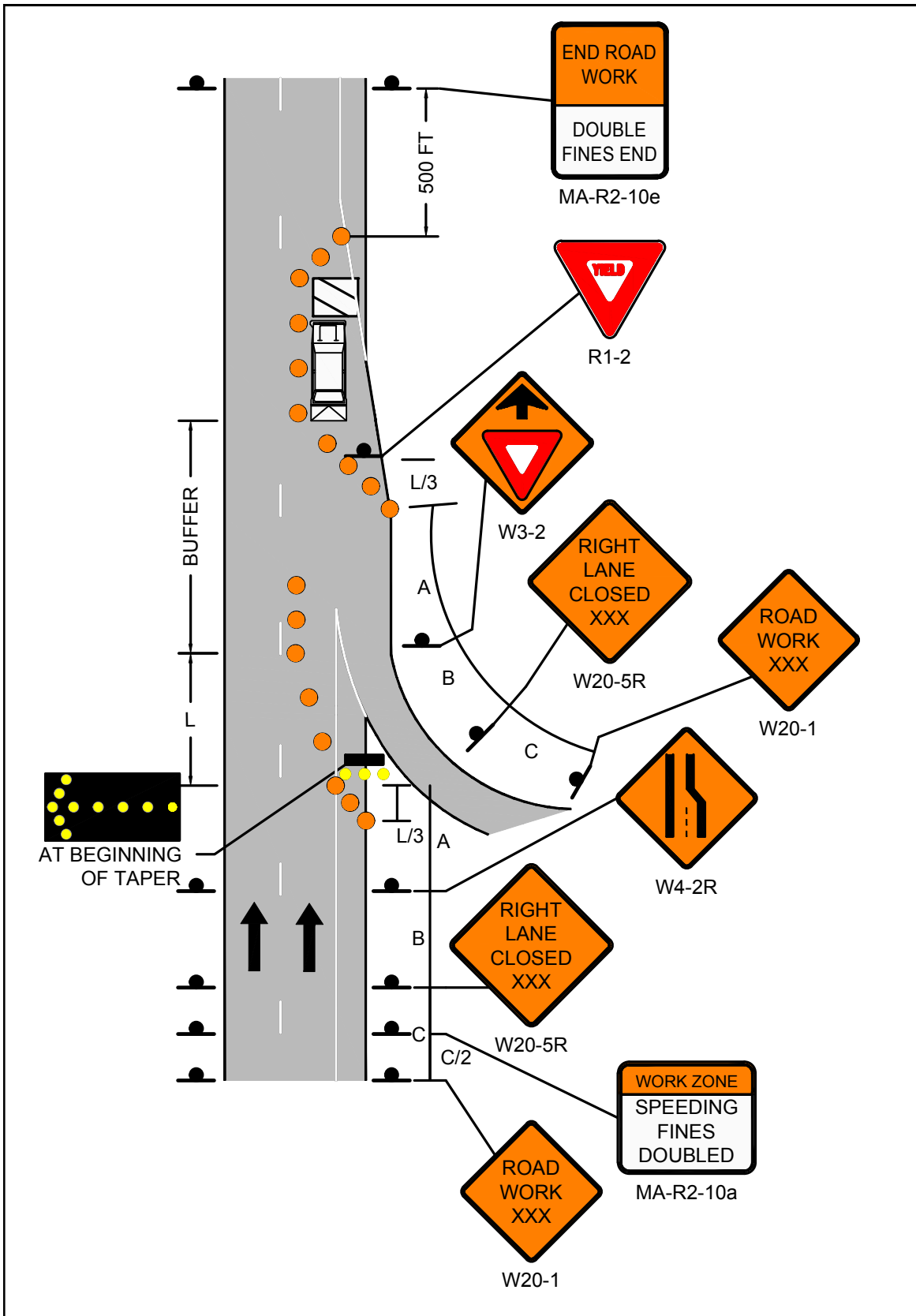
**NOTES**

1. MA-R2-10a LOCATED AT C/2.

**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE





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Work Zone Safety  
Standard Details  
and Drawings

STATIONARY OPERATIONS  
MULTILANE DIVIDED ROADWAY  
ROADWORK BEYOND OFF RAMP

POSTED SPEED LIMIT (MPH)	CHANNELIZATION DEVICES (DRUMS OR CONES)					
	SHOULDER TAPER LENGTH (L/3) (FT)	TRAVEL LANE CLOSURE LENGTH (L) (FT)	TRAVEL LANE SHIFT LENGTH (L/2) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	110	320	160	305	20	70
45-55	220	660	330	495	40	55
60-65	260	780	390	645	40	65










\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)
25-40	500 / 500 / 500
45-55	500 / 1000 / 1000
60-65	1000 / 1600 / 2600

**NOTES**

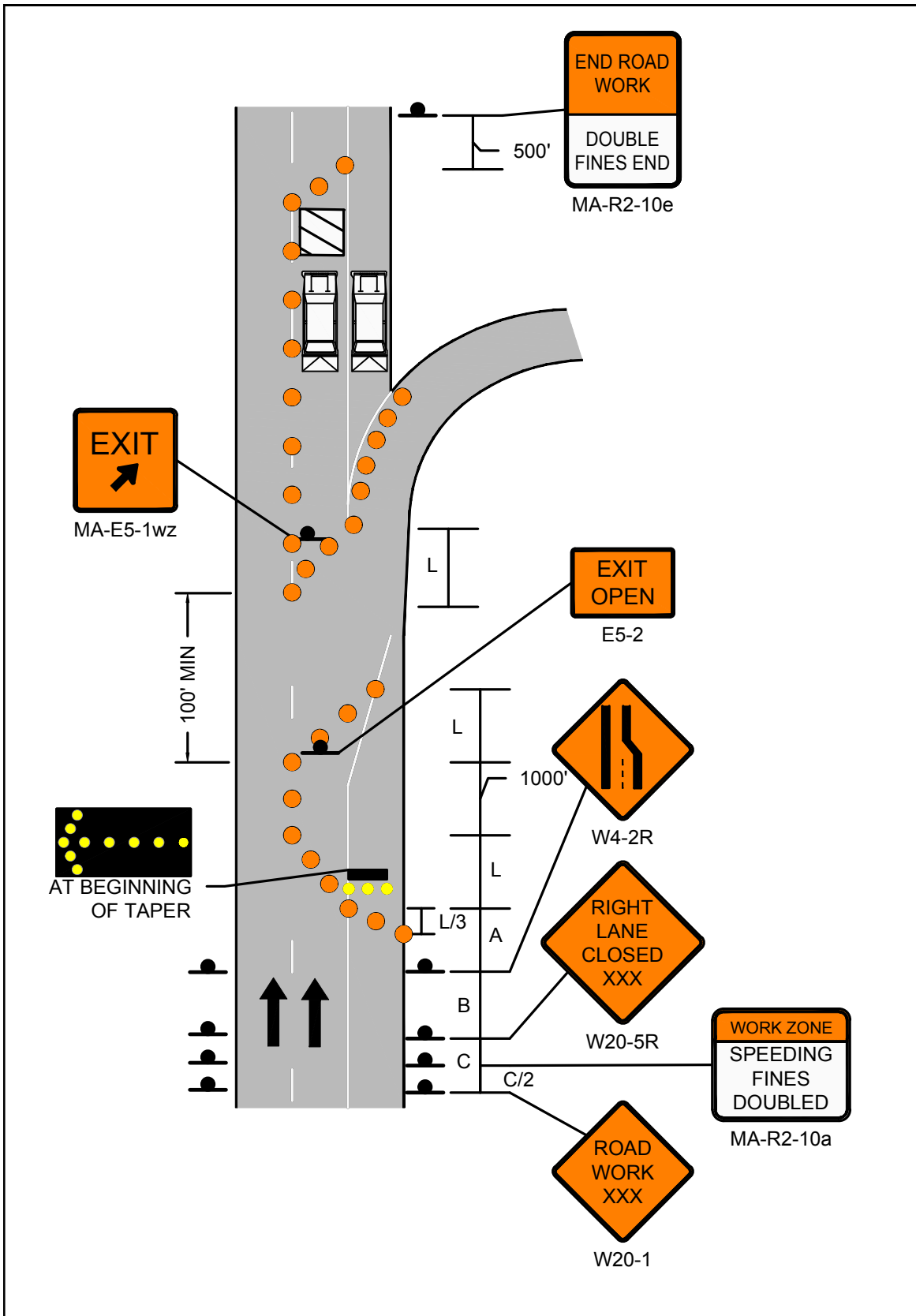
1. MA-R2-10a LOCATED AT C/2.

**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE







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Work Zone Safety  
Standard Details  
and Drawings










MULTILANE DIVIDED ROADWAY  
TYPICAL RAMP CLOSURE

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		SHOULDER TAPER LENGTH (L/3) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES
25-40	500 / 500 / 500	110	305	20	45
45-55	500 / 1000 / 1000	220	495	40	30
60-65	1000 / 1600 / 2600	260	645	40	35

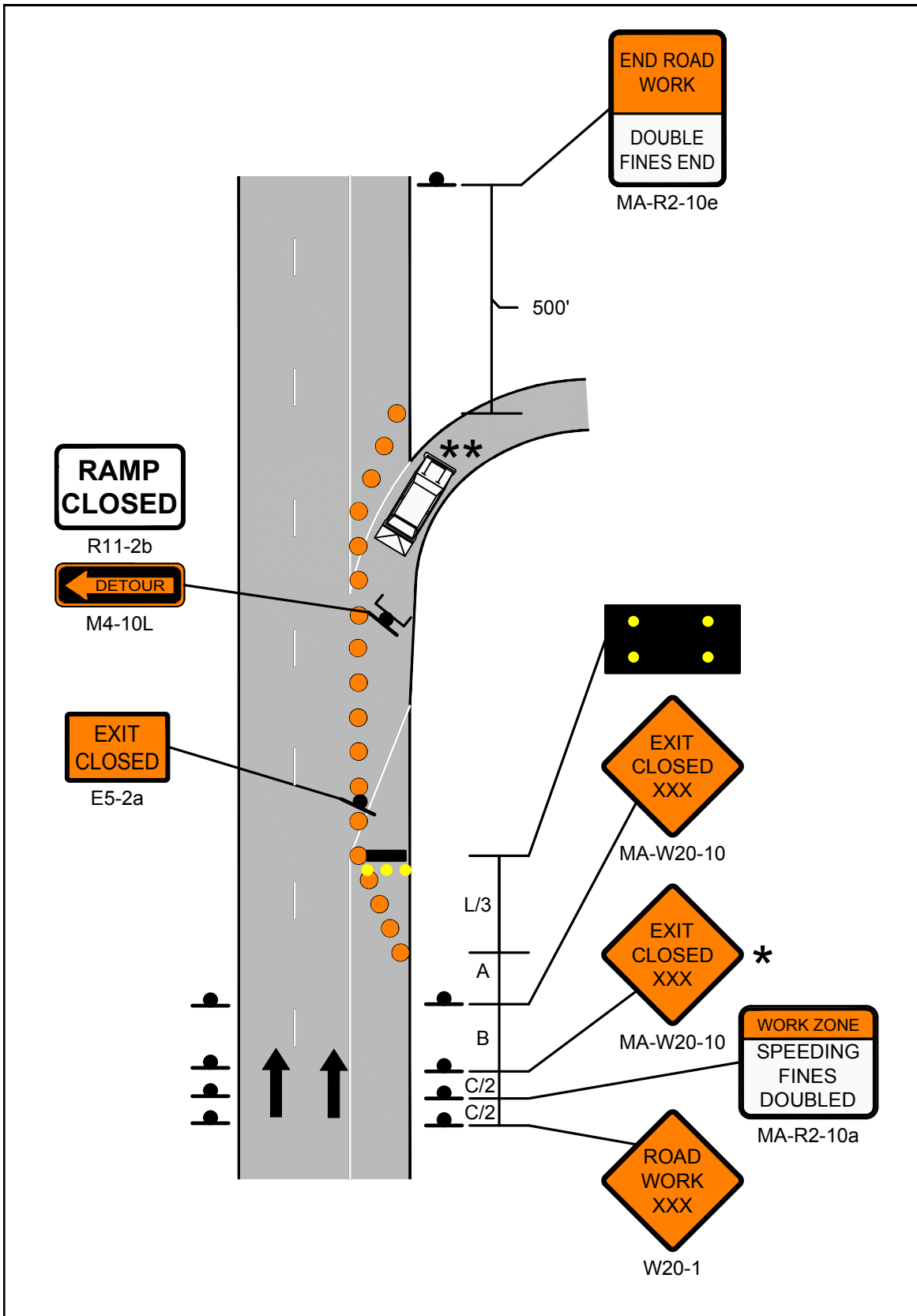
NOTES

1. MA-R2-10a LOCATED AT C/2.
2. \* NOT REQUIRED IF RIGHT LANE IS CLOSED IN ADVANCE OF EXIT.
3. \*\* OPTIONAL AT ENGINEER'S DISCRETION.

LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE





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Work Zone Safety  
Standard Details  
and Drawings










MULTILANE DIVIDED ROADWAY  
TYPICAL CLOVERLEAF RAMP CLOSURE

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		SHOULDER TAPER LENGTH (L/3) (FT)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES
25-40	500 / 500 / 500	110	305	20	45
45-55	500 / 1000 / 1000	220	495	40	30
60-65	1000 / 1600 / 2600	260	645	40	35

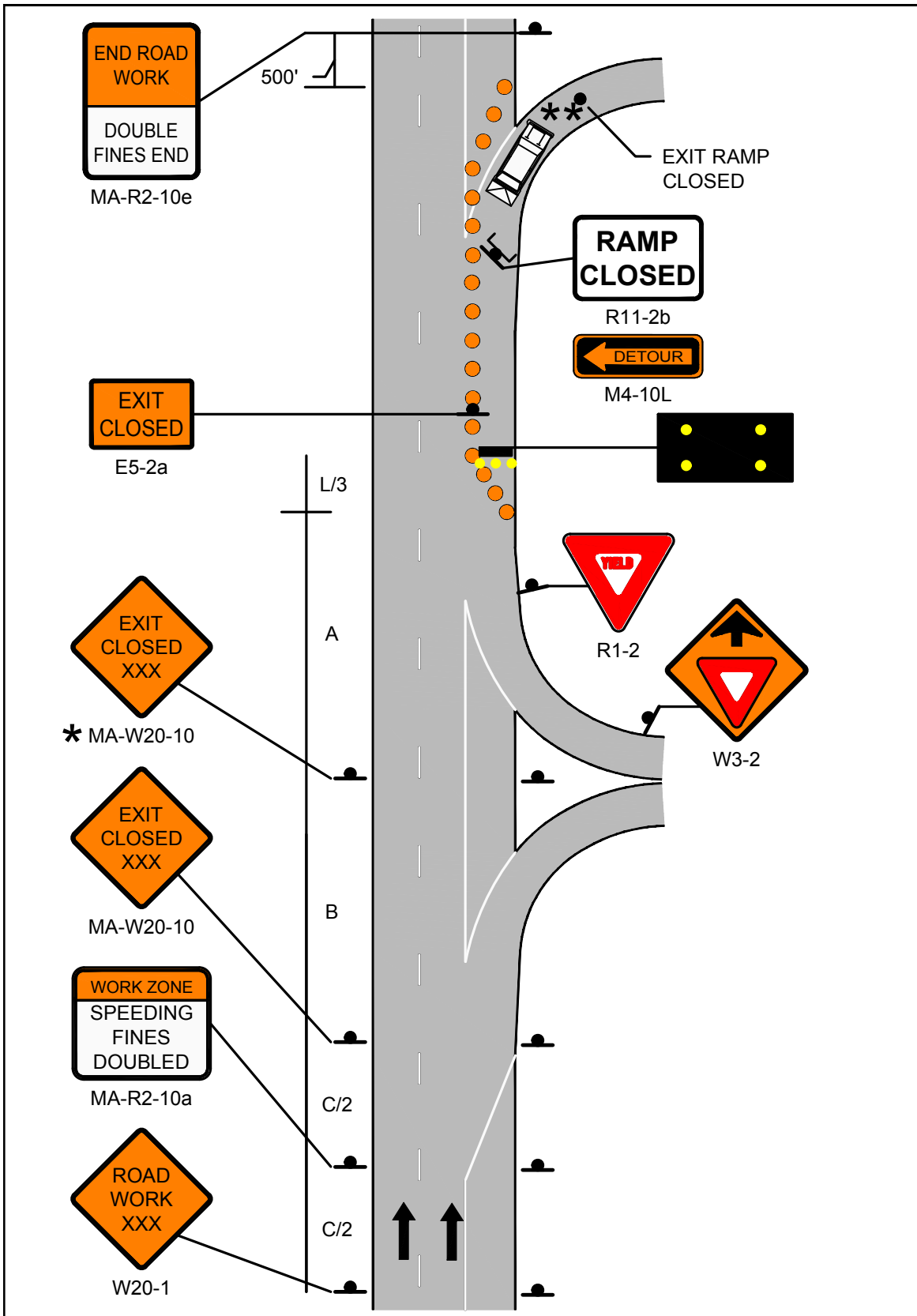
NOTES


1. MA-R2-10a LOCATED AT C/2.
2. \* NOT REQUIRED IF RIGHT LANE IS CLOSED IN ADVANCE OF EXIT.
3. \*\* OPTIONAL AT ENGINEER'S DISCRETION.

LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>PAGE 51</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 22 MULTILANE DIVIDED ROADWAY TYPICAL CLOVERLEAF RAMP CLOSURE</p>
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
Work Zone Safety  
Standard Details  
and Drawings

MULTILANE DIVIDED ROADWAY  
TYPICAL RAMP CLOSURE  
ADVANCE SIGNING

NOTES

1. IF THE CLOSED RAMP IS LOCATED DOWNSTREAM FROM THE PROPOSED DETOUR ROUTE/RAMP, A PCMS SHALL BE POSITIONED AT A SUFFICIENT DISTANCE IN ADVANCE OF THE DETOUR ROUTE/RAMP AND SHOULD STATE WHICH RAMP IS CLOSED AND WHICH SHALL BE USED FOR THE DETOUR.
2. IF THE CLOSED RAMP IS LOCATED UPSTREAM FROM THE PROPOSED DETOUR ROUTE/RAMP, A PCMS SHALL BE POSITIONED PRIOR TO THE CLOSED RAMP AND SHOULD STATE WHICH RAMP IS CLOSED AND WHICH SHALL BE USED FOR THE DETOUR.
3. A SUFFICIENT NUMBER OF DETOUR SIGNS (M4-9 SERIES) SHOULD BE DEPLOYED TO PROPERLY DIRECT DETOURED TRAFFIC. SIGN SPACING SHALL BE AT THE DIRECTION OF THE ENGINEER.

LEGEND

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE

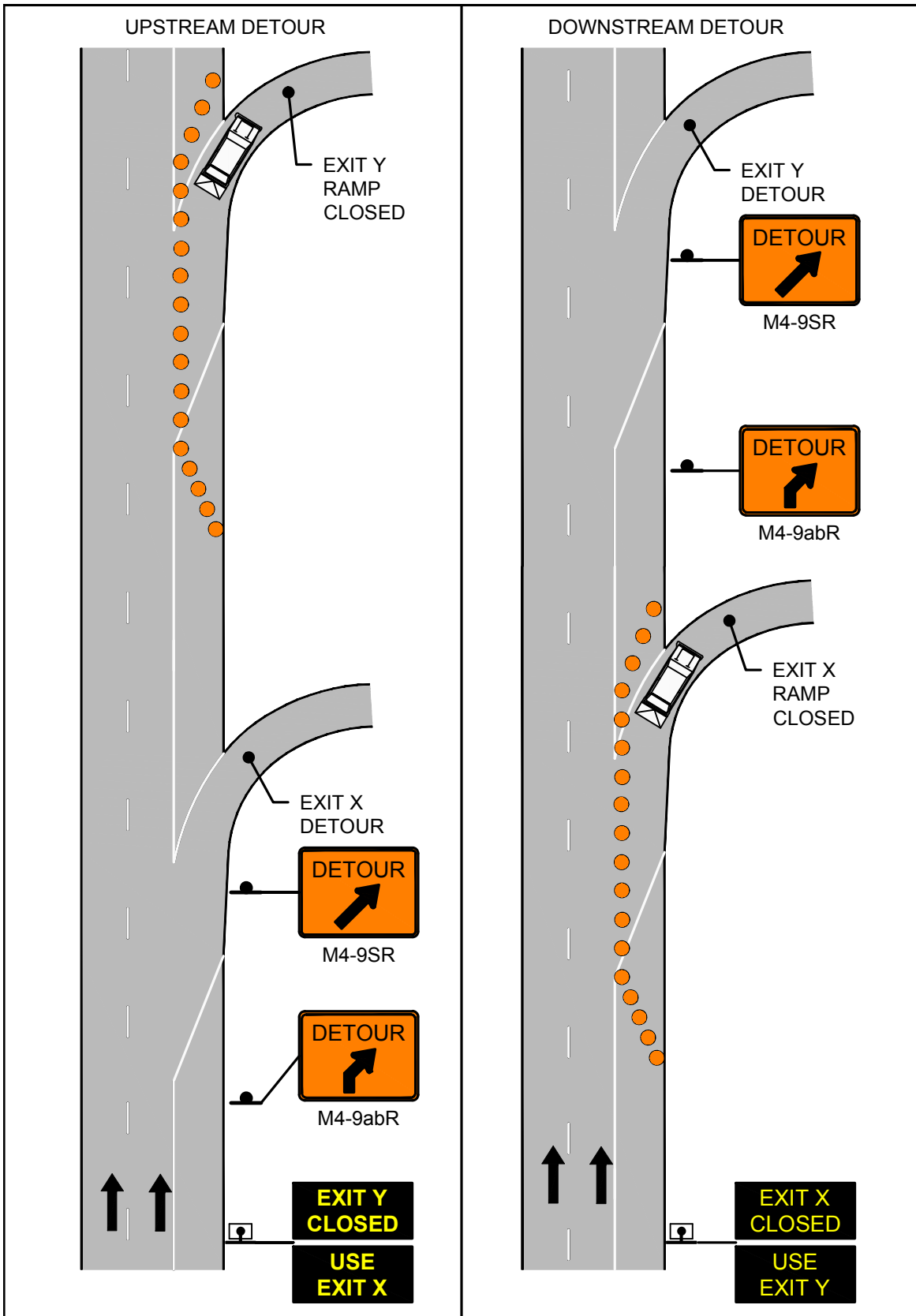




FIGURE 24-1  
MULTILANE DIVIDED ROADWAY  
PLACEMENT OF TEMPORARY  
PORTABLE RUMBLE STRIPS  
SHEET 1 OF 2




POSTED REGULATORY OR WORK ZONE SPEED	SEPARATION BETWEEN RUMBLE STRIPS
Above 55-mph	20-feet
36-mph to 55-mph	15-feet
35-mph and under	10-feet

POSTED SPEED LIMIT (MPH)	SPACING FOR ADVANCE WARNING SIGNS (FT) (A,B,C)	TANGENT LENGTH BETWEEN TAPERS (T) (FT)
25-40	500 / 500 / 500	640
45-55	500 / 1000 / 1000	1320
60-65	1000 / 1600 / 2600	1560

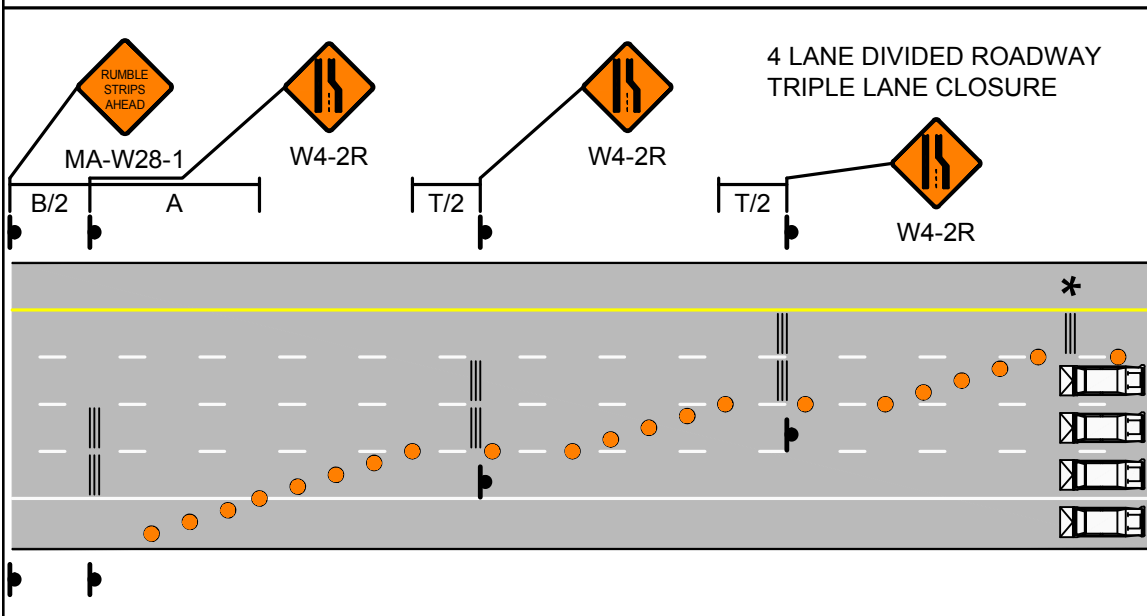
**NOTES**

1. THE INTENTION OF THESE DETAILS IS ONLY TO DEPICT THE PLACEMENT OF TEMPORARY PORTABLE RUMBLE STRIPS (TPRS) IN RELATIONSHIP TO THE TAPER AND THE BUFFER OF A SINGLE- OR MULTI-LANE CLOSURE. THE DEPICTION OF THE NUMBER AND SPACING OF ALL OTHER TRAFFIC CONTROL DEVICES IS NOT TO SCALE. REFER TO OTHER DETAILS FOR LANE CLOSURES FOR THE PLACEMENT AND NUMBER OF ALL OTHER TRAFFIC CONTROL DEVICES.
2. THESE DETAILS ONLY DEPICT RIGHT LANE CLOSURES. LEFT LANE CLOSURES SHOULD UTILIZE A MIRROR IMAGE OF THESE SETUPS, STARTING WITH CLOSURE OF THE LEFTMOST LANE.
3. ★ THIS TPRS ARRAY IS OPTIONAL AT THE ENGINEER'S DISCRETION. IF USED, IT SHOULD BE PLACED ADJACENT TO THE BUFFER.
4. DETAILS SHOW THE MINIMUM NUMBER OF TPRS REQUIRED. ADDITIONAL MAY BE USED IF CONDITIONS WARRANT.

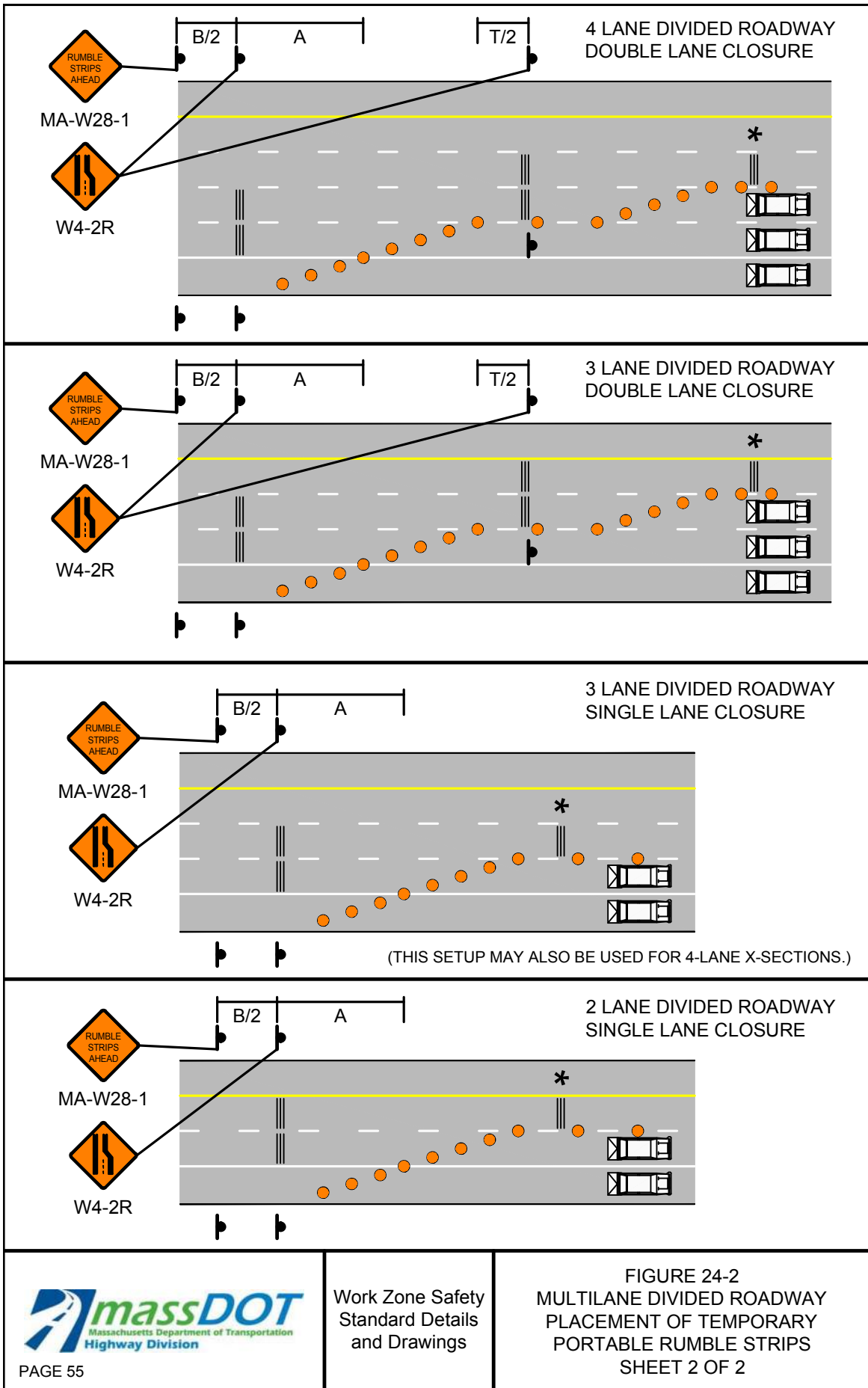
**LEGEND**


-  CHANNELIZATION DEVICE
-  TRUCK MOUNTED ATTENUATOR
-  TEMPORARY PORTABLE RUMBLE STRIP

NOT TO SCALE



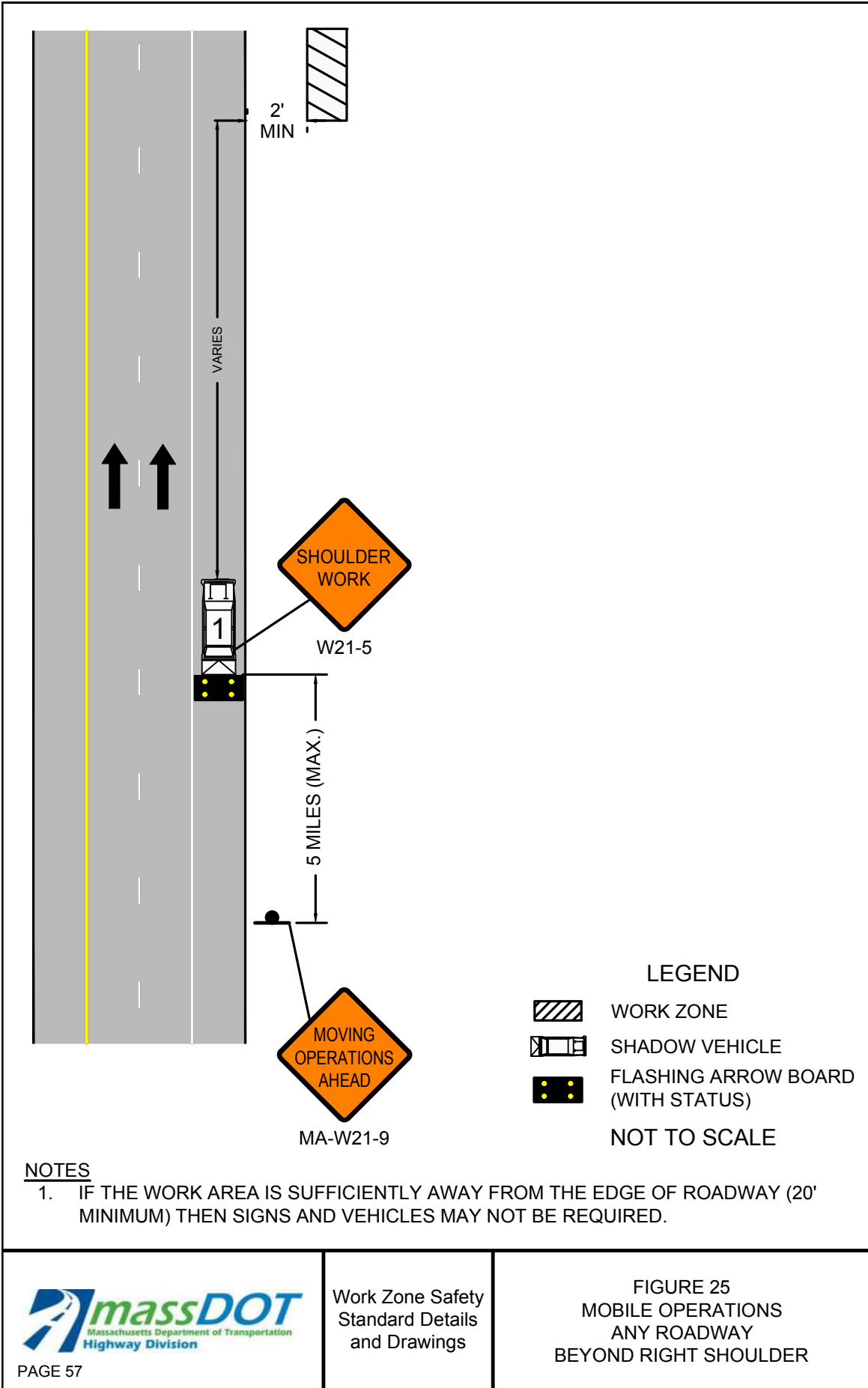


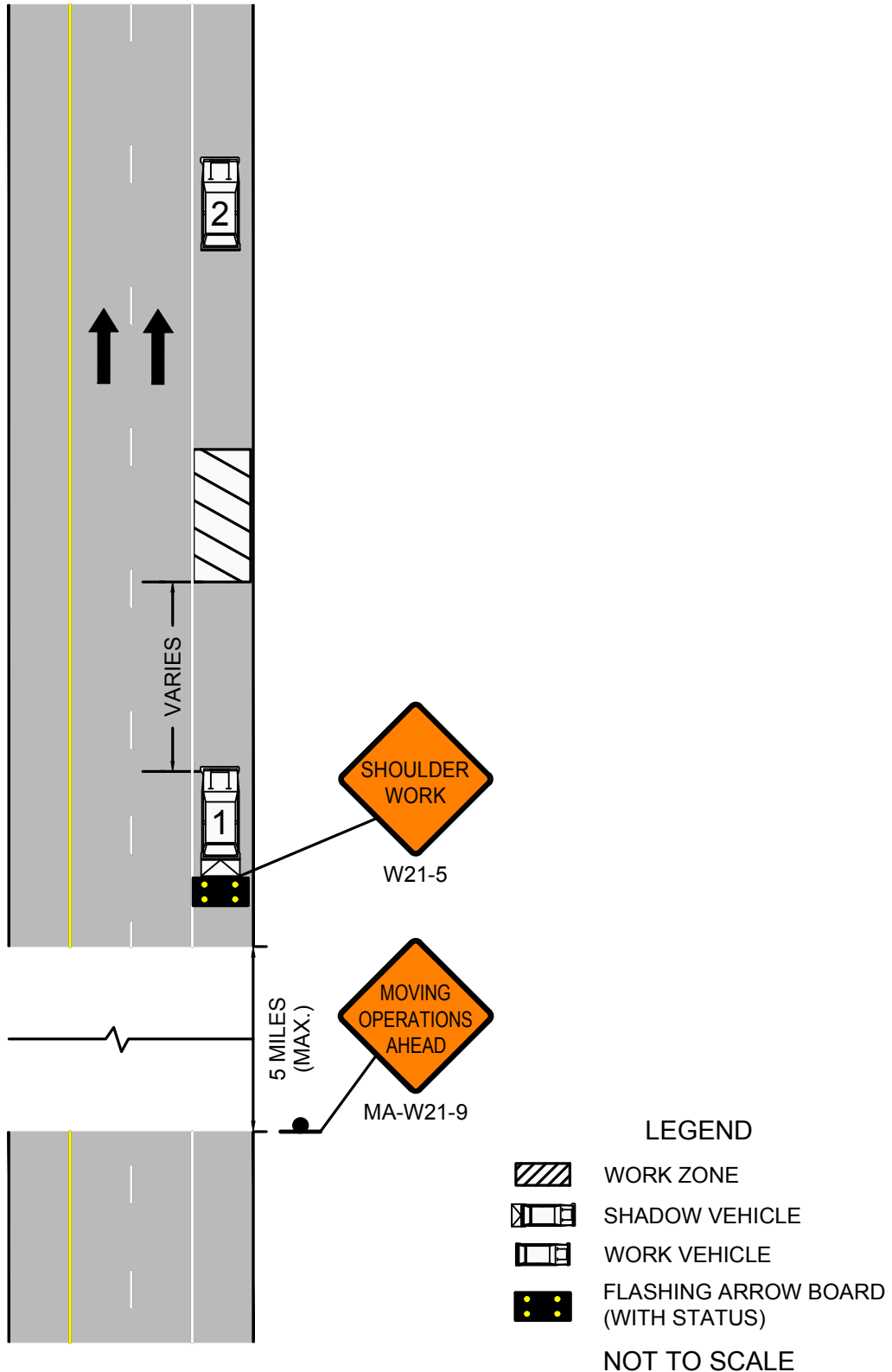


 <p>PAGE 56</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>NOTES FOR MOBILE OPERATIONS</p>
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**Notes for Mobile Operations**

- Unless otherwise stated, these notes shall apply to all Mobile Operation setups.
  - Additional, setup-specific notes may be found on individual sheets.
1. The Supervisor shall travel the designated roadway prior to scheduling the work to ensure that sufficient and appropriate traffic control devices will be available. Special consideration shall be exercised to ensure that appropriate traffic controls be placed in areas that will have limited visibility of the work areas or any associated traffic queues.
  2. Vehicles used for these operations shall be made highly visible with appropriate equipment such as flashing lights, rotating beacons, flags, signs, flashing arrow boards, and/or portable changeable message signs. Any signs mounted to these vehicles shall not obscure the visibility of other devices.
  3. All vehicles shown may not be required based upon roadway conditions. However, when needed and practical, additional shadow vehicles and equipment to warn and protect motorists and workers should be used. Based upon roadway conditions, the addition of a police detail with cruiser may be used for additional protection or warning for the traveling public.
  4. The distance between the work and shadow vehicle(s) may vary according to the terrain and other factors. Shadow vehicles are used to warn traffic of the operations ahead. Whenever adequate sight distance exists, the shadow vehicle(s) should maintain the minimum appropriate distance and maintain the same speed to prevent non-work related vehicles from entering the work convoy. If this formation cannot be maintained then additional traffic control devices should be deployed in advance of any vertical or horizontal curves that may restrict the sight distance of an oncoming vehicle to either the work vehicle or associated traffic queue.
  5. All shadow vehicles shall be equipped with a truck or trailer mounted attenuator (TMA) and a flashing arrow board.
  6. Signs should be covered or turned from view when work is not in progress.
  7. Portable changeable message signs may be used in lieu of MA-W21-9 signs and any signs mounted directly to a shadow vehicle.





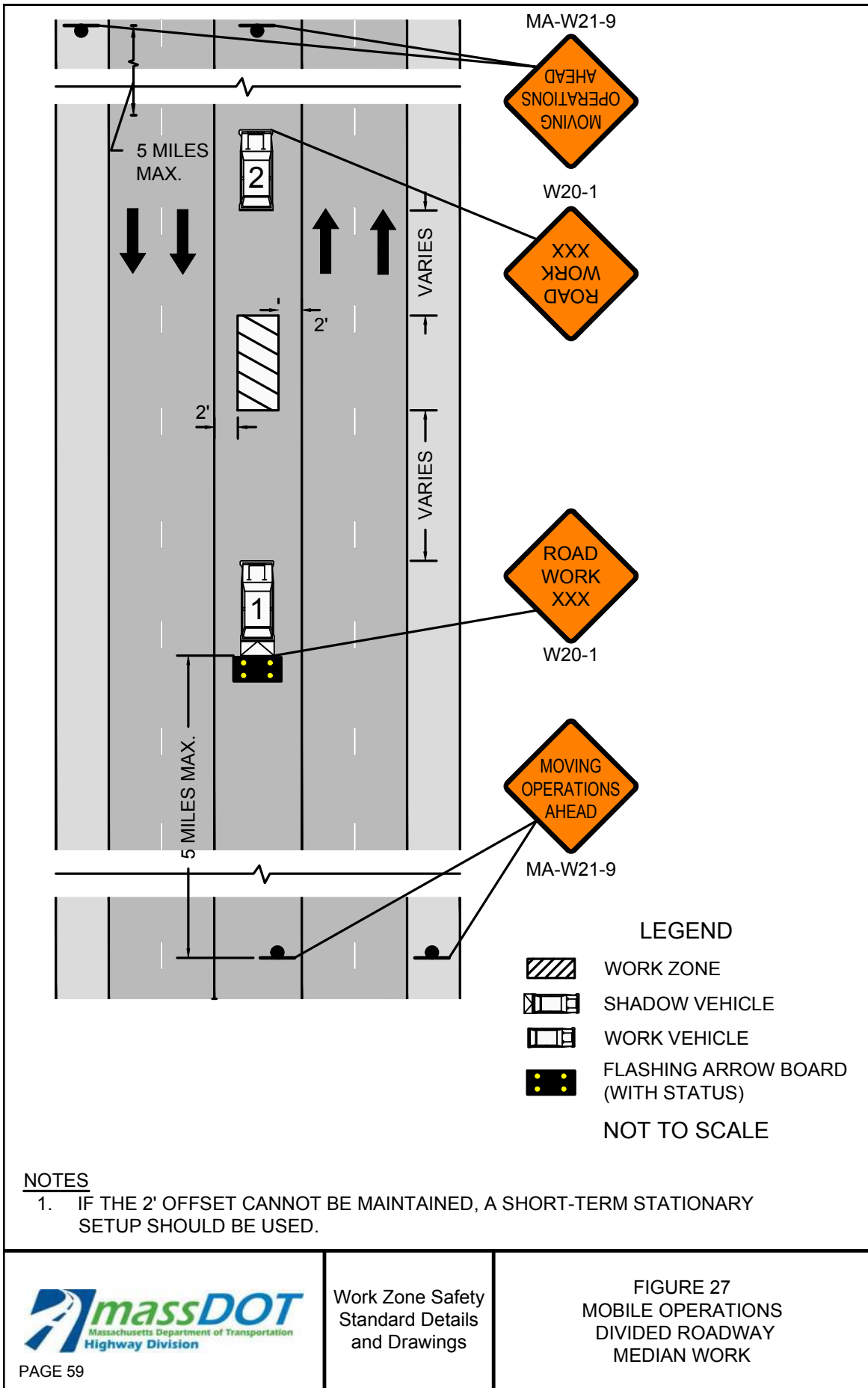
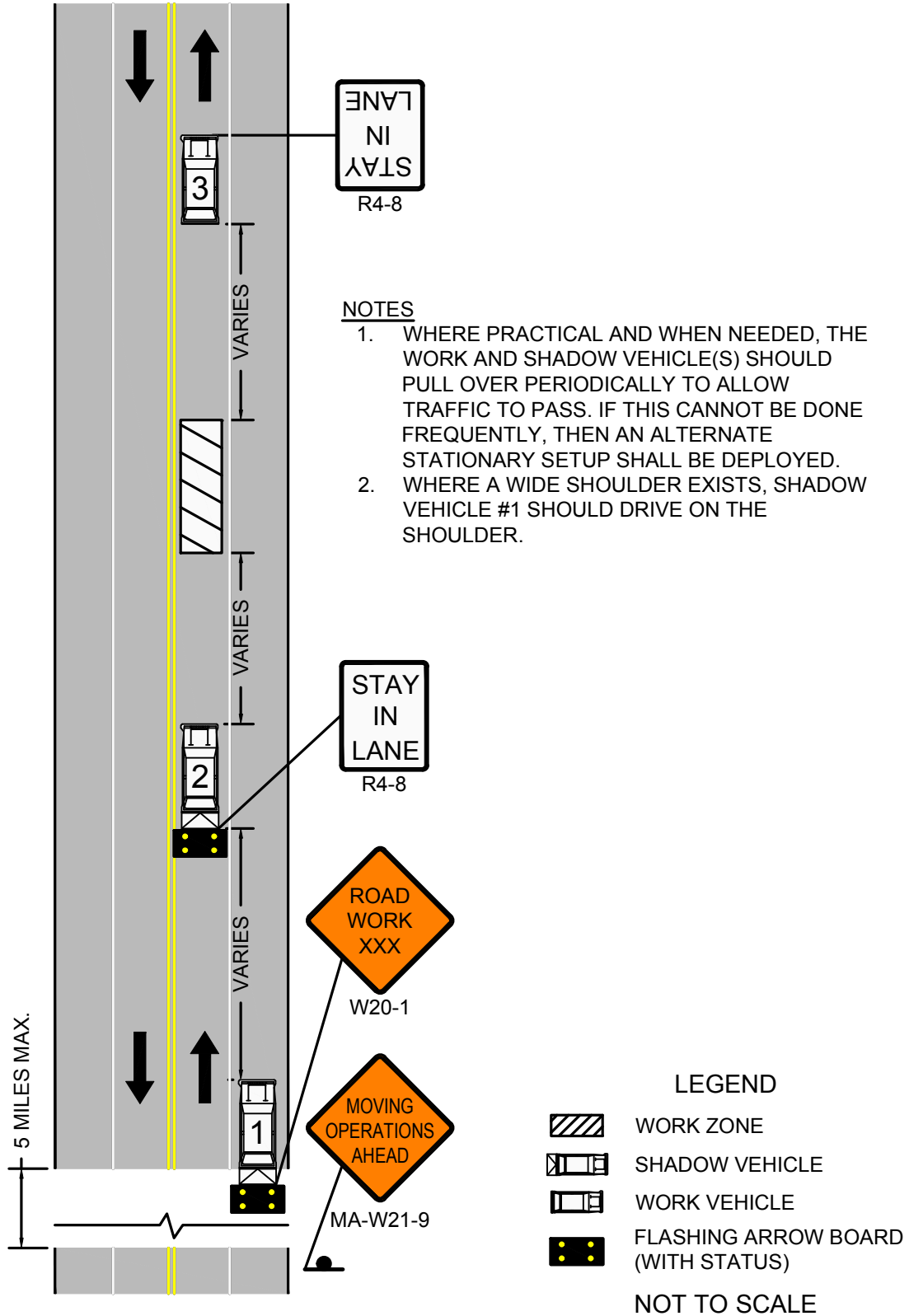




FIGURE 28  
MOBILE OPERATIONS  
UNDIVIDED TWO LANE ROADWAY  
HALF OF ROADWAY CLOSED



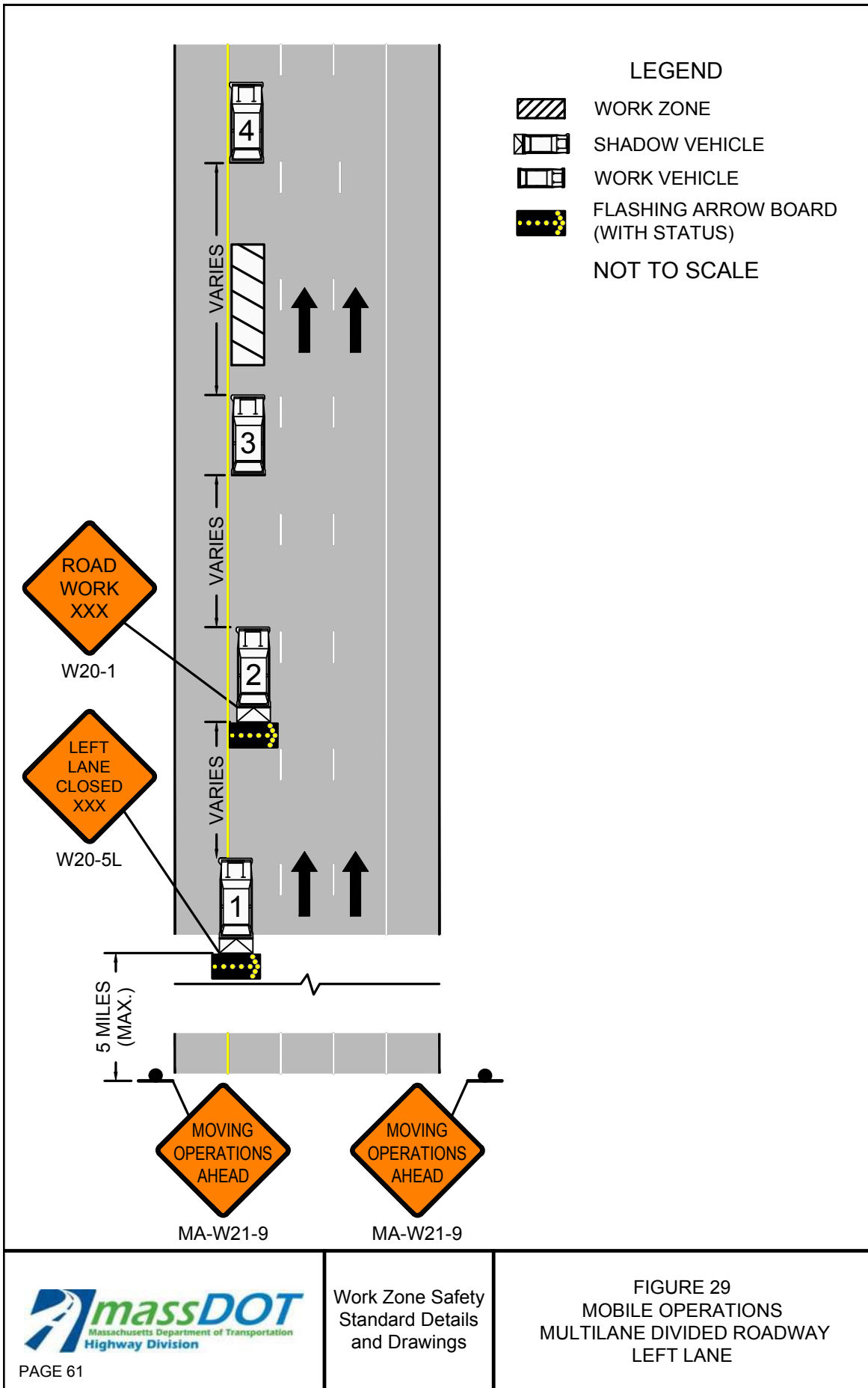
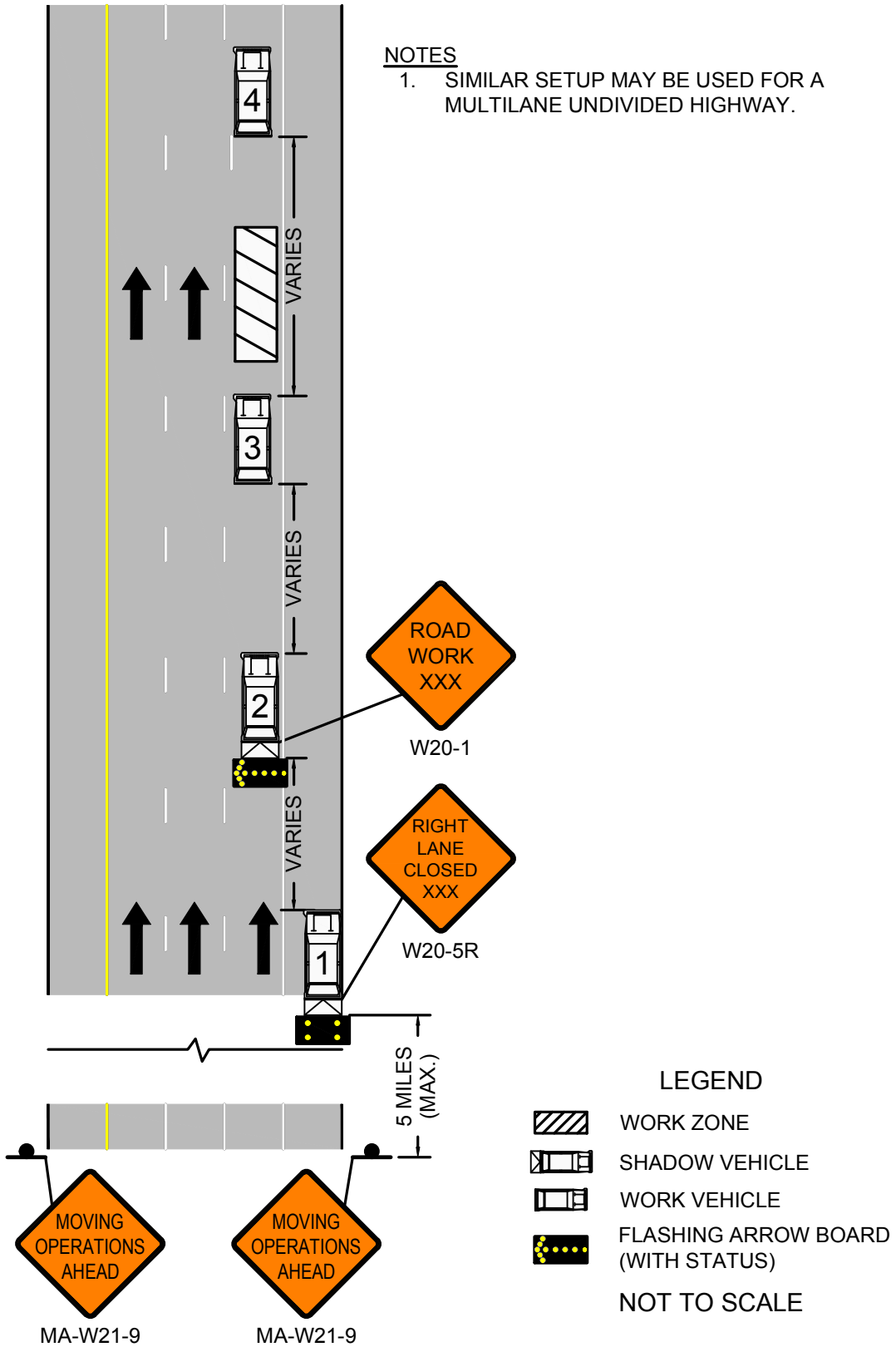
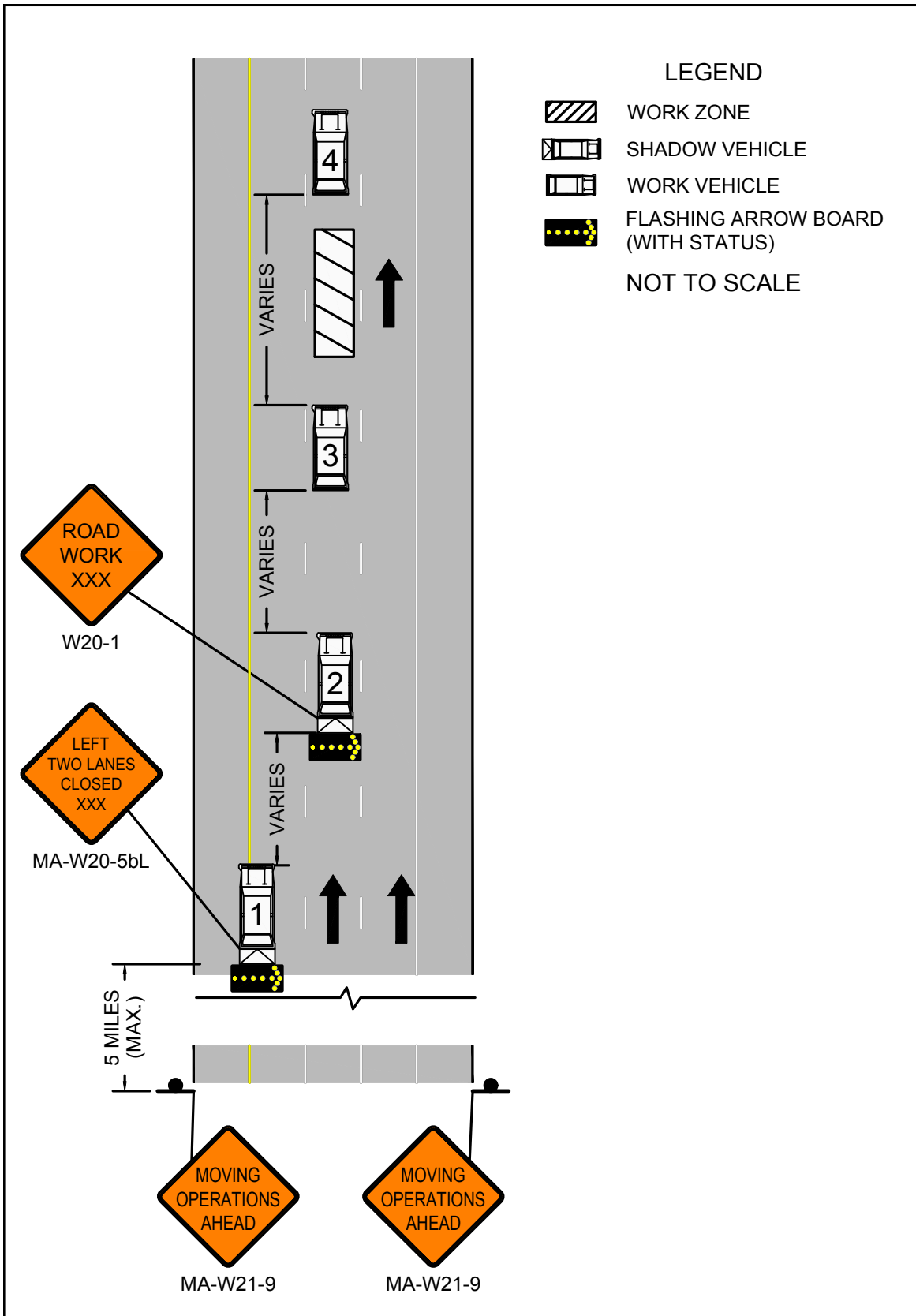





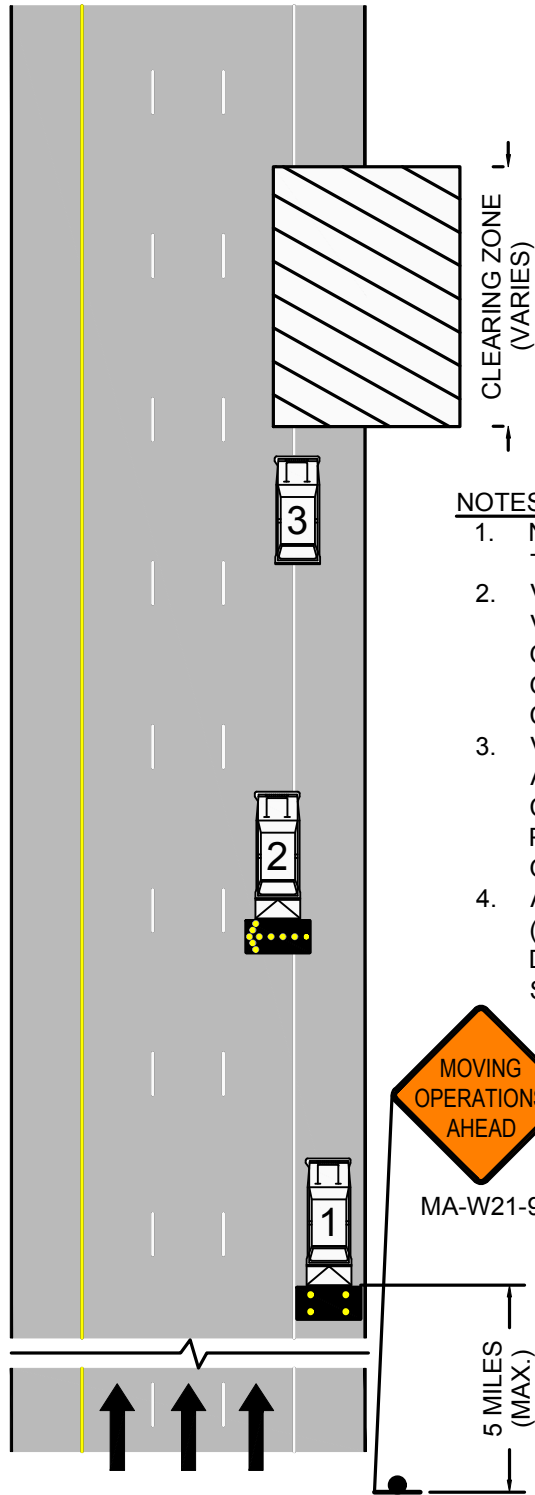
FIGURE 30  
MOBILE OPERATIONS  
MULTILANE DIVIDED ROADWAY  
RIGHT LANE







 Massachusetts Department of Transportation Highway Division PAGE 63	Work Zone Safety Standard Details and Drawings	FIGURE 31 MOBILE OPERATIONS MULTILANE DIVIDED ROADWAY CENTER LANE
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NOTES

1. NO OTHER NOTES ARE APPLICABLE TO THIS DETAIL.
2. VEHICLE #3 IS A SNOW/DEBRIS REMOVAL VEHICLE AND SHALL ALWAYS BE AWARE OF THE SURROUNDINGS. MORE THAN ONE VEHICLE MAY BE USED IN THE CLEARING ZONE.
3. VEHICLE #1 SHOULD BE EQUIPPED WITH A PCMS, A TMA, AND STAY IN VISUAL CONTACT WITH VEHICLE #3 WHILE PROVIDING AMPLE WARNING TO ONCOMING TRAFFIC.
4. A POLICE DETAIL WITH BLUE LIGHTS (OPTIONAL) SHALL REMAIN DOWNSTREAM OF VEHICLE #1 IN THE SHOULDER.

**LEGEND**

- WORK ZONE
- SHADOW VEHICLE
- WORK VEHICLE
- FLASHING ARROW BOARD (WITH STATUS)

NOT TO SCALE

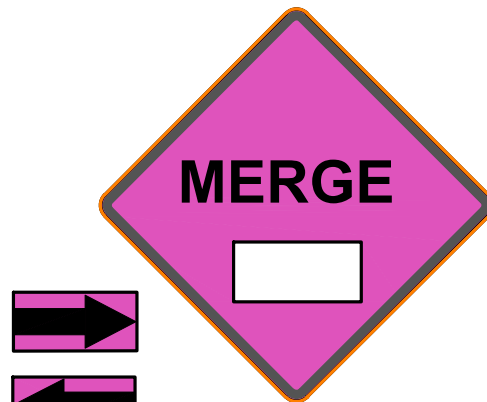
**Notes for Traffic Emergency or Incident Operations**

- The goal is to increase awareness of during traffic emergencies or incidents.
- These signs are to be used to differentiate from the traditional construction work zone and an emergency or incident.
- Upon arrival MassDOT First Responders shall assess the magnitude of the scene to determine if the incident is likely to last an hour or more in duration which would trigger the requirement to use these signs.
- Place the “Emergency Ahead” sign on the same side of the road as the incident, if possible, for up to an hour. Emergency response signs should be put up for all incidents and emergencies as soon as possible.
- Place the emergency sign 500 to 1000 feet before the first channelization devices.
- As an incident evolves this sign would be used as a secondary sign with all other emergency controls put in place.
- Only use “MERGE” signs where applicable (Not on 2 lane roads).
- Use MERGE signs on Multi-lane Roads to move traffic away from the incident and keep them in a safe lane.
- Place the MERGE sign about 500 feet before the closure.
- If additional signs are available, they should be placed accordingly as a sign informing people coming in the other direction or on the opposite side of the roadway.
- Use 12 emergency cones spaced 40 to 80 feet apart to form a taper and protect the scene.
- Sequential flashing lights/flares may be used in lieu of or to supplement cones.
- During a major incident that will last for a long duration, the EMERGENCY AHEAD sign should be moved back before an intersecting road or ramp to alert travelers and give them an option of using an alternate route. (Be sure all other devices are in place before moving this sign).

**Standard Emergency Signs (36"x36" or 48"x48")**



MA-W20-9






MA-W4-2aR/L



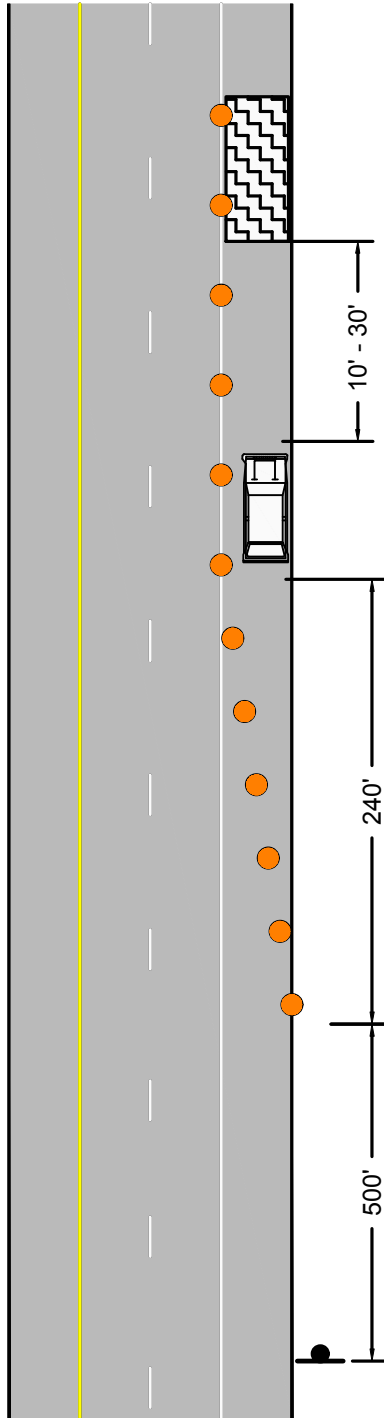


FIGURE 33  
EMERGENCY RESPONSE  
ANY ROADWAY  
SHOULDER ENCROACHMENT

LEGEND

-  EMERGENCY AREA
-  CHANNELIZATION DEVICE
-  EMERGENCY RESPONSE VEHICLE

NOT TO SCALE



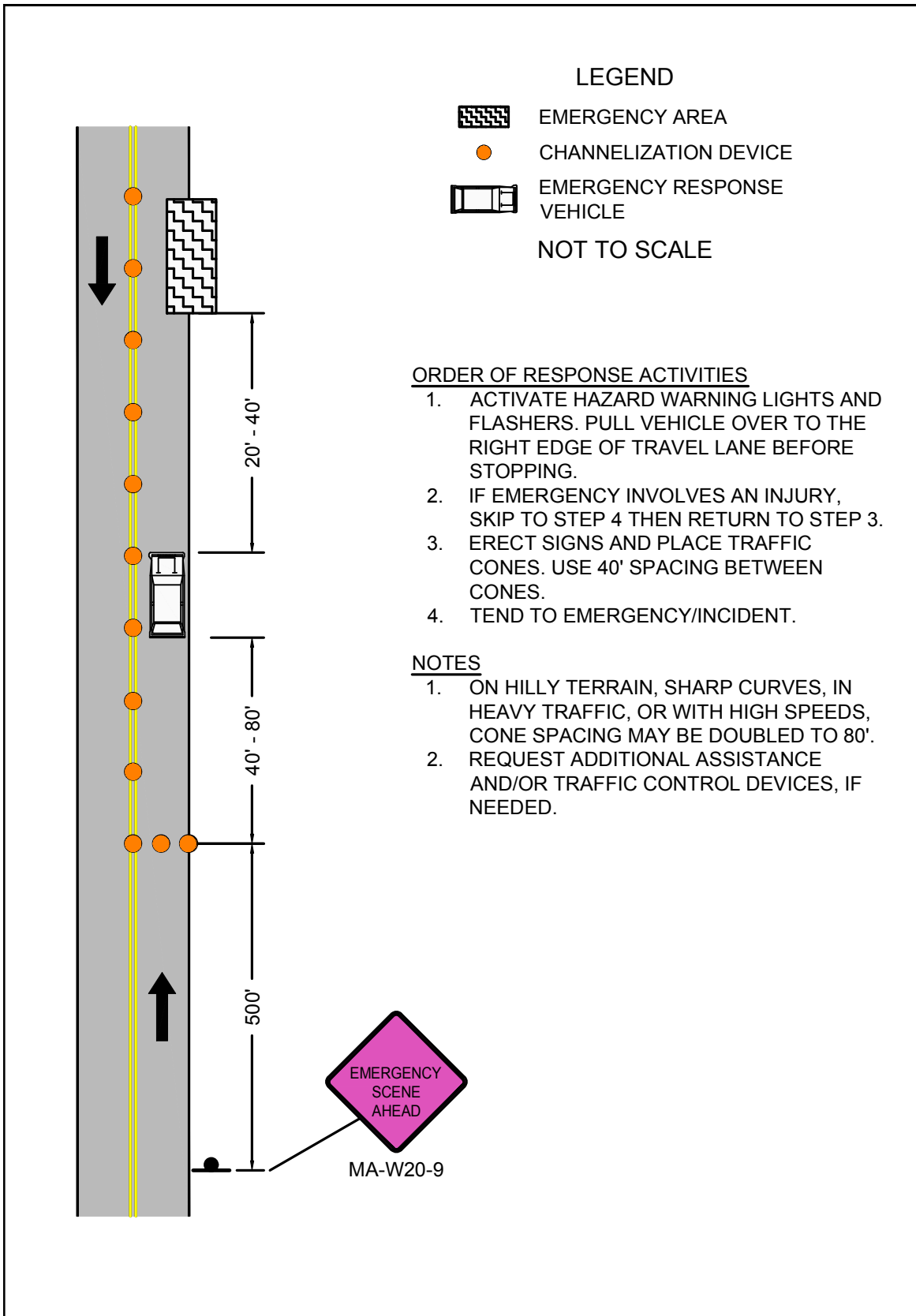
ORDER OF RESPONSE ACTIVITIES

1. ACTIVATE HAZARD WARNING LIGHTS AND FLASHERS. PULL VEHICLE OVER TO THE RIGHT EDGE OF TRAVEL LANE BEFORE STOPPING.
2. IF EMERGENCY INVOLVES AN INJURY, SKIP TO STEP 4 THEN RETURN TO STEP 3.
3. ERECT SIGNS AND PLACE TRAFFIC CONES. USE 40' SPACING BETWEEN CONES.
4. TEND TO EMERGENCY/INCIDENT.

NOTES

1. ON HILLY TERRAIN, SHARP CURVES, IN HEAVY TRAFFIC, OR WITH HIGH SPEEDS, CONE SPACING MAY BE DOUBLED TO 80'.
2. REQUEST ADDITIONAL ASSISTANCE AND/OR TRAFFIC CONTROL DEVICES, IF NEEDED.

MA-W20-9







 <p>Massachusetts Department of Transportation Highway Division</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p><b>FIGURE 34</b> EMERGENCY RESPONSE TWO LANE ROADWAY NO SHOULDER TRAVEL LANE ENCROACHMENT</p>
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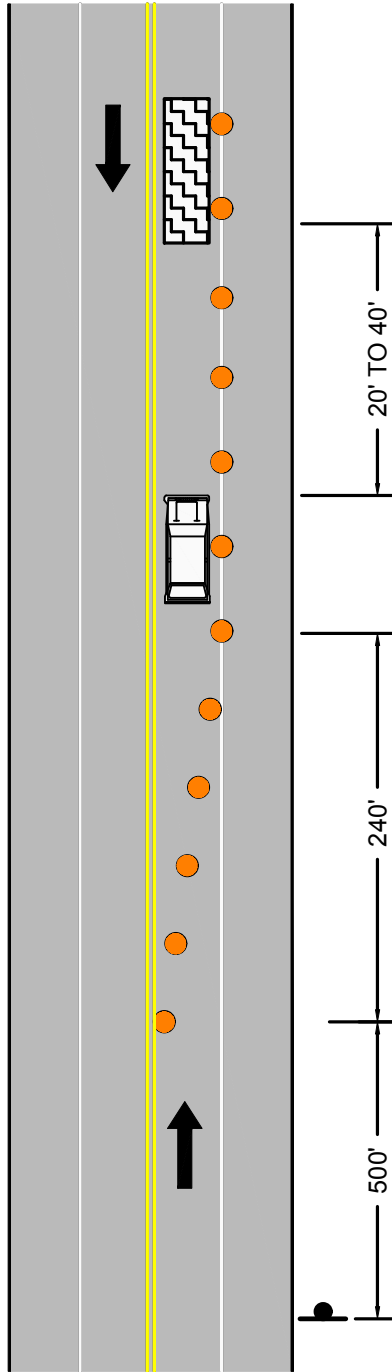


FIGURE 35  
EMERGENCY RESPONSE  
TWO LANE ROADWAY  
TRAVERSABLE SHOULDER  
SINGLE LANE ENCROACHMENT

LEGEND

-  EMERGENCY AREA
-  CHANNELIZATION DEVICE
-  EMERGENCY RESPONSE VEHICLE

NOT TO SCALE

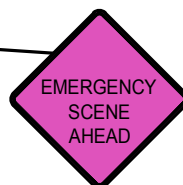


ORDER OF RESPONSE ACTIVITIES

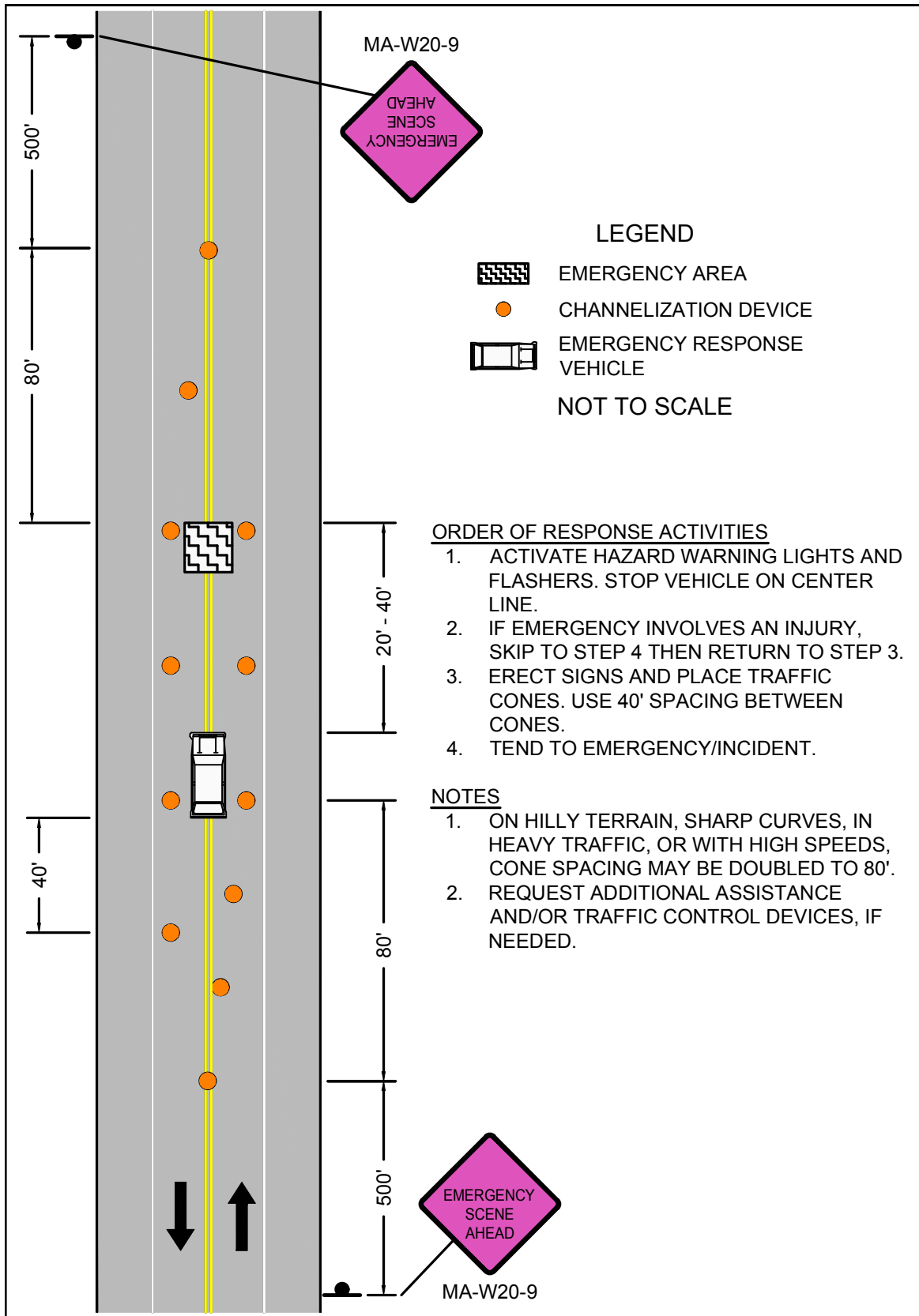
1. ACTIVATE HAZARD WARNING LIGHTS AND FLASHERS. PULL VEHICLE OVER TO THE LEFT EDGE OF TRAVEL LANE BEFORE STOPPING.
2. IF EMERGENCY INVOLVES AN INJURY, SKIP TO STEP 4 THEN RETURN TO STEP 3.
3. ERECT SIGNS AND PLACE TRAFFIC CONES. USE 40' SPACING BETWEEN CONES.
4. TEND TO EMERGENCY/INCIDENT.

NOTES

1. ON HILLY TERRAIN, SHARP CURVES, IN HEAVY TRAFFIC, OR WITH HIGH SPEEDS, CONE SPACING MAY BE DOUBLED TO 80'.
2. REQUEST ADDITIONAL ASSISTANCE AND/OR TRAFFIC CONTROL DEVICES, IF NEEDED.



MA-W20-9




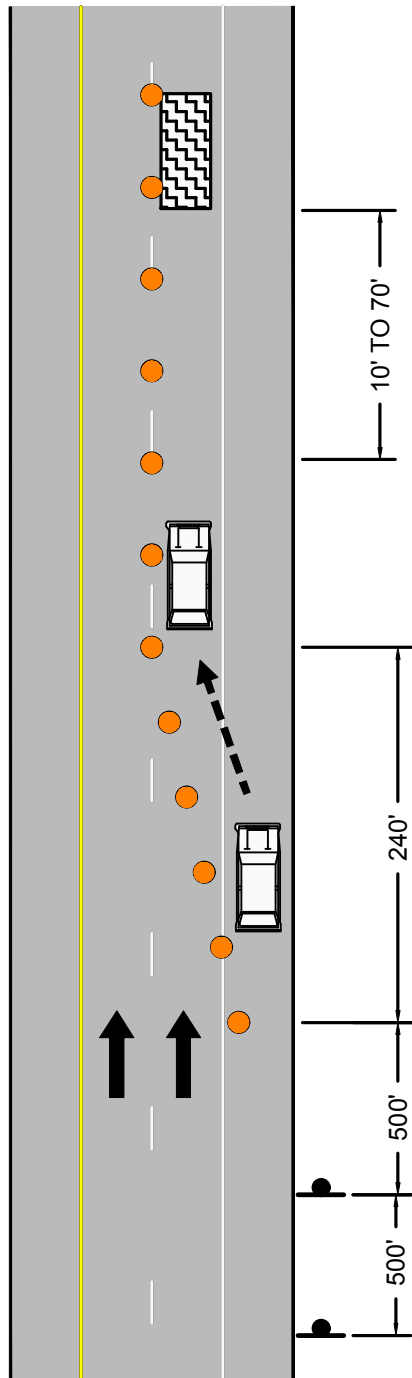




 Massachusetts Department of Transportation Highway Division PAGE 69	Work Zone Safety Standard Details and Drawings	<b>FIGURE 36</b> EMERGENCY RESPONSE TWO LANE ROADWAY TRAVERSABLE SHOULDER CENTER OF ROADWAY
--	--	---



FIGURE 37  
EMERGENCY RESPONSE  
MULTILANE DIVIDED ROADWAY  
RIGHT LANE



LEGEND

-  EMERGENCY AREA
-  CHANNELIZATION DEVICE
-  EMERGENCY RESPONSE VEHICLE
-  RESPONSE VEHICLE MOVEMENT

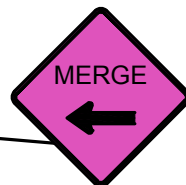
NOT TO SCALE

ORDER OF RESPONSE ACTIVITIES

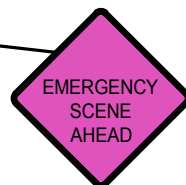
1. ACTIVATE HAZARD WARNING LIGHTS AND FLASHERS. STOP VEHICLE IN BREAKDOWN LANE.
2. IF EMERGENCY INVOLVES AN INJURY, SKIP TO STEP 6 THEN RETURN TO STEP 3.
3. ERECT SIGNS AND PLACE TRAFFIC CONES. USE 40' SPACING BETWEEN CONES.
4. MOVE RESPONSE VEHICLE BEHIND EMERGENCY.
5. PLACE ADDITIONAL CONES.
6. TEND TO EMERGENCY.

NOTES

1. ON HILLY TERRAIN, SHARP CURVES, IN HEAVY TRAFFIC, OR WITH HIGH SPEEDS, CONE SPACING MAY BE DOUBLED TO 80'.
2. REQUEST ADDITIONAL ASSISTANCE AND/OR TRAFFIC CONTROL DEVICES, IF NEEDED.



MA-W4-2aL



MA-W20-9



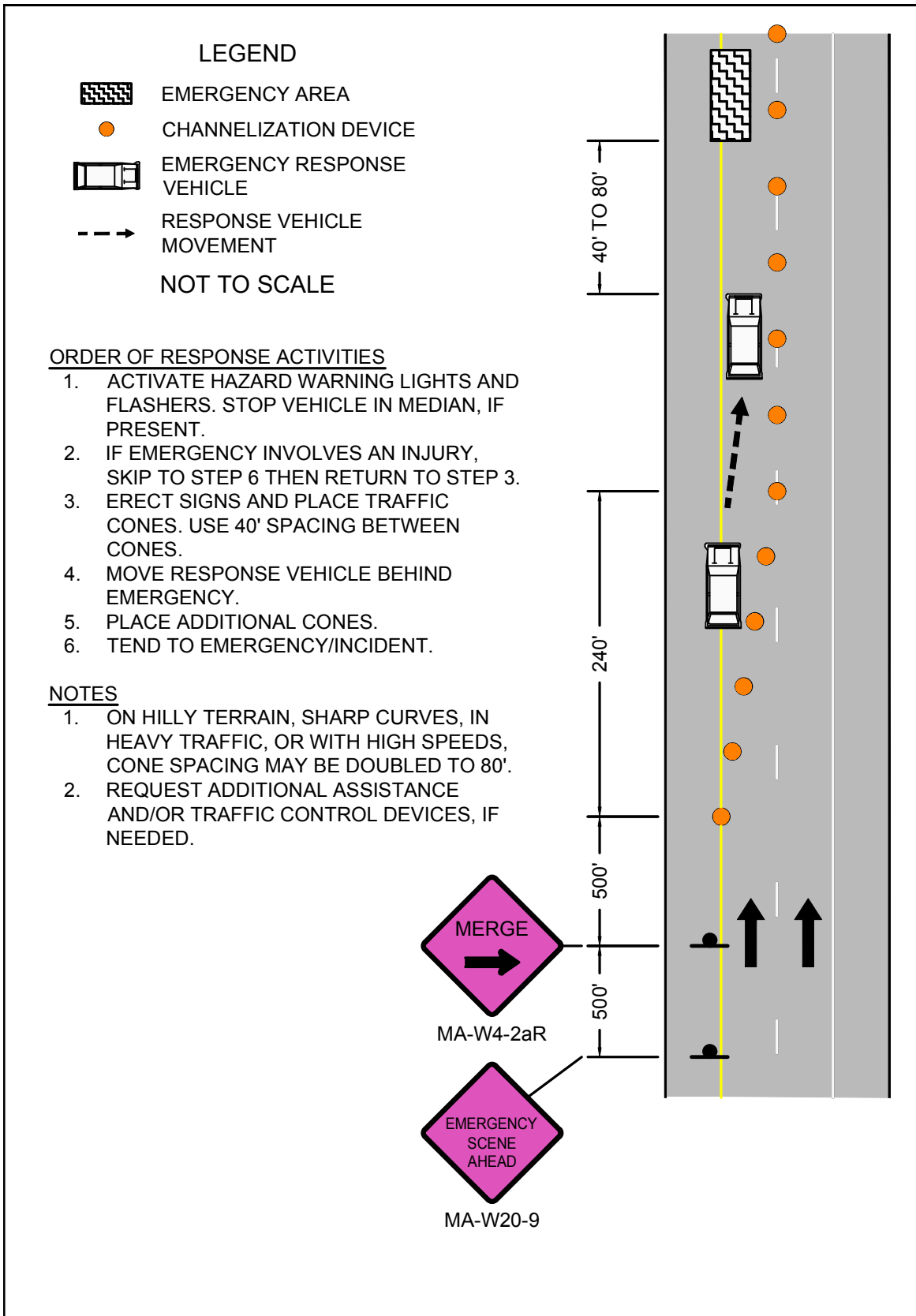
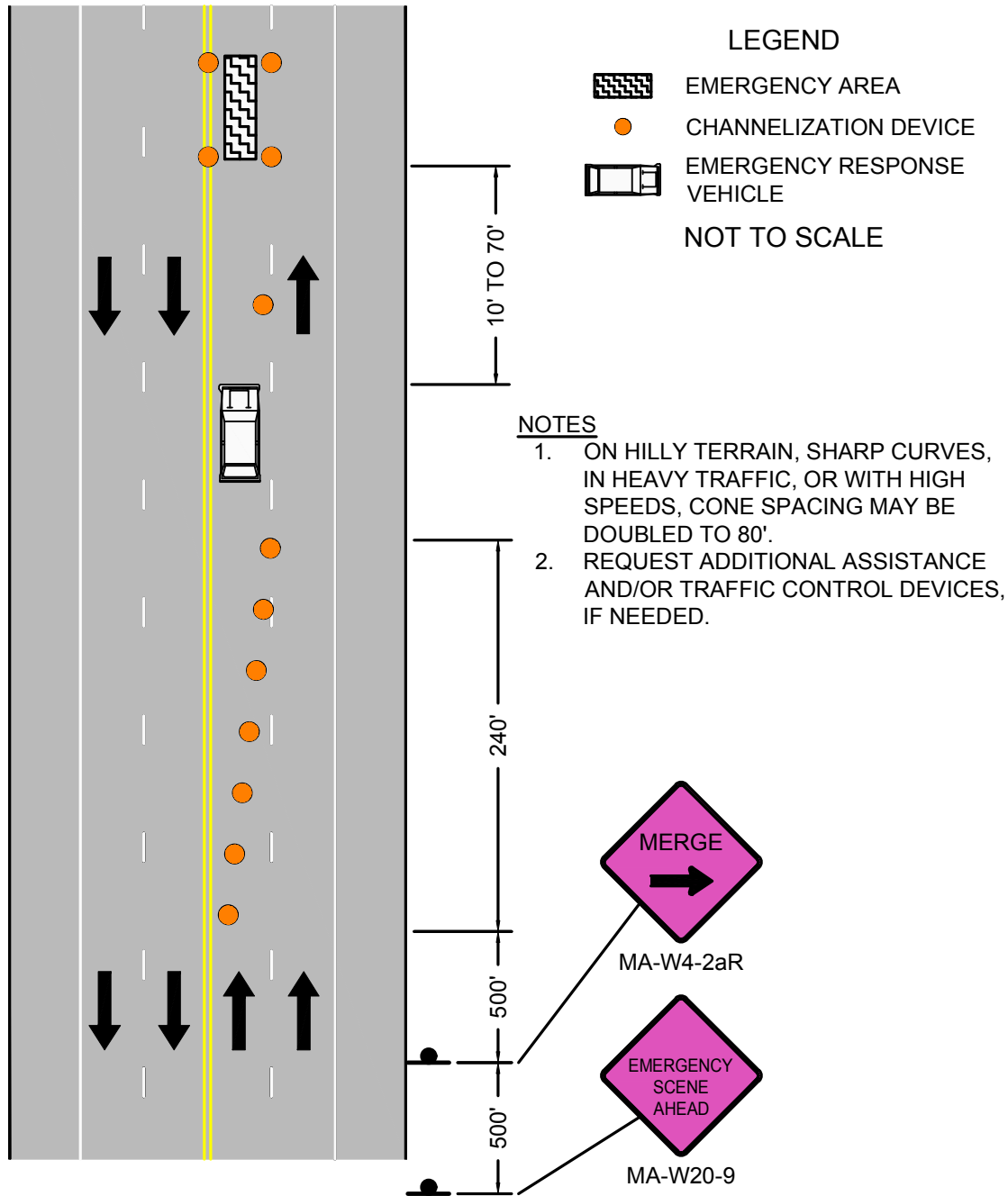


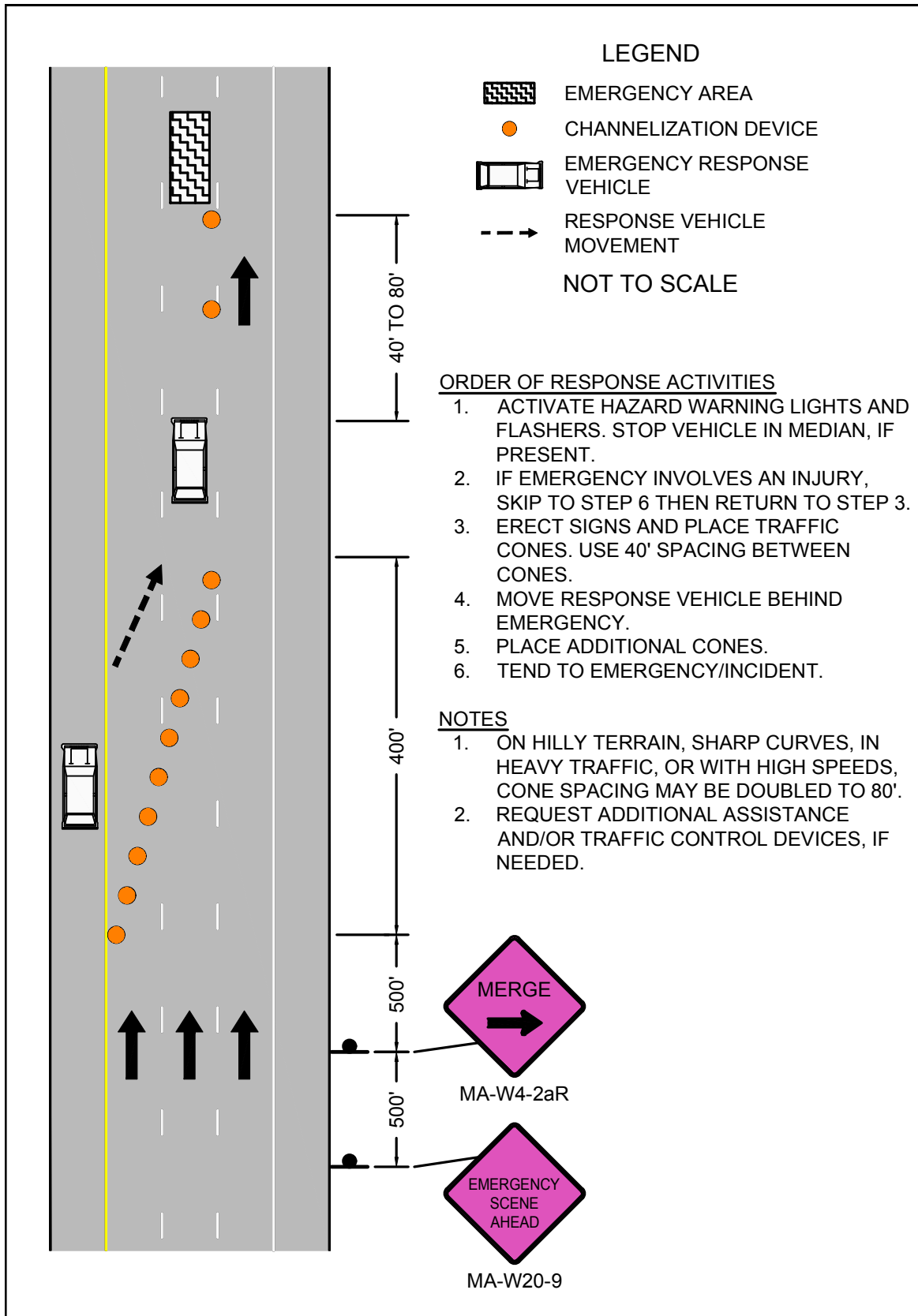


FIGURE 39  
EMERGENCY RESPONSE  
MULTILANE UNDIVIDED  
ROADWAY  
LEFT LANE



**ORDER OF RESPONSE ACTIVITIES**

1. ACTIVATE HAZARD WARNING LIGHTS AND FLASHERS. PULL VEHICLE OVER TO THE RIGHT EDGE OF BREAKDOWN LANE OR SHOULDER OR, IF NOT PRESENT, RIGHT EDGE OF TRAVEL LANE BEFORE STOPPING.
2. IF EMERGENCY INVOLVES AN INJURY, SKIP TO STEP 4 THEN RETURN TO STEP 3.
3. ERECT SIGNS AND PLACE TRAFFIC CONES. USE 40' SPACING BETWEEN CONES.
4. TEND TO EMERGENCY/INCIDENT.




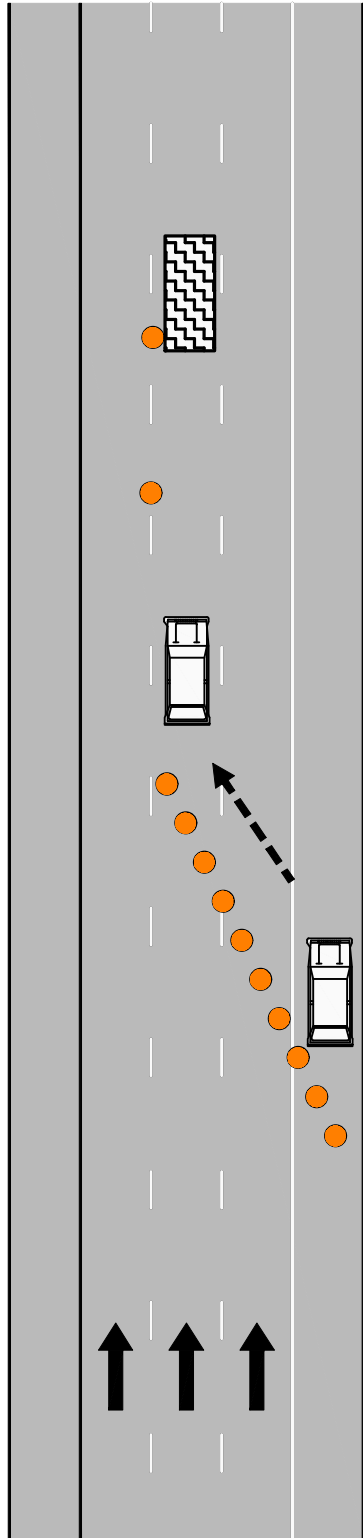




 <p>Massachusetts Department of Transportation Highway Division</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p><b>FIGURE 40</b> EMERGENCY RESPONSE MULTILANE DIVIDED ROADWAY MIDDLE LANE APPROACH FROM LEFT</p>
--	---	---



FIGURE 41  
EMERGENCY RESPONSE  
MULTILANE DIVIDED ROADWAY  
MIDDLE LANE  
APPROACH FROM RIGHT



LEGEND

-  EMERGENCY AREA
-  CHANNELIZATION DEVICE
-  EMERGENCY RESPONSE VEHICLE
-  RESPONSE VEHICLE MOVEMENT

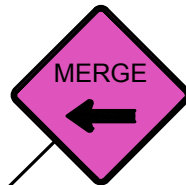
NOT TO SCALE

ORDER OF RESPONSE ACTIVITIES

1. ACTIVATE HAZARD WARNING LIGHTS AND FLASHERS. STOP VEHICLE IN BREAKDOWN LANE.
2. IF EMERGENCY INVOLVES AN INJURY, SKIP TO STEP 6 THEN RETURN TO STEP 3.
3. ERECT SIGNS AND PLACE TRAFFIC CONES. USE 40' SPACING BETWEEN CONES.
4. MOVE RESPONSE VEHICLE BEHIND EMERGENCY.
5. PLACE ADDITIONAL CONES.
6. TEND TO EMERGENCY.

NOTES

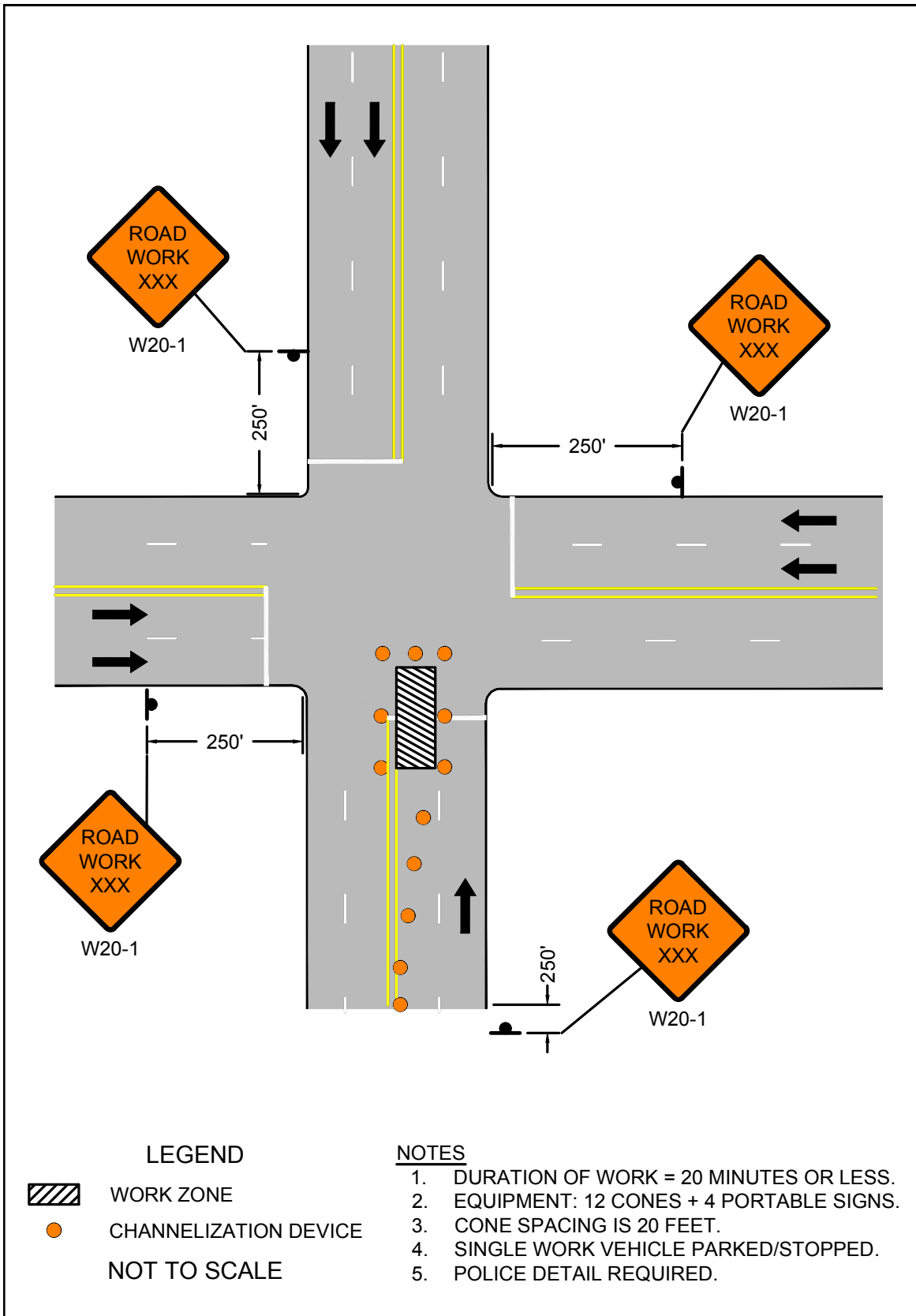
1. ON HILLY TERRAIN, SHARP CURVES, IN HEAVY TRAFFIC, OR WITH HIGH SPEEDS, CONE SPACING MAY BE DOUBLED TO 80'.
2. REQUEST ADDITIONAL ASSISTANCE AND/OR TRAFFIC CONTROL DEVICES, IF NEEDED.



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MA-W20-9

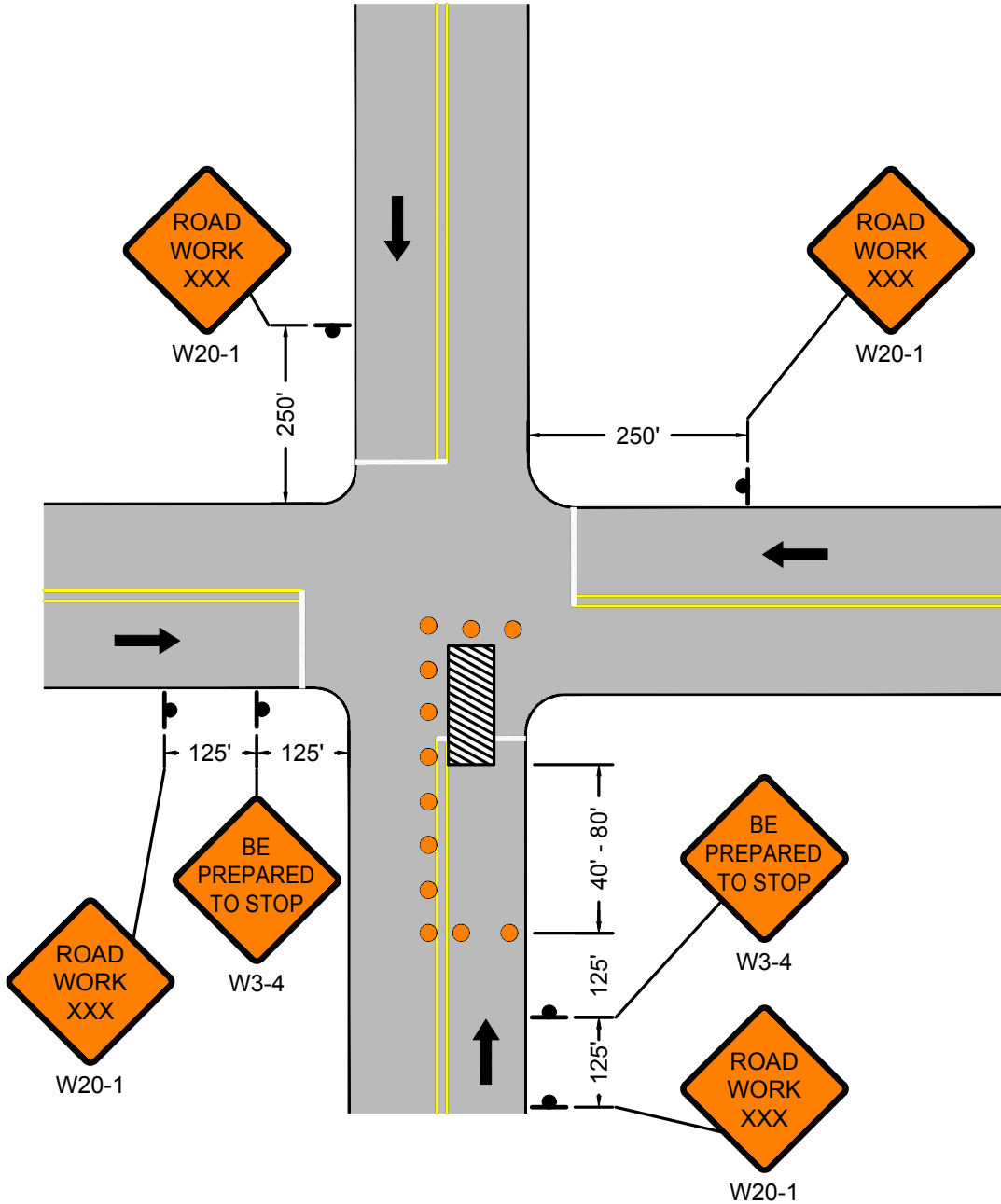






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Work Zone Safety  
Standard Details  
and Drawings

FIGURE 43  
TRAFFIC SIGNAL REPAIR WORK  
TWO LANE UNDIVIDED ROADWAY  
ONE LEG OF INTERSECTION



**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
- NOT TO SCALE

**NOTES**

1. DURATION OF WORK = 20 MINUTES OR LESS.
2. EQUIPMENT: 12 CONES + 6 PORTABLE SIGNS.
3. CONE SPACING IS 20 FEET.
4. SINGLE WORK VEHICLE PARKED/STOPPED.
5. POLICE DETAIL REQUIRED.

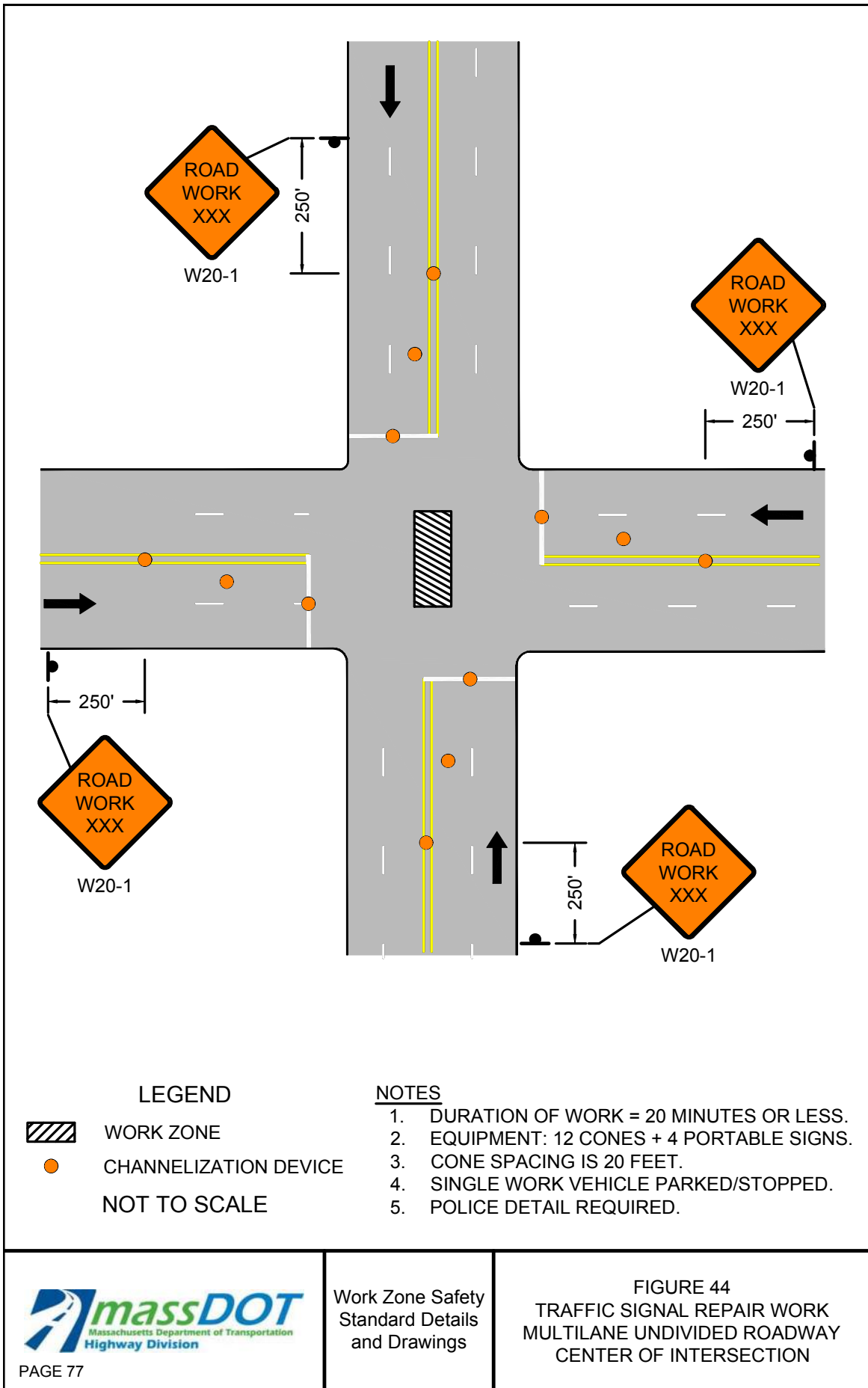
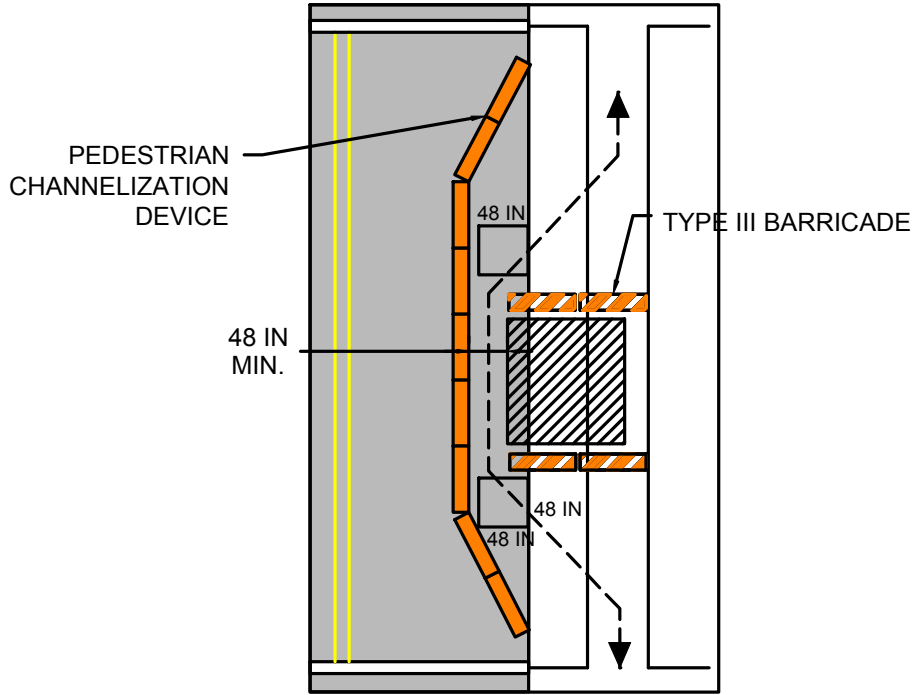




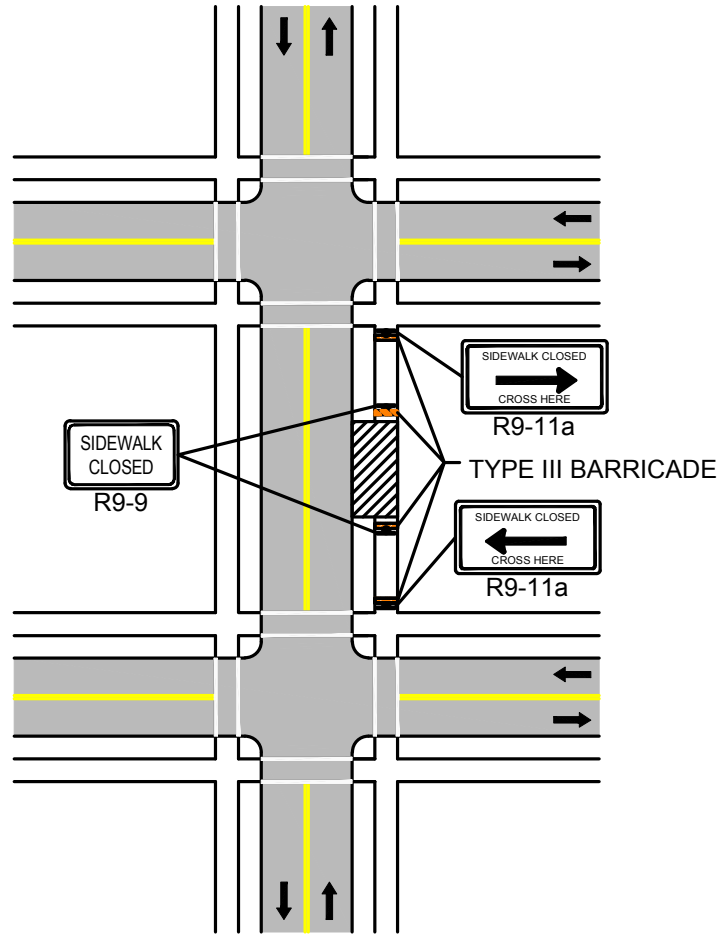
FIGURE 45  
PEDESTRIAN BYPASS



**NOTES:**

1. WHEN EXISTING PEDESTRIAN FACILITIES ARE DISRUPTED, CLOSED, OR RELOCATED IN A TTC ZONE, TEMPORARY FACILITIES SHALL BE PROVIDED AND THEY SHALL BE DETECTABLE AND INCLUDE ACCESSIBILITY FEATURES CONSISTENT WITH THE FEATURES PRESENT IN THE EXISTING PEDESTRIAN FACILITY.
2. A PEDESTRIAN CHANNELIZATION DEVICE THAT IS DETECTABLE BY A PERSON WITH A VISUAL DISABILITY TRAVELING WITH THE AID OF A LONG CANE SHALL BE PLACED ALONG THE FULL LENGTH OF THE TEMPORARY PEDESTRIAN ROUTE.
3. WHEN USED, TEMPORARY RAMPS SHALL COMPLY WITH AMERICANS WITH DISABILITIES ACT.
4. THE ALTERNATE PATHWAY SHOULD HAVE A SMOOTH CONTINUOUS HARD SURFACE FOR THE ENTIRE LENGTH OF THE TEMPORARY PEDESTRIAN FACILITY.
5. THE TEMPORARY SIDEWALK SHOULD BE A MINIMUM OF 4 FEET WIDE. IF THE SIDEWALK EXCEEDS 200 FEET THEN A 5 FOOT BY 5 FOOT PASSING ZONE SHALL BE PROVIDED NEAR THE MID-POINT OF THE CLOSURE.
6. THE PROTECTIVE REQUIREMENTS OF A TTC WORK ZONE MAY HAVE AN IMPACT IN DETERMINING THE NEED FOR TEMPORARY TRAFFIC BARRIERS AND THEIR USE IN PROVIDING PEDESTRIAN DELINEATION SHOULD BE BASED ON ENGINEERING JUDGMENT.
7. ON-DEMAND PEDESTRIAN ASSISTANCE PERSONNEL TO ASSIST WITH NAVIGATION AROUND THE CLOSURE/WORK AREA MAY BE CONSIDERED AS AN OPTION IN PLACE OF PROVIDING ADA/AAB DEVICES FOR WORK FOR CLOSURES LASTING 4 HOURS OR LESS.
8. CONTROLS ONLY FOR PEDESTRIAN TRAFFIC ARE SHOWN; VEHICULAR TRAFFIC SHOULD BE HANDLED AS SHOWN ELSEWHERE. THESE DETAILS ARE USED IN CONJUNCTION WITH THE PROPOSED LANE CLOSURE DETAILS AND DURING CONSTRUCTION STAGING, AS DETERMINED BY THE ENGINEER.





**NOTES:**

1. CLOSURE OF A SIDEWALK FACILITY SHALL CONSTITUTE THE PROVISION FOR MANAGING PEDESTRIAN TRAFFIC AND ACCOMMODATING ALL USERS. IF THE EXISTING PEDESTRIAN ACCESS ROUTE(S) CAN BE TEMPORARILY RELOCATED ALONG THE EXISTING SIDEWALK , AND SAID FACILITY PROVIDES A MINIMUM WIDTH OF 48-INCHES OF SOLID, SMOOTH UNOBSTRUCTED SURFACE, THEN NO DETOURING OF THE ROUTE SHALL BE REQUIRED. DELINEATION OF THE WORK AREA IS STILL REQUIRED.
2. IF IT IS NECESSARY TO DIVERT PEDESTRIAN TRAFFIC TO AN ALTERNATE ROUTE ACROSS THE ROADWAY FROM THE EXISTING FACILITY, THE FIGURE ABOVE SHALL BE FOLLOWED TO PROVIDE ADEQUATE DIRECTION TO PEDESTRIANS. ALTERNATE ROUTE SHALL PROVIDE THE SAME LEVEL OF ACCOMMODATION AS THE FACILITY THAT IS BEING DETOURED AND RETAIN ADA COMPLIANCE IN ITS ENTIRETY.
3. FOR EMERGENCY OR SHORT-DURATION SIDEWALK CLOSURES OF 4-HOURS OR LESS, IT IS OPTIONAL TO HAVE ON-DEMAND PEDESTRIAN ASSISTANCE PERSONNEL AVAILABLE AT ALL TIMES DURING THE CLOSURE TO ASSIST THOSE MOBILITY CHALLENGED PERSONS WHO REQUIRE ADDITIONAL ASSISTANCE TO SAFELY NAVIGATE AROUND THE WORK AREA IN LIEU OF A FULL DETOUR.





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Work Zone Safety  
Standard Details  
and Drawings

STATIONARY OPERATIONS  
BIKE LANE CLOSURE










POSTED SPEED LIMIT (MPH)	SPACING FOR BIKE ADVANCE WARNING SIGNS (FT) (A,B))	CHANNELIZATION DEVICES (DRUMS OR CONES)			
		TRANSITION LENGTH (L/3)	BUFFER ZONE LENGTH (FT)	DEVICE SPACING (FT)	MIN # OF DEVICES*
25-40	150 / 150	100	305	20	45
45-55	150 / 150	220	495	40	35
60-65	150 / 150	260	645	40	40

\* NUMBER OF DEVICES BASED ON 400 FT WORK ZONE.

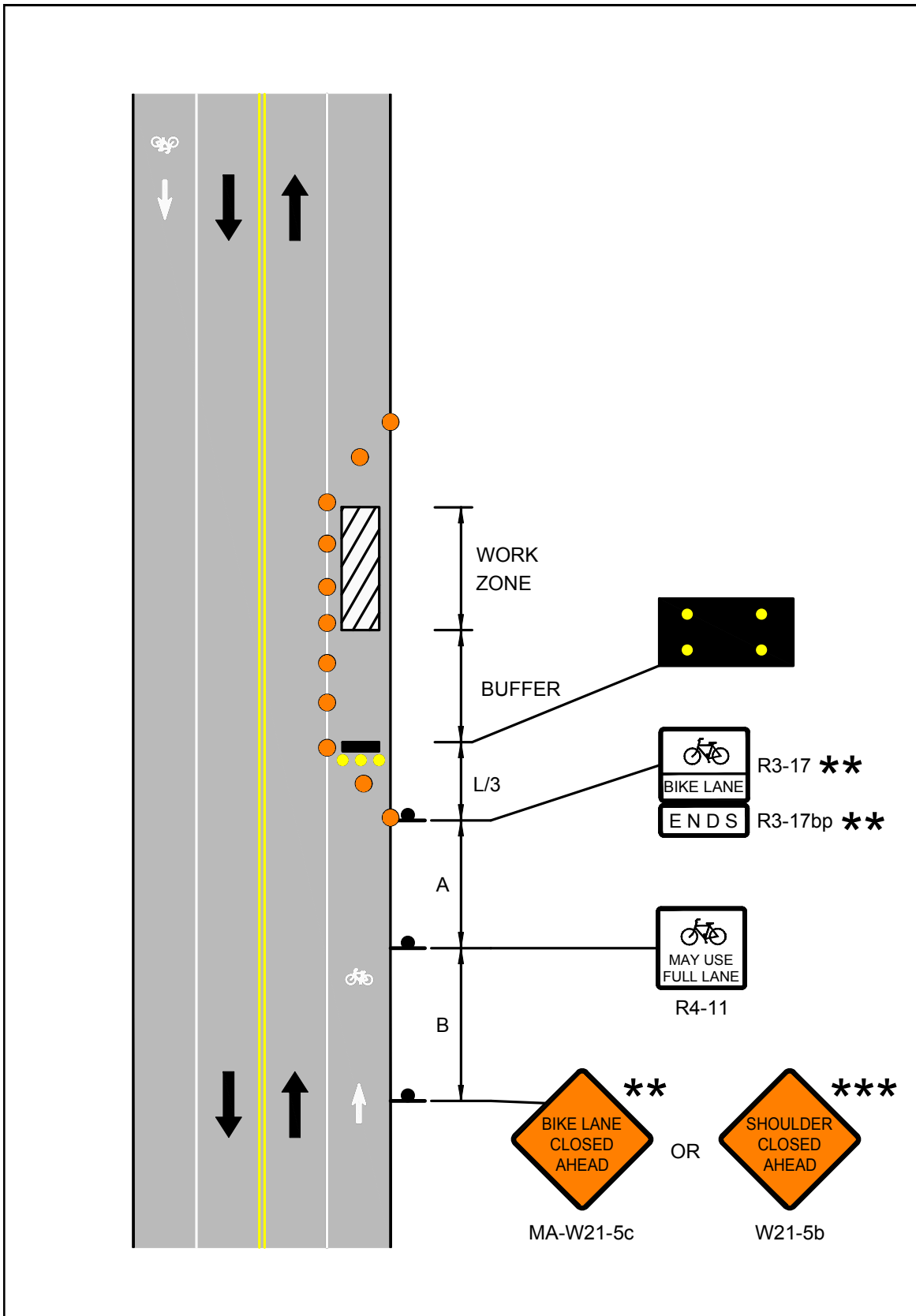
**NOTES**


1. DETAIL SHALL BE USED IN CONJUNCTION WITH THE PROPOSED LANE CLOSURE DETAILS. SIGNING SHOWN ONLY FOR BIKE TRAFFIC. FOLLOW ALL OTHER RELEVANT DETAILS FOR TTC DEVICES FOR VEHICULAR TRAFFIC.
2. **\*\*** SIGN SHALL BE USED ONLY IF THERE IS A MARKED BIKE LANE.
3. **\*\*\*** SIGN SHALL BE USED ONLY IF THERE IS NO MARKED BIKE LANE.

**LEGEND**

-  WORK ZONE
-  CHANNELIZATION DEVICE
-  FLASHING ARROW BOARD
-  PORTABLE CHANGEABLE MESSAGE SIGN
-  TRUCK MOUNTED ATTENUATOR
-  RADAR SPEED FEEDBACK BOARD
-  POLICE DETAIL OR UNIFORMED FLAGGER
-  TEMPORARY PORTABLE RUMBLE STRIP
-  TYPE III BARRICADE

NOT TO SCALE



 <p>Massachusetts Department of Transportation Highway Division</p> <p>PAGE 81</p>	<p>Work Zone Safety Standard Details and Drawings</p>	<p>FIGURE 48 STATIONARY OPERATIONS BIKE LANE CLOSURE</p>
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**Safety is everyone's business**

Rev. June, 2017

DOCUMENT A00820

**Massachusetts Department of Transportation  
Conditions of Custody**

REQUEST FOR RELEASE OF MASSDOT AUTOCAD FILES FORM  
(Only to be used following award of contract)

City/Town: WESTFORD Project File Number: 609035

Contract Number: 126590

Project Description: Rehabilitation of Boston Road

All AutoCAD files are provided solely as a courtesy to facilitate public access to information. MassDOT attempts to provide current and accurate information but cannot guarantee so. MassDOT provides such documents, files or other data "as is" without any warranty of any kind, either expressed or implied, including but not limited to, accuracy, reliability, omissions, completeness and currentness. The Commonwealth of Massachusetts and its Consultants shall not be liable for any claim for damages, including lost profits or other consequential, exemplary, incidental, indirect or special damages, relating in any way to the documents, files or other data accessible from this file, including, but not limited to, claims arising out of or related to electronic access or transmission of data or viruses. Because data stored on electronic media can deteriorate undetected or be modified without our knowledge, MassDOT cannot be held liable for its completeness or correctness. MassDOT makes no representation as to the compatibility of these files beyond the version of the stated CAD software.

By signing this form, I agree that it shall be my responsibility to reconcile this electronic data with the conformed contract documents, and that only the conformed contract documents shall be regarded as legal documents for this Project. I understand that this authorization does not give me the right to distribute the files. I agree to the terms above and wish to receive the AutoCAD files.

This signed form shall be emailed to the Highway Design Engineer at the MassDOT -Highway Division at the following email address:

[DOTHighwayDesign@dot.state.ma.us](mailto:DOTHighwayDesign@dot.state.ma.us)  
Attn: AutoCAD Files

Name of person requesting AutoCAD files: \_\_\_\_\_

Affiliation/Company: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone number: \_\_\_\_\_

Email address: \_\_\_\_\_

Signature/Date: \_\_\_\_\_

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DOCUMENT A00860

**MASSACHUSETTS**

**DEPARTMENT OF ENVIRONMENTAL PROTECTION**

**NOTICE OF INTENT**

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Notice of Intent

*MassDOT Project No. 609035*

---

***Roadway Improvement Project***  
***Boston Road,***  
***Westford, MA***

---

Prepared for: **Town of Westford**  
**Department of Public Works**  
28 North Street  
Westford, MA 01886



Prepared by: **TEC, Inc.**  
282 Merrimack Street  
2<sup>nd</sup> Floor  
Lawrence, MA 01843



---

**March 22, 2023**

## Notice of Intent (NOI) Application Checklist

X	Completed WPA Form 3 with all required signatures (attach additional pages if necessary)
X	Project narrative and any supporting documentation necessary to describe how the project meets all Performance Standards
X	Documentation of the methodology used to delineate the Bordering Vegetated Wetlands boundary and/or other wetland resource areas
X	Certified List of Abutters prepared by the Assessor's Office (≤ 3 months old)
X	Completed Notification to Abutters and Affidavit of Service forms
X	Completed and signed Third Party Billing Form authorizing legal advertising expenses
X	Copy of Town GIS Map, USGS quadrangle, or other map sufficiently displaying subject property and surrounding area
X	Plans depicting the proposed work and/or activity on the project site, and resource area boundaries. Plans shall be signed and stamped by a registered professional engineer, land surveyor or landscape architect as appropriate
X	Completed NOI Wetland Fee Transmittal Form <input type="checkbox"/> Copy of MassDEP Fee Submittal Form and payment made to the State (variable)
Exempt	Town Application fees (check or cash) <input type="checkbox"/> Filing fee (\$25)

**(2) Complete collated hard copy sets of all application materials are required including (2) full size copies of the plan, (8) 11 x 17 copies of the plan and a digital copy of complete application and plans emailed to [conservation@westfordma.gov](mailto:conservation@westfordma.gov). If the files are large, they may be submitted on a flash drive.**

- US Postal Service receipts (Certified Mail or Certificate of Mailing) of the mailed Notification to Abutters must be presented to the Commission prior to the opening of the public hearing.

## **TABLE OF CONTENTS**

---

WPA FORM 3

1 NARRATIVE

INTRODUCTION AND PURPOSE .....	1
EXISTING CONDITONS .....	1
PROPOSED IMPROVEMENTS .....	2
CONSTRUCTION SEQUENCE .....	4
MITIGATION.....	4
CONCLUSION .....	5

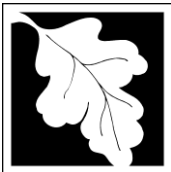
2 WETLAND DELINEATION REPORT

3 STORMWATER REPORT

4 SUPPORTING MAPS AND DATA

5 PHOTO LOG

6 ABUTTERS INFORMATION



**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands  
**WPA Form 3 – Notice of Intent**  
 Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

---

MassDEP File Number

---

Document Transaction Number

---

Westford

---

City/Town

**Important:**  
 When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



Note:  
 Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

**A. General Information**

1. Project Location (**Note:** electronic filers will click on button to locate project site):

<u>Boston Road</u> a. Street Address	<u>Westford</u> b. City/Town	<u>01886</u> c. Zip Code
Latitude and Longitude:		
<u>N/A - Roadway</u> f. Assessors Map/Plat Number	<u>N/A - Roadway</u> g. Parcel /Lot Number	<u></u> e. Longitude

2. Applicant:

<u>Paul</u> a. First Name	<u>Starratt</u> b. Last Name	
<u>Town of Westford Department of Public Works</u> c. Organization		
<u>28 North Street</u> d. Street Address		
<u>Westford</u> e. City/Town	<u>MA</u> f. State	<u>01886</u> g. Zip Code
<u>978-692-5520</u> h. Phone Number	<u>978-399-2739</u> i. Fax Number	<u>pstarratt@westfordma.gov</u> j. Email Address

3. Property owner (required if different from applicant):  Check if more than one owner

<u>Town of Westford &amp; MassDOT</u> a. First Name			<u></u> b. Last Name		
<u></u> c. Organization					
<u></u> d. Street Address					
<u></u> e. City/Town		<u></u> f. State		<u></u> g. Zip Code	
<u></u> h. Phone Number	<u></u> i. Fax Number	<u></u> j. Email address			

4. Representative (if any):

<u>Jonathan</u> a. First Name	<u>Rockwell</u> b. Last Name	
<u>TEC, Inc.</u> c. Company		
<u>282 Merrimack Street</u> d. Street Address		
<u>Lawrence</u> e. City/Town	<u>MA</u> f. State	<u>01843</u> g. Zip Code
<u>978-794-1792</u> h. Phone Number	<u></u> i. Fax Number	<u>jrockwell@theengineeringcorp.com</u> j. Email address

5. Total WPA Fee Paid (from NOI Wetland Fee Transmittal Form):

<u>Exempt</u> a. Total Fee Paid	<u>Exempt</u> b. State Fee Paid	<u>Exempt</u> c. City/Town Fee Paid
------------------------------------	------------------------------------	--



**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands

**WPA Form 3 – Notice of Intent**

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
MassDEP File Number
Document Transaction Number
Westford
City/Town

**A. General Information (continued)**

6. General Project Description:

The proposed project includes roadway widening, traffic signal modifications, new sidewalks, new drainage infrastructure, new water infrastructure, new stormwater basin, and new outlet sediment trap.

7a. Project Type Checklist: (Limited Project Types see Section A. 7b.)

- |   |   |
|---|---|
| 1. <input type="checkbox"/> Single Family Home                        | 2. <input type="checkbox"/> Residential Subdivision       |
| 3. <input type="checkbox"/> Commercial/Industrial                     | 4. <input type="checkbox"/> Dock/Pier                     |
| 5. <input type="checkbox"/> Utilities                                 | 6. <input type="checkbox"/> Coastal engineering Structure |
| 7. <input type="checkbox"/> Agriculture (e.g., cranberries, forestry) | 8. <input checked="" type="checkbox"/> Transportation     |
| 9. <input type="checkbox"/> Other                                     |   |

7b. Is any portion of the proposed activity eligible to be treated as a limited project (including Ecological Restoration Limited Project) subject to 310 CMR 10.24 (coastal) or 310 CMR 10.53 (inland)?

1.  Yes  No      If yes, describe which limited project applies to this project. (See 310 CMR 10.24 and 10.53 for a complete list and description of limited project types)

310 CMR 10.53(3)(f) "Maintenance and improvement of existing public roadways, but limited to widening less than a single lane, adding shoulders, correcting substandard intersections..."

If the proposed activity is eligible to be treated as an Ecological Restoration Limited Project (310 CMR10.24(8), 310 CMR 10.53(4)), complete and attach Appendix A: Ecological Restoration Limited Project Checklist and Signed Certification.

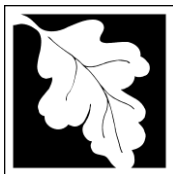
8. Property recorded at the Registry of Deeds for:

N/A	
a. County	b. Certificate # (if registered land)
c. Book	d. Page Number

**B. Buffer Zone & Resource Area Impacts (temporary & permanent)**

- Buffer Zone Only – Check if the project is located only in the Buffer Zone of a Bordering Vegetated Wetland, Inland Bank, or Coastal Resource Area.
- Inland Resource Areas (see 310 CMR 10.54-10.58; if not applicable, go to Section B.3, Coastal Resource Areas).

Check all that apply below. Attach narrative and any supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.



**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands

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Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

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MassDEP File Number

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Document Transaction Number

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Westford

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City/Town

**B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)**

For all projects affecting other Resource Areas, please attach a narrative explaining how the resource area was delineated.

<u>Resource Area</u>	<u>Size of Proposed Alteration</u>	<u>Proposed Replacement (if any)</u>
a. <input type="checkbox"/> Bank	1. linear feet _____	2. linear feet _____
b. <input type="checkbox"/> Bordering Vegetated Wetland	1. square feet _____	2. square feet _____
c. <input type="checkbox"/> Land Under Waterbodies and Waterways	1. square feet _____	2. square feet _____
	3. cubic yards dredged _____	

<u>Resource Area</u>	<u>Size of Proposed Alteration</u>	<u>Proposed Replacement (if any)</u>
d. <input type="checkbox"/> Bordering Land Subject to Flooding	1. square feet _____	2. square feet _____
	3. cubic feet of flood storage lost _____	4. cubic feet replaced _____
e. <input type="checkbox"/> Isolated Land Subject to Flooding	1. square feet _____	
	2. cubic feet of flood storage lost _____	3. cubic feet replaced _____
f. <input type="checkbox"/> Riverfront Area	1. Name of Waterway (if available) - <b>specify coastal or inland</b> _____	

2. Width of Riverfront Area (check one):

- 25 ft. - Designated Densely Developed Areas only
- 100 ft. - New agricultural projects only
- 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project: \_\_\_\_\_ square feet

4. Proposed alteration of the Riverfront Area:

a. total square feet \_\_\_\_\_ b. square feet within 100 ft. \_\_\_\_\_ c. square feet between 100 ft. and 200 ft. \_\_\_\_\_

5. Has an alternatives analysis been done and is it attached to this NOI?  Yes  No

6. Was the lot where the activity is proposed created prior to August 1, 1996?  Yes  No

3.  Coastal Resource Areas: (See 310 CMR 10.25-10.35)

**Note:** for coastal riverfront areas, please complete **Section B.2.f.** above.



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**B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)**

Check all that apply below. Attach narrative and supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

Online Users:  
 Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

<u>Resource Area</u>	<u>Size of Proposed Alteration</u>	<u>Proposed Replacement (if any)</u>
a. <input type="checkbox"/> Designated Port Areas	Indicate size under Land Under the Ocean, below	
b. <input type="checkbox"/> Land Under the Ocean	_____	
	1. square feet	
	_____	
	2. cubic yards dredged	
c. <input type="checkbox"/> Barrier Beach	Indicate size under Coastal Beaches and/or Coastal Dunes below	
d. <input type="checkbox"/> Coastal Beaches	_____	_____
	1. square feet	2. cubic yards beach nourishment
e. <input type="checkbox"/> Coastal Dunes	_____	_____
	1. square feet	2. cubic yards dune nourishment

	<u>Size of Proposed Alteration</u>	<u>Proposed Replacement (if any)</u>
f. <input type="checkbox"/> Coastal Banks	_____	
	1. linear feet	
g. <input type="checkbox"/> Rocky Intertidal Shores	_____	
	1. square feet	
h. <input type="checkbox"/> Salt Marshes	_____	_____
	1. square feet	2. sq ft restoration, rehab., creation
i. <input type="checkbox"/> Land Under Salt Ponds	_____	
	1. square feet	
	_____	
	2. cubic yards dredged	
j. <input type="checkbox"/> Land Containing Shellfish	_____	
	1. square feet	
k. <input type="checkbox"/> Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above	
	_____	
	1. cubic yards dredged	
l. <input type="checkbox"/> Land Subject to Coastal Storm Flowage	_____	
	1. square feet	

4.  Restoration/Enhancement  
 If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.2.b or B.3.h above, please enter the additional amount here.

\_\_\_\_\_

a. square feet of BVW

\_\_\_\_\_

b. square feet of Salt Marsh

5.  Project Involves Stream Crossings

\_\_\_\_\_

a. number of new stream crossings

\_\_\_\_\_

b. number of replacement stream crossings



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**C. Other Applicable Standards and Requirements**

- This is a proposal for an Ecological Restoration Limited Project. Skip Section C and complete Appendix A: Ecological Restoration Limited Project Checklists – Required Actions (310 CMR 10.11).

**Streamlined Massachusetts Endangered Species Act/Wetlands Protection Act Review**

- 1. Is any portion of the proposed project located in **Estimated Habitat of Rare Wildlife** as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP)? To view habitat maps, see the *Massachusetts Natural Heritage Atlas* or go to [http://maps.massgis.state.ma.us/PRI\\_EST\\_HAB/viewer.htm](http://maps.massgis.state.ma.us/PRI_EST_HAB/viewer.htm).

a.  Yes  No **If yes, include proof of mailing or hand delivery of NOI to:**

**Natural Heritage and Endangered Species Program**  
**Division of Fisheries and Wildlife**  
 1 Rabbit Hill Road  
 Westborough, MA 01581

10/24/2022  
 b. Date of map

If yes, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18). To qualify for a streamlined, 30-day, MESA/Wetlands Protection Act review, please complete Section C.1.c, and include requested materials with this Notice of Intent (NOI); *OR* complete Section C.2.f, if applicable. *If MESA supplemental information is not included with the NOI, by completing Section 1 of this form, the NHESP will require a separate MESA filing which may take up to 90 days to review (unless noted exceptions in Section 2 apply, see below).*

c. Submit Supplemental Information for Endangered Species Review\*

- 1.  Percentage/acreage of property to be altered:
  - (a) within wetland Resource Area \_\_\_\_\_ percentage/acreage
  - (b) outside Resource Area \_\_\_\_\_ percentage/acreage

2.  Assessor’s Map or right-of-way plan of site

- 2.  Project plans for entire project site, including wetland resource areas and areas outside of wetlands jurisdiction, showing existing and proposed conditions, existing and proposed tree/vegetation clearing line, and clearly demarcated limits of work \*\*
  - (a)  Project description (including description of impacts outside of wetland resource area & buffer zone)
  - (b)  Photographs representative of the site

\* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review (see <http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/>). Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.

\*\* MESA projects may not be segmented (321 CMR 10.16). The applicant must disclose full development plans even if such plans are not required as part of the Notice of Intent process.





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**C. Other Applicable Standards and Requirements (cont'd)**

(c)  MESA filing fee (fee information available at [http://www.mass.gov/dfwele/dfw/nhosp/regulatory\\_review/mesa/mesa\\_fee\\_schedule.htm](http://www.mass.gov/dfwele/dfw/nhosp/regulatory_review/mesa/mesa_fee_schedule.htm)).  
 Make check payable to “Commonwealth of Massachusetts - NHESP” and **mail to NHESP** at above address

*Projects altering 10 or more acres of land, also submit:*

(d)  Vegetation cover type map of site

(e)  Project plans showing Priority & Estimated Habitat boundaries

(f) OR Check One of the Following

1.  Project is exempt from MESA review.  
 Attach applicant letter indicating which MESA exemption applies. (See 321 CMR 10.14, [http://www.mass.gov/dfwele/dfw/nhosp/regulatory\\_review/mesa/mesa\\_exemptions.htm](http://www.mass.gov/dfwele/dfw/nhosp/regulatory_review/mesa/mesa_exemptions.htm); the NOI must still be sent to NHESP if the project is within estimated habitat pursuant to 310 CMR 10.37 and 10.59.)

2.  Separate MESA review ongoing. a. NHESP Tracking # \_\_\_\_\_ b. Date submitted to NHESP \_\_\_\_\_

3.  Separate MESA review completed.  
 Include copy of NHESP “no Take” determination or valid Conservation & Management Permit with approved plan.

3. For coastal projects only, is any portion of the proposed project located below the mean high water line or in a fish run?

a.  Not applicable – project is in inland resource area only      b.  Yes     No

If yes, include proof of mailing, hand delivery, or electronic delivery of NOI to either:

South Shore - Cohasset to Rhode Island border, and the Cape & Islands:

Division of Marine Fisheries -  
 Southeast Marine Fisheries Station  
 Attn: Environmental Reviewer  
 1213 Purchase Street – 3rd Floor  
 New Bedford, MA 02740-6694  
 Email: [DMF.EnvReview-South@state.ma.us](mailto:DMF.EnvReview-South@state.ma.us)

North Shore - Hull to New Hampshire border:

Division of Marine Fisheries -  
 North Shore Office  
 Attn: Environmental Reviewer  
 30 Emerson Avenue  
 Gloucester, MA 01930  
 Email: [DMF.EnvReview-North@state.ma.us](mailto:DMF.EnvReview-North@state.ma.us)

Also if yes, the project may require a Chapter 91 license. For coastal towns in the Northeast Region, please contact MassDEP’s Boston Office. For coastal towns in the Southeast Region, please contact MassDEP’s Southeast Regional Office.



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**Online Users:**  
 Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

**C. Other Applicable Standards and Requirements (cont'd)**

4. Is any portion of the proposed project within an Area of Critical Environmental Concern (ACEC)?  
 a.  Yes  No If yes, provide name of ACEC (see instructions to WPA Form 3 or MassDEP Website for ACEC locations). **Note:** electronic filers click on Website.  
 b. ACEC
5. Is any portion of the proposed project within an area designated as an Outstanding Resource Water (ORW) as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00?  
 a.  Yes  No
6. Is any portion of the site subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L. c. 131, § 40A) or the Coastal Wetlands Restriction Act (M.G.L. c. 130, § 105)?  
 a.  Yes  No
7. Is this project subject to provisions of the MassDEP Stormwater Management Standards?  
 a.  Yes. Attach a copy of the Stormwater Report as required by the Stormwater Management Standards per 310 CMR 10.05(6)(k)-(q) and check if:  
 1.  Applying for Low Impact Development (LID) site design credits (as described in Stormwater Management Handbook Vol. 2, Chapter 3)  
 2.  A portion of the site constitutes redevelopment  
 3.  Proprietary BMPs are included in the Stormwater Management System.  
 b.  No. Check why the project is exempt:  
 1.  Single-family house  
 2.  Emergency road repair  
 3.  Small Residential Subdivision (less than or equal to 4 single-family houses or less than or equal to 4 units in multi-family housing project) with no discharge to Critical Areas.

**D. Additional Information**

- This is a proposal for an Ecological Restoration Limited Project. Skip Section D and complete Appendix A: Ecological Restoration Notice of Intent – Minimum Required Documents (310 CMR 10.12).

Applicants must include the following with this Notice of Intent (NOI). See instructions for details.

**Online Users:** Attach the document transaction number (provided on your receipt page) for any of the following information you submit to the Department.

1.  USGS or other map of the area (along with a narrative description, if necessary) containing sufficient information for the Conservation Commission and the Department to locate the site. (Electronic filers may omit this item.)
2.  Plans identifying the location of proposed activities (including activities proposed to serve as a Bordering Vegetated Wetland [BVW] replication area or other mitigating measure) relative to the boundaries of each affected resource area.



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**D. Additional Information (cont'd)**

3.  Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s), Determination of Applicability, Order of Resource Area Delineation, etc.), and attach documentation of the methodology.

4.  List the titles and dates for all plans and other materials submitted with this NOI.

Reconstruction of Boston Road NOI Submittal

a. Plan Title

TEC, Inc.

Jonathan A. Rockwell, P.E.

b. Prepared By

c. Signed and Stamped by

March 22, 2023

1" = 20'

d. Final Revision Date

e. Scale

f. Additional Plan or Document Title

g. Date

5.  If there is more than one property owner, please attach a list of these property owners not listed on this form.

6.  Attach proof of mailing for Natural Heritage and Endangered Species Program, if needed.

7.  Attach proof of mailing for Massachusetts Division of Marine Fisheries, if needed.

8.  Attach NOI Wetland Fee Transmittal Form

9.  Attach Stormwater Report, if needed.

**E. Fees**

1.  Fee Exempt: No filing fee shall be assessed for projects of any city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority, municipal housing authority, or the Massachusetts Bay Transportation Authority.

Applicants must submit the following information (in addition to pages 1 and 2 of the NOI Wetland Fee Transmittal Form) to confirm fee payment:

2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payor name on check: First Name

7. Payor name on check: Last Name



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**F. Signatures and Submittal Requirements**

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

1. Signature of Applicant		3-21-2023	2. Date
3. Signature of Property Owner (if different)		3/21/2023	4. Date
5. Signature of Representative (if any)			6. Date

**For Conservation Commission:**

Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

**For MassDEP:**

One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a **copy** of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

**Other:**

If the applicant has checked the “yes” box in any part of Section C, Item 3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.



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**NOI Wetland Fee Transmittal Form**  
 Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



**A. Applicant Information**

1. Location of Project:

<u>Boston Road</u>	<u>Westford</u>
a. Street Address	b. City/Town
<u>Exempt</u>	<u>Exempt</u>
c. Check number	d. Fee amount

2. Applicant Mailing Address:

<u>Paul</u>	<u>Starratt</u>	
a. First Name	b. Last Name	
<u>Town of Westford</u>		
c. Organization		
<u>28 North Street</u>		
d. Mailing Address		
<u>Westford</u>	<u>MA</u>	<u>01886</u>
e. City/Town	f. State	g. Zip Code
<u>978-692-5520</u>	<u>978-399-2739</u>	<u>pstarratt@westfordma.gov</u>
h. Phone Number	i. Fax Number	j. Email Address

3. Property Owner (if different):

<u>See attachment</u>		
a. First Name	b. Last Name	
<u></u>		
c. Organization		
<u></u>		
d. Mailing Address		
<u></u>	<u></u>	<u></u>
e. City/Town	f. State	g. Zip Code
<u></u>	<u></u>	<u></u>
h. Phone Number	i. Fax Number	j. Email Address

To calculate filing fees, refer to the category fee list and examples in the instructions for filling out WPA Form 3 (Notice of Intent).

**B. Fees**

Fee should be calculated using the following process & worksheet. **Please see Instructions before filling out worksheet.**

**Step 1/Type of Activity:** Describe each type of activity that will occur in wetland resource area and buffer zone.

**Step 2/Number of Activities:** Identify the number of each type of activity.

**Step 3/Individual Activity Fee:** Identify each activity fee from the six project categories listed in the instructions.

**Step 4/Subtotal Activity Fee:** Multiply the number of activities (identified in Step 2) times the fee per category (identified in Step 3) to reach a subtotal fee amount. Note: If any of these activities are in a Riverfront Area in addition to another Resource Area or the Buffer Zone, the fee per activity should be multiplied by 1.5 and then added to the subtotal amount.

**Step 5/Total Project Fee:** Determine the total project fee by adding the subtotal amounts from Step 4.

**Step 6/Fee Payments:** To calculate the state share of the fee, divide the total fee in half and subtract \$12.50. To calculate the city/town share of the fee, divide the total fee in half and add \$12.50.



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**B. Fees** (continued)

Step 1/Type of Activity	Step 2/Number of Activities	Step 3/Individual Activity Fee	Step 4/Subtotal Activity Fee
Roadway Reconstruction	1	Exempt	Exempt
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
<b>Step 5/Total Project Fee:</b>			Exempt
<b>Step 6/Fee Payments:</b>			
Total Project Fee:			Exempt
			a. Total Fee from Step 5
State share of filing Fee:			b. 1/2 Total Fee <b>less</b> \$12.50
City/Town share of filing Fee:			c. 1/2 Total Fee <b>plus</b> \$12.50

**C. Submittal Requirements**

- a.) Complete pages 1 and 2 and send with a check or money order for the state share of the fee, payable to the Commonwealth of Massachusetts.

Department of Environmental Protection  
 Box 4062  
 Boston, MA 02211

- b.) **To the Conservation Commission:** Send the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and the city/town fee payment.

**To MassDEP Regional Office** (see Instructions): Send a copy of the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and a **copy** of the state fee payment. (E-filers of Notices of Intent may submit these electronically.)

Property Owners:

Naga Venkata Lakshmi, Sandeep Inampudi & Pallavi Doradla

1 Crown Road

Westford, MA 01886

Book-Page 35945-125

Parcel ID – Map 021 Parcel 0114 Lot 0000

Peter L Pozerski & Jessica L Pozerski

44 Boston Road

Westford, MA 01886

Book-Page 31062-275

Parcel ID – Map 021 Parcel 0115 Lot 0000

Inhabitants of the Town of Westford

Boston Road

Westford, MA 01886

Book-Page 4446-228

Parcel ID – Map 022 Parcel 0117 Lot 0001

Inhabitants of the Town of Westford

Boston Road

Westford, MA 01886

Book-Page 4446-228

Parcel ID – Map 022 Parcel 0117 Lot 0002

Town of Westford

Boston Road

Westford, MA 01886

Book-Page 5117-304

Parcel ID – Map 022 Parcel 0117 Lot 0304

# **1 NARRATIVE**

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## **INTRODUCTION AND PURPOSE**

The Town of Westford, in conjunction with Massachusetts Department of Transportation, is proposing vehicular, bicycle, and pedestrian safety improvements along Boston Road from Main Street to the on-ramps to Interstate 495 Southbound. In addition to improving safety for users within the project area, there are proposed utility upgrades as well as stormwater BMP's to create a more efficient drainage system. Improvements include roadway resurfacing, full- depth roadway reconstruction and widening, sidewalk construction, granite curb. Upgrades to the utilities consist of a sediment forebay, constructed wet detention basin, deep sump catch basins with hoods, and replacement of the existing water line along Boston Road.

The project is proposed to be funded and constructed by MassDOT with the Town of Westford funding the design, permitting and right-of-way acquisition. The purpose of this project is to provide necessary upgrades to the Boston Road corridor in order to improve upon existing drainage and stormwater conditions, vehicular traffic and pedestrian safety deficiencies and encourage more bicycling and walking through the introduction of 5-foot bicycle lanes and 5.5-foot wide sidewalks with granite curbing.

## **EXISTING CONDITIONS**

### **ROADWAY CONDITIONS**

Boston Road is a two lane north-south paved roadway approximately 30 feet wide. The existing cross section of the roadway contains various stretches of vertical granite curb, concrete or bituminous curb or areas of no curb. The roadway is classified as an urban principal arterial under the jurisdiction of the Town of Westford from Main Street to approximately 400' south of Crown Road, and under jurisdiction of MassDOT from that point to the interchange with I-495.

### **DRAINAGE CONDITIONS**

There is an existing closed drainage system along Main Street beginning west of the intersection and continuing northeast on Main Street outside of project limits. Along Boston Road there is an existing closed drainage system which begins at the northeast end of Hildreth Street and continues across Boston Road. Sections of pipe in this system are assumed and labeled in the plans as such. A larger closed drainage system along Boston Road covers a little less than a half mile of roadway beginning southeast of Hildreth Street and flowing southeast until an outlet is reached at the existing wetlands/intermittent stream delineated by wetland flags E1-E6 south of Crown Road. Continuing southeast, a separate closed drainage system approximately 170 feet from the previous drainage outlet which flows into the resource area. This system continues approximately 750' until it is directed to outlet to an open field on the property of 50 Boston Road. The existing system is typically basin-to-basin connections.



West of Blakes Hill Road, there is an existing closed drainage system covering the north end of Blakes Hill Road continuing into the Westford Fire Department property and connecting with multiple basins on Boston Road which ultimately flows to a large wetland resource area north of the corridor.

According to the Natural Resource Conservation Service (NRCS), the site is comprised mostly of Paxton Fine Sandy Loam and Woodbridge Fine Sandy Loam type soils. Hydrologic soil group B, C & D has been utilized for the hydrology calculations based on these soil types.

## **RESOURCE AREAS**

Resource areas on or adjacent to the project site were delineated and flagged by Rimmer Environmental Consulting, LLC in October 2018. Please see the attached Wetland Delineation Report and DEP BVW Delineation Field Forms.

Onsite resource areas delineated by Rimmer Environmental Consulting LLC were Bordering Vegetated Wetlands (BVW) along three areas of the project and an intermittent stream between 44 Boston Road and 1 Crown Road.

Two of the three BVW areas which were delineated will be indirectly impacted by the proposed project. In the area between 1 Crown Road and 44 Boston Road there is a small BVW adjacent to the existing intermittent stream which brings stormwater runoff down the hill from Blake's Hill Road and under Boston Road to this wetland area and was delineated by wetland flags E1 – E6.

Within the town-owned land with access between 66 and 70 Boston Road, there are two separate BVW's which are delineated by wetland flags A1 – A14 and B1 – B7, respectively.

## **PROPOSED IMPROVEMENTS**

The proposed project includes full-depth pavement reconstruction as well as mill and overlay with the installation of granite curbing, new ADA compliant sidewalks and pedestrian curb ramps, and upgrades to the drainage and stormwater management system. The proposed cross section will be typically slightly widened to 32 feet along with introducing flush traffic calming median islands which will widen the road to 38 feet at key locations to promote slower speeds. There are also horizontal geometric improvements to the roadway for safety. Typical normal crown cross slopes are 2% however, the cross slope of the bike lane was increased to 3% in areas of potential roadway flooding.

Additionally, the existing water main, which ranges between 4" and 12" within Boston Road will be either abandoned or removed and replaced with a 12" CLDI water main within the proposed roadway.

The existing drainage system is currently undersized and not adequate to support the existing conditions today nor the increased stormwater flow through the proposed widening. Upgrades must be made to sufficiently accommodate the stormwater runoff for Boston Road and ensure proper drainage. Improvements include upgrading the existing drainage trunk, the addition of manholes at lateral drain lines connecting to the trunk line, the addition of deep sump catch basins with hoods that will discharge either to the proposed wet detention basin before

discharging into the nearby wetlands via an outlet control structure or in the case between Main Street and Crown Road during low flow periods to an outlet sediment trap between 1 Crown Road and 44 Boston Road.

The outlet sediment trap will be constructed on privately-owned land at 1 Crown Road adjacent to the driveway of 44 Boston Road. A permanent drainage easement will be obtained by the Town prior to the start of construction. The outlet sediment trap will consist of a 24" HDPE pipe which will daylight with a flared end section along with a riprap apron for energy dissipation before entering the sediment trap. The sediment trap paving will consist of granite curbing or edging stacked flat to provide a level protective surface over a compacted gravel borrow foundation and geotextile fabric to facilitate in maintenance of the pretreatment outlet trap. A riprap spillway the full length of the sediment trap adjacent to the wetland will convey treated stormwater into the nearby wetlands/intermittent stream.

The wet detention basin will be constructed on town-owned land behind #66 and #70 Boston Road with an access road to the basin constructed between these properties. The wet detention basin will consist of clearing the existing vegetation and re-grading the existing topography to construct a wet detention basin between elevation 247 and elevation 250 along with an adjacent sediment forebay and riprap spillway with a 1-foot wide top at elevation 254.0. The resulting wet basin will have a volume of approximately 30,000 CF. A four-foot by four-foot outlet control structure will be installed, with an 18-inch tall by 18-inch wide at elevation 250.0 for low flow events and a 17-inch high by 12-inch wide primary orifice at elevation 252.65. The structure will then outlet via a 30" RCP pipe. A 20-foot wide by 25-foot long emergency riprap spillway will be constructed at the top of the basin at elevation 257.5 to provide an outlet in case of overflow of the outlet control structure. A fifteen-foot wide level bench will be provided at the top of the basin to provide access for maintenance.

With the design as proposed, there are no areas of permanent impacts to the BVW. All temporary impacts to the BVW 100-foot buffer area adjacent to Crown Road will be fully restored once construction is completed. The total area of temporary impacts to the 100-foot buffer zone to BVW adjacent to 1 Crown Road and 44 Boston Road is 18,540 square feet (sf). The total area of temporary impacts to the 100-foot buffer zone to BVW's adjacent to 66 and 70 Boston Road is 29,015 square feet (sf).

This project qualifies as a limited project under 310 CMR 10.53(3)(f) of the Wetlands Protection Act. This regulation grants limited project status to projects that propose "maintenance and improvement of existing public roadways, but limited to widening less than a single lane, adding shoulders, correcting substandard intersections, and improving inadequate drainage systems."

## **CONSTRUCTION SEQUENCE**

The following sequence is typical of roadway construction; however, this may be modified based on any special conditions contained within the final Order of Conditions.

1. Obtain/record Order of Conditions from Conservation Commission (ConCom).
2. Conduct pre-construction meeting with CONCOM agent, the Engineer, and the Town.
3. Install erosion control barriers consisting of 12-inch compost filter tube along the limit of the existing wetland boundary and silt sacks in existing catch basins as indicated on the project highway plans. All erosion control barriers will be approved by a ConCom agent.
4. Perform general site prep including clearing and grubbing for new roadway widening and installation of all required temporary construction signage.
5. Perform excavation for drainage infrastructure, utility lines, curbing and incremental removal of existing roadway layers.
6. Construct wet detention basin and sediment forebay.
7. Install proposed drainage structures and proposed utility lines.
8. Perform full depth pavement and install curbing as indicated on the highway plans.
9. Repair/install removed or damaged sections of landscaped areas with loam and seed.
10. Install permanent traffic signs and pavement markings.
11. Perform final inspection and address punch list items.
12. Request final acceptance by the Town.
13. Request and obtain Certificate of Compliance from ConCom.
14. Remove erosion control barriers and silt sacks.

## **MITIGATION**

Prior to construction, erosion control and sedimentation barriers will be installed between the project area and the wetlands as well as the project area and surrounding properties to establish a limit-of-work. See attached construction plans for the location and detail of the sediment control barriers as well as 100-foot and 50-foot wetland buffer zones. Sediment control barriers will not be removed until site is completely stabilized. Additionally, silt sacks will be placed in all existing and proposed catch basins within the limits of work to intercept construction sediments if deemed necessary by the Contractor.

There is no wetland replication required for this project due to there being no need for permanent wetland impacts with the design proposed. It was the intention of the design engineer to avoid impacts to the wetlands as much as possible throughout the project area. The sediment control barrier is a temporary measure and will be removed after construction.

According to the Town of Westford Planning Board Stormwater Management Regulations, Section 7.0.D.a, Performance Standards for Redevelopment Sites, "stormwater management systems on redeveloped sites shall be design to meet an average pollutant removal equivalent to 80% of the average annual postconstruction load of Total Suspended Solids (TSS) and 50% of the average annual load of Total Phosphorus (TP) related to the total post-construction impervious surface area on site". However, Section 7.0.D.b states that "...redevelopment activities that are exclusively limited to maintenance and improvement of existing roadways (including widening less than a single lane, adding shoulders, correction substandard intersections, improving existing drainage systems and repaving projects) shall improve existing conditions where feasible and are exempt from Section 7.D.a and may be exempt from Massachusetts Stormwater Standards 1, 2, 3, 4, and 6". It is TEC's understanding that this project would be considered a "limited project" and thus does not need to meet the above criteria.

The project will provide a drastic improvement to the stormwater drainage conditions by implementing an outlet sediment trap for low-flow periods and a new wet detention basin to improve upon peak flow existing conditions. The work proposed has been designed to comply with the stormwater standards to the maximum extent possible. Refer to the stormwater report for additional information on the standards being met.

## **CONCLUSION**

The proposed work includes multiple drainage system upgrades. These upgrades are to help improve the existing stormwater flow more efficiently throughout Boston Road and the surrounding area. The proposed improvements are intended to mediate the increased impervious area created with sections of roadway widening and sidewalk construction.

These proposed elements include a new drainage trunkline and removal of the existing basin-to-basin connections, construction of an outlet sediment trap adjacent to the intermittent stream adjacent to 44 Boston Road and 1 Crown Road, and construction of a new detention basin to manage both stormwater quantity and quality of the stormwater before releasing into the existing wetland.

The Applicant requests that the Conservation Commission find that the project as described in this Notice of Intent application successfully upholds the interest of the Wetlands Protection Act and local bylaws, and subsequently issues an Order of Conditions for the proposed project.

## **2 WETLAND DELINEATION REPORT**

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**Wetland Resource Delineation Report  
Boston Road Improvements  
Westford, MA  
November 20, 2018**

The project site is the location of proposed road improvements on Boston Road from the intersection with Main Street extending east approximately 1 mile to the Route 495 interchange in addition to areas on the east side of Boston Road proposed for potential stormwater management facilities. The project area is approximated on the site locus provided as Figure 1 below.

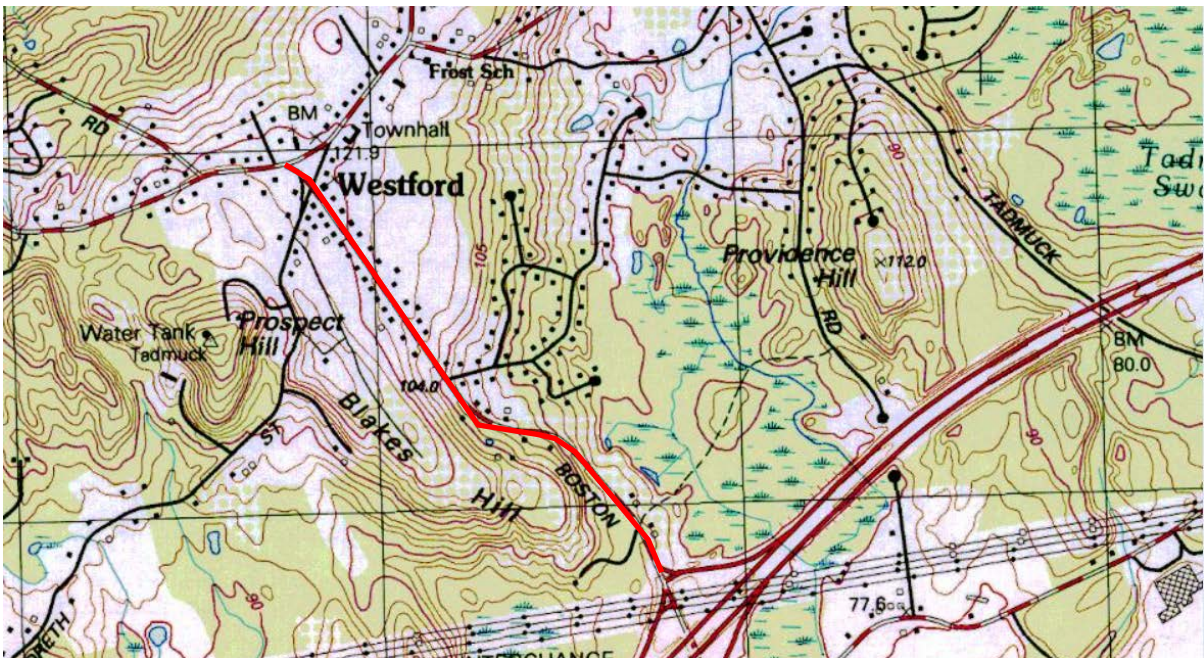


Fig. 1: USGS Site Locus

Rimmer Environmental Consulting (REC) conducted a field inspection of the project area on October 24, 2018. At that time, wetland resources subject to jurisdiction under the Massachusetts Wetlands Protection Act (MGL Ch 131 §. 40) and the Town of Westford Wetlands Protection Bylaw within the project area were identified. Wetlands were delineated in accordance with the procedures established in the Mass. Wetlands Protection Act Regulations (310 CMR 10.00) and the Westford Wetlands Bylaw Regulations. Numbered sequences of flags were placed in the field to delineate the boundary between upland and wetland resources. The presence of 50% or more wetland plant species as well as other indicators of hydrology

including hydric soil was used to establish the wetland boundary. DEP Bordering Vegetated Wetland Delineation Field Forms were completed within each wetland system and are attached to provide additional documentation of the wetland boundary.

The following wetland resource areas were determined to be present within the project area:

*Wetland A – Bordering Vegetated Wetland Behind 70 Boston Road*

Wetland flags A1-A14 delineate the limits of a forested swamp and freshwater marsh behind 70 Boston Road. This wetland is well defined by changes in topography. Its border consists of mostly red maple (*Acer rubrum*), glossy buckthorn (*Frangula alnus*), and highbush blueberry (*Vaccinium corymbosum*). The adjacent upland is a mixed forest of red oak (*Quercus rubra*), black cherry (*Prunus serotina*) and red maple. The interior of the wetland consists of a freshwater marsh dominated by broadleaf cattail (*Typha latifolia*). This wetland is jurisdictional under both state and local wetland regulations and contains a 100-foot Buffer Zone extending from the flagged boundary.

*Wetland B – Bordering Vegetated Wetland Behind 66 Boston Road*

This wetland was delineated by flags B1-B7 and identifies the boundaries of a very dense scrub shrub swamp bordering a field to the west and the cattail marsh to the east. This wetland connects off site to the A-series wetland described above. It includes glossy buckthorn as well as winterberry (*Ilex verticillata*), and elderberry (*Sambucus canadensis*) with spotted jewelweed (*Impatiens capensis*) common as groundcover. The adjacent upland contains a band of upland forest dominated by cottonwood (*Populus deltoides*), black cherry and glossy buckthorn between the field edge and the wetland edge. The A and B series are hydrologically connected by an unnamed intermittent stream off-site to the east. This wetland is jurisdictional under both state and local wetland regulations and contains a 100-foot Buffer Zone extending from the flagged boundary.

*Wetland C – Bordering Vegetated Wetland Behind 66 Boston Road and 0 Boston Road*

Flags C1-C30 delineate an additional section of the A/B wetland described above. It extends from the rear of 66 Boston Road northwest along the edge of a farm field and contains a vegetative community similar to the wetlands described above. The wetland occurs along a clear break in slope and was partially ponded at the time of observation. This wetland is jurisdictional under both state and local wetland regulations and contains a 100-foot Buffer Zone extending from the flagged boundary.

*Wetland E – Intermittent Stream between 44 Boston Road and 1 Crown Road*

Flags E1-E3 and E4-E6 delineate the north and south banks to a drainage channel which conveys stormwater runoff from Boston Road into a culvert located just south of Crown Road. The channel continues eastward towards Kings Pine Road and eventually toward Wetland C described above. There is no associated vegetated wetland extending from the banks of this channel. Because the channel originates at Boston Road and does not derive from another wetland resource, it is considered an upgradient non-jurisdictional

stream under the Mass. Wetlands Protection Act. However, it is considered to be jurisdictional under the Westford Wetlands Protection Bylaw and contains a 100-foot Buffer Zone extending from its flagged banks.

*Bordering Land Subject to Flooding (BLSF)*

FEMA indicates portions of Wetland A described above are within mapped 100-year floodplain as indicated in Figure 2 below. There is no elevation provided, however the portion of the floodplain which extends beyond the limits of the delineated BVW is regulated as BLSF under state and local wetland regulations. In addition, the local bylaw includes a 100-foot Buffer Zone to BLSF.



Fig. 2: FEMA Flood Map

*Other Resources*

The project site is not within Priority Habitat and Estimated Habitat of Rare Wetlands Wildlife and there are no certified vernal pools as determined by reference to the most recently available data from the Massachusetts Division of Fisheries and Wildlife – Natural Heritage and Endangered Species Program available on MassGIS.



## DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant: Town of Westford Prepared by: Rimmer Environmental Project location: Boston Rd, Westford DEP File #: \_\_\_\_\_

Check all that apply:

- Vegetation alone presumed adequate BVW boundary: fill out section I only
- Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out sections I and II
- Method other than dominance test used (attach additional information)

**Section I. Vegetation:** Observation plot Number: wet Transect number: A13 Date of delineation: 10/24/18

A. Sample layer and plant species (by common name/scientific name)	B. Percent cover (or basal area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Canopy				
red maple/Acer rubrum	63	100	Y	FAC*
Shrub				
highbush blueberry/Vaccinium corymbosum	20.5	66	Y	FACW*
glossy buckthorn/Frangula alnus	10.5	33	Y	FAC*
Herb				
cinnamon fern/Osmunda cinnamomea	10.5	50	Y	FACW*
tussock sedge/Carex stricta	10.5	50	Y	FACW*

Use an asterisk to mark wetland indicator plants: species listed in the Wetlands Protection Act (MGL c. 131, s. 40); plants in the genus *Sphagnum*; plants listed as FAC, FAC+, FAC-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.

**Vegetation conclusion:**  
**Number of dominant wetland indicator plants: 5** **Number of dominant non-wetland plants: 0**  
**Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants?**  yes  no

*If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent*

## Section II. Indicators of Hydrology

### Hydric Soil Interpretation

#### 1. Soil Survey

Is there a published soil survey for this site? Yes

Title/date: Web Soil Survey  
 Map number:  
 Soil type mapped: Swansea 51A  
 Hydric soil inclusions: NA

Are field observations consistent with soil survey? yes no  
 Remarks:

#### 2. Soil description

Horizon	Depth	Matrix Color	Mottles Color
O	0-18"	10YR 2/1	

Remarks

3. Other histosol

Conclusion: Is soil hydric?  yes  no

Other Indicators of Hydrology: (check all that apply and describe)

- Site inundated: \_\_\_\_\_
- Depth to free water in observation hole: \_\_\_\_\_
- Water marks: \_\_\_\_\_
- Drift lines: \_\_\_\_\_
- Sediment deposits: \_\_\_\_\_
- Drainage patterns in BVW: \_\_\_\_\_
- Oxidized rhizospheres: \_\_\_\_\_
- Water-stained leaves: \_\_\_\_\_
- Recorded data(stream, lake, or tidal gauge; aerial photo, other): \_\_\_\_\_
- Other: \_\_\_\_\_

### Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants $\geq$ number of non-wetland indicator plants:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Wetland hydrology present: Hydric soil present	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Other indicators of hydrology present:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sample location is in a BVW	<input checked="" type="checkbox"/>	<input type="checkbox"/>

## DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant: Town of Westford Prepared by: Rimmer Environmental Project location: Boston Rd, Westford DEP File #: \_\_\_\_\_

Check all that apply:

- Vegetation alone presumed adequate BVW boundary: fill out section I only
- Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out sections I and II
- Method other than dominance test used (attach additional information)

**Section I. Vegetation:** Observation plot Number: upl Transect number: A13 Date of delineation: 10/24/18

A. Sample layer and plant species (by common name/scientific name)	B. Percent cover (or basal area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Canopy				
red oak/ <i>Quercus rubra</i>	63	75	Y	FACU
red maple/ <i>Acer rubrum</i>	20.5	25	Y	FAC*
shrub				
black cherry/ <i>Prunus serotina</i>	10.5	100	Y	FACU
Ground cover	-	-0	-	-

Use an asterisk to mark wetland indicator plants: species listed in the Wetlands Protection Act (MGL c. 131, s. 40); plants in the genus *Sphagnum*; plants listed as FAC, FAC+, FAC-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.

**Vegetation conclusion:**  
**Number of dominant wetland indicator plants: 1** **Number of dominant non-wetland plants: 2**  
**Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants?**  yes  no

*If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent*

## Section II. Indicators of Hydrology

### Hydric Soil Interpretation

#### 1. Soil Survey

Is there a published soil survey for this site? Yes

Title/date: Web Soil Survey Middlesex County  
 Map number: NA  
 Soil type mapped: Woodbridge 310B  
 Hydric soil inclusions: Whitman, Ridgebury

Are field observations consistent with soil survey? yes no  
 Remarks:

#### 2. Soil description

Horizon	Depth	Matrix Color	Mottles Color
A	0-4"	10YR 2/2	
B	4-15"	10YR 4/6	

Remarks

3. Other refusal 15"

Conclusion: Is soil hydric?  yes  no

### Other Indicators of Hydrology: (check all that apply and describe)

- Site inundated: \_\_\_\_\_
- Depth to free water in observation hole: \_ \_\_\_\_\_
- Water marks: \_\_\_\_\_
- Drift lines: \_\_\_\_\_
- Sediment deposits: \_\_\_\_\_
- Drainage patterns in BVW: \_\_\_\_\_
- Oxidized rhizospheres: \_\_\_\_\_
- Water-stained leaves: \_\_\_\_\_
- Recorded data(stream, lake, or tidal gauge; aerial photo, other):\_\_
- Other: \_\_\_\_\_

### Vegetation and Hydrology Conclusion

	Yes	No
<b>Number of wetland indicator plants</b> <b>≥ number of non-wetland indicator plants:</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Wetland hydrology present:</b> <b>Hydric soil present</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Other indicators of hydrology present:</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Sample location is in a BVW</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

## DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant: Town of Westford Prepared by: Rimmer Environmental Project location: Boston Rd, Westford DEP File #: \_\_\_\_\_

Check all that apply:

- Vegetation alone presumed adequate BVW boundary: fill out section I only
- Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out sections I and II
- Method other than dominance test used (attach additional information)

**Section I. Vegetation:** Observation plot Number: wet Transect number: B4 Date of delineation: 10/24/18

A. Sample layer and plant species (by common name/scientific name)	B. Percent cover (or basal area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Canopy	-	-0	-	-
Shrub				
winterberry/Ilex verticillata	20.5	40	Y	FACW*
glossy buckthorn/Frangula alnus	20.5	40	Y	FAC*
elderberry/Sambucas canadensis	10.5	20	Y	FACW*
Ground cover				
jewelweed/Impatiens capensis	20.5	50	Y	FACW*
garlic mustard/Alliaria petiolata	20.5	50	Y	FACU

Use an asterisk to mark wetland indicator plants: species listed in the Wetlands Protection Act (MGL c. 131, s. 40); plants in the genus *Sphagnum*; plants listed as FAC, FAC+, FAC-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.

**Vegetation conclusion:**  
**Number of dominant wetland indicator plants: 4** **Number of dominant non-wetland plants: 1**  
**Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants?**  **yes**  **no**

*If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent*

## Section II. Indicators of Hydrology

### Hydric Soil Interpretation

#### 1. Soil Survey

Is there a published soil survey for this site? Yes

Title/date: Web Soil Survey Middlesex County  
 Map number:  
 Soil type mapped: Hinckley 253A  
 Hydric soil inclusions: Swansea, Wareham

Are field observations consistent with soil survey? yes no  
 Remarks: Swansea

#### 2. Soil description

Horizon	Depth	Matrix Color	Mottles Color
O	0-16"	10YR 2/1	

Remarks

3. Other histosol

Conclusion: Is soil hydric?  yes  no

### Other Indicators of Hydrology: (check all that apply and describe)

- Site inundated: \_\_\_\_\_
- Depth to free water in observation hole: \_ \_\_\_\_\_
- Water marks: \_\_\_\_\_
- Drift lines: \_\_\_\_\_
- Sediment deposits: \_\_\_\_\_
- Drainage patterns in BVW: \_\_\_\_\_
- Oxidized rhizospheres: \_\_\_\_\_
- Water-stained leaves: \_\_\_\_\_
- Recorded data(stream, lake, or tidal gauge; aerial photo, other):\_\_
- Other: \_\_\_\_\_

### Vegetation and Hydrology Conclusion

	Yes	No
<b>Number of wetland indicator plants</b> <b>≥ number of non-wetland indicator plants:</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Wetland hydrology present:</b> <b>Hydric soil present</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Other indicators of hydrology present:</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Sample location is in a BVW</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

## DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant: Town of Westford Prepared by: Rimmer Environmental Project location: Boston Rd, Westford DEP File #: \_\_\_\_\_

Check all that apply:

- Vegetation alone presumed adequate BVW boundary: fill out section I only
- Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out sections I and II
- Method other than dominance test used (attach additional information)

**Section I. Vegetation:** Observation plot Number: up Transect number: B4 Date of delineation: 10/24/18

A. Sample layer and plant species (by common name/scientific name)	B. Percent cover (or basal area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Sapling				
norway maple/Acer platanoides	20.5	50	Y	UPL
black cherry/Prunus serotina	20.5	50	Y	FACU
shrub				
glossy buckthorn/Frangula alnus	38	100	Y	FAC*
Vine				
asiatic bittersweet/Celastrus orbiculatus	63	100	Y	UPL

Use an asterisk to mark wetland indicator plants: species listed in the Wetlands Protection Act (MGL c. 131, s. 40); plants in the genus *Sphagnum*; plants listed as FAC, FAC+, FAC-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.

**Vegetation conclusion:**  
**Number of dominant wetland indicator plants:** \_\_\_\_\_ **Number of dominant non-wetland plants:** **4**  
**Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants?**  yes  no

*If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent*

## Section II. Indicators of Hydrology

### Hydric Soil Interpretation

#### 1. Soil Survey

Is there a published soil survey for this site? Yes

Title/date: Web Soil Survey Middlesex County  
 Map number:  
 Soil type mapped: Woodbridge 310B  
 Hydric soil inclusions: Ridgebury, Whitman

Are field observations consistent with soil survey? yes no  
 Remarks:

#### 2. Soil description

Horizon	Depth	Matrix Color	Mottles Color
Ap	0-20"	10YR 2/2	

Remarks

#### 3. Other

Conclusion: Is soil hydric?  yes  no

### Other Indicators of Hydrology: (check all that apply and describe)

- Site inundated: \_\_\_\_\_
- Depth to free water in observation hole: \_ \_\_\_\_\_
- Water marks: \_\_\_\_\_
- Drift lines: \_\_\_\_\_
- Sediment deposits: \_\_\_\_\_
- Drainage patterns in BVW: \_\_\_\_\_
- Oxidized rhizospheres: \_\_\_\_\_
- Water-stained leaves: \_\_\_\_\_
- Recorded data(stream, lake, or tidal gauge; aerial photo, other):\_\_
- Other: \_\_\_\_\_

### Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants $\geq$ number of non-wetland indicator plants:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Wetland hydrology present: Hydric soil present	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Other indicators of hydrology present:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sample location is in a BVW	<input type="checkbox"/>	<input checked="" type="checkbox"/>



## DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant: Town of Westford Prepared by: Rimmer Environmental Project location: Boston Rd, Westford DEP File #: \_\_\_\_\_

Check all that apply:

- Vegetation alone presumed adequate BVW boundary: fill out section I only
- Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out sections I and II
- Method other than dominance test used (attach additional information)

**Section I. Vegetation:** Observation plot Number: wet Transect number: C30 Date of delineation: 10/24/18

A. Sample layer and plant species (by common name/scientific name)	B. Percent cover (or basal area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Canopy				
red maple/Acer rubrum	20.5	100	Y	FAC*
sapling				
crabapple/Malus sp.	10.5	100	Y	UPL
shrub				
glossy buckthorn/Frangula alnus	38	100	Y	FAC*
Ground cover				
royal fern/Osmunda regalis	20.5	100	Y	OBL*

Use an asterisk to mark wetland indicator plants: species listed in the Wetlands Protection Act (MGL c. 131, s. 40); plants in the genus *Sphagnum*; plants listed as FAC, FAC+, FAC-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.

**Vegetation conclusion:**  
**Number of dominant wetland indicator plants: 3** **Number of dominant non-wetland plants: 1**  
**Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants?**  **yes**  **no**

*If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent*

## Section II. Indicators of Hydrology

### Hydric Soil Interpretation

#### 1. Soil Survey

Is there a published soil survey for this site? Yes

Title/date: Web Soil Survey Middlesex County  
 Map number:  
 Soil type mapped: Hinckley  
 Hydric soil inclusions: Swansea, Wareham

Are field observations consistent with soil survey? yes no  
 Remarks: Wareham

#### 2. Soil description

Horizon	Depth	Matrix Color	Mottles Color
A	0-11"	10YR 2/1	
B	11-20"	10YR 4/1	10YR 4/6

Remarks

#### 3. Other

Conclusion: Is soil hydric?  yes  no

### Other Indicators of Hydrology: (check all that apply and describe)

- Site inundated: \_\_\_\_\_
- Depth to free water in observation hole: \_ \_\_\_\_\_
- Water marks: \_\_\_\_\_
- Drift lines: \_\_\_\_\_
- Sediment deposits: \_\_\_\_\_
- Drainage patterns in BVW: \_\_\_\_\_
- Oxidized rhizospheres: \_\_\_\_\_
- Water-stained leaves: \_\_\_\_\_
- Recorded data(stream, lake, or tidal gauge; aerial photo, other):\_\_
- Other: \_\_\_\_\_

### Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ number of non-wetland indicator plants:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Wetland hydrology present: Hydric soil present	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Other indicators of hydrology present:	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sample location is in a BVW	<input checked="" type="checkbox"/>	<input type="checkbox"/>

## DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Form

Applicant: Town of Westford Prepared by: Rimmer Environmental Project location: Boston Rd, Westford DEP File #: \_\_\_\_\_

Check all that apply:

- Vegetation alone presumed adequate BVW boundary: fill out section I only
- Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out sections I and II
- Method other than dominance test used (attach additional information)

**Section I. Vegetation:** Observation plot Number: upl Transect number: C30 Date of delineation: 10/24/18

A. Sample layer and plant species (by common name/scientific name)	B. Percent cover (or basal area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Tree				
black cherry/ <i>Prunus serotina</i>	20.5	50	Y	FACU
red maple/ <i>Acer rubrum</i>	20.5	50	Y	FAC*
shrub				
multiflora rose/ <i>Rosa multiflora</i>	20.5	50	Y	FACU
privet/ <i>Ligustrum vulgare</i>	20.5	50	Y	FACU
Ground cover				
rough stem goldenrod/ <i>Solidago rugosa</i>	10.5	100	Y	FAC*

Use an asterisk to mark wetland indicator plants: species listed in the Wetlands Protection Act (MGL c. 131, s. 40); plants in the genus *Sphagnum*; plants listed as FAC, FAC+, FAC-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.

**Vegetation conclusion:**  
**Number of dominant wetland indicator plants: 2** **Number of dominant non-wetland plants: 3**  
**Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants?**  yes  no

*If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent*

## Section II. Indicators of Hydrology

### Hydric Soil Interpretation

#### 1. Soil Survey

Is there a published soil survey for this site? Yes

Title/date: Web Soil Survey Middlesex County  
 Map number:  
 Soil type mapped: Woodbridge 310M  
 Hydric soil inclusions: Ridgebury, Whitman

Are field observations consistent with soil survey? yes no  
 Remarks:

#### 2. Soil description

Horizon	Depth	Matrix Color	Mottles Color
A	0-9"	10YR 2/1	
B	9-28"	10YR 5/4	

Remarks

#### 3. Other

Conclusion: Is soil hydric?  yes  no

Other Indicators of Hydrology: (check all that apply and describe)

- Site inundated: \_\_\_\_\_
- Depth to free water in observation hole: \_ \_\_\_\_\_
- Water marks: \_\_\_\_\_
- Drift lines: \_\_\_\_\_
- Sediment deposits: \_\_\_\_\_
- Drainage patterns in BVW: \_\_\_\_\_
- Oxidized rhizospheres: \_\_\_\_\_
- Water-stained leaves: \_\_\_\_\_
- Recorded data(stream, lake, or tidal gauge; aerial photo, other):\_\_
- Other: \_\_\_\_\_

### Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ number of non-wetland indicator plants:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Wetland hydrology present: Hydric soil present	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Other indicators of hydrology present:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sample location is in a BVW	<input type="checkbox"/>	<input checked="" type="checkbox"/>

## **3 STORMWATER REPORT**

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# Stormwater Report

MassDOT Project No. 609035

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## ***Roadway Improvement Project***

*Boston Road,  
Westford, MA*

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Prepared for: **Town of Westford**  
**Department of Public Works**  
28 North Street  
Westford, MA 01886



Prepared by: **TEC, Inc.**  
282 Merrimack Street  
2<sup>nd</sup> Floor  
Lawrence, MA 01843



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**March 22, 2023**

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## **1. Project Summary**

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### **1.01 Project Description**

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The Town of Westford, in conjunction with MassDOT, is proposing roadway improvements along Boston Road from Main Street to the on-ramps to Interstate 495 Southbound. This project area contains reconstruction of approximately 5,550 feet of Boston Road. Improvements include installation of a new sidewalk along the east side of Boston Road, bike lanes, full depth pavement reclamation, new stormwater drainage infrastructure and a new water main.

The purpose of this project is to provide safer vehicular, bicycle and pedestrian routes along with upgrading the existing undersized and aging drainage infrastructure along Boston Road with the improvements mentioned as well as a more efficient stormwater management throughout the corridor.

The project will significantly improve upon the existing TSS removal rate for impervious areas and lower the overall peak stormwater flowrates within the project limits through the introduction of deep sump catch basins with hoods, a wet detention basin, and an outlet sediment trap. The applicant requests that the Conservation Commission finds that the project as described in this Notice of Intent successfully upholds the interest of the Wetlands Protection Act and the Town of Westford's Stormwater Management Bylaw, and subsequently issues an Order of Conditions for the proposed improvements.

### **1.02 Existing Conditions**

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Boston Road is a variable width two lane north-south paved roadway that ranges from approximately 24' to 30' wide. Roadway grades are highly variable and range from 0.5% up to 5.9%. There is minimal pedestrian infrastructure along this route and no dedicated bike lanes currently exist in the project area.

The existing stormwater network is a combination of both closed stormwater systems as well as several sections of open conveyance. Large off-site drainage areas coming off the hillside to the west collect in the roadway and often overtax the existing drainage network. In addition to surface runoff created by storm events, this area also experiences substantial seasonal groundwater breakout which drains off the hill and onto the road and can further inundate the existing system. The Existing Drainage Pattern map, included as Figure 2, shows the extent of the 53 subcatchment areas and includes a listing of the ground features of each used to calculate the weighted curve number.

The project area drains to two distinct design points (DP) DP-1 and DP-2 where water leaves the roadway corridor. All design points eventually drain to the large wetland network to the east before entering Tadmuck Brook which eventually flows to the Merrimack River. Also considered in the analysis is the bypass flow for existing catch basins 32 and 33 at the southern terminus of the project.

- DP-1 is located just south of the intersection of Crown Road and drains to an open conveyance which leads to the northern portion of the wetland network to the east



- DP-2 consists of a combination of flows from four pipes under Boston Rd that lead to the southern portion of the wetland network to the east. These pipes are located just south of the property at 50 Boston Rd., just north of the fire station, across from Blakes Hill Road, and adjacent to the off-ramp for I-495 Southbound
- EXCB32 Bypass consists of flow not picked up by existing catch basin 32 that continues down the curb along the southbound lane of Boston Road past the project limits
- EXCB33 Bypass consists of flow not picked up by existing catch basin 33 that continues down the curb on the off-ramp towards I-495.

Modeling indicates that during large storm events ponding and large roadway spreads over 15' will occur at several points along the roadway and surcharges of the closed conveyance network are observed during the 2-year storm event. There are no current measures in place to control either stormwater quantity or quality within the proposed corridor before discharging to the large wetland resource area to the east. Two existing detention ponds are located on the fire department headquarters property near the southern end of the project. While not within the project area, both ponds discharge to the closed drainage system within Boston Road. These ponds(FSP-1 and FSP-2) have been modeled based on as-built data and remain unaltered. No part of the project area is within a recognized floodplain.

Soils within the project area are predominantly comprised of Paxton Fine Sandy Loam and Woodbridge Fine Sandy Loam type soils. Hydrologic soil group B, C, and D were used to create composite Curve Numbers(CN).

### **1.03 Proposed Conditions**

The proposed project includes several roadway improvements and upgrades to the existing drainage infrastructure. The roadway corridor will be improved to include both a sidewalk and bike lanes through the entire length of the project and several other driver safety improvements.

The existing drainage network will be largely replaced with a new closed conveyance system that runs the entire length of the project corridor. Several new deep sump catch basins are proposed, mostly along the western side of the road, to help manage both the on- and off-site runoff the site will encounter. Per discussions with MassDOT, a maximum roadway spread of 10.5', 5' shoulder/bike lane plus half of the 11' wide lane, was used as a basis of design for inlet spacing. Additionally, the cross slope of the bike lane was increased to 3% in areas where roadway spread is a concern.

In addition to the deep sump catch basins, a sediment trap has been added at the outfall just south of Crown Rd. to help manage stormwater quality to the maximum extent practicable due to limitations of buildable area. Towards the south end of the project, a wet detention basin is proposed across from the fire station site to manage both stormwater quantity and quality. At the south terminus of the project four new catch basins have been added in vicinity to the I-495 interchange to help limit stormwater spread and improve inlet efficiency in this high traffic area. In addition to structural Stormwater control measures (SCMs) mentioned above, several non-structural SCMs will be employed to further protect water quality leaving the site. These measures include litter pick-up, inspection and maintenance of assets, landscape area maintenance, snow and ice management, street sweeping, illicit discharge prohibition, and procedures for spill prevention and response. Further information on the non-structural SCMs can be found within

the Long-Term Pollution Prevention Plan (LTPPP) located in Appendix E of this document. Given the narrow work corridor for this redevelopment project, no structural Low Impact Development (LID) techniques are employed. However, there will no disturbance to any wetland resource areas and any disturbance to existing trees and shrubs has been minimized.

The Proposed Drainage Pattern map, included as Figure 5, shows the extent of the 77 proposed subcatchment areas and includes a listing of the ground features of each used to calculate the weighted curve number. The proposed condition includes the same design points as the pre-developed model. At Design Point 1, DP-1, stormwater exits the system via a 24" pipe from junction structure 31. Structure 31 has an additional 30" outlet that allows stormwater during larger events to continue to Design Point 2. This was done to maintain comparable flows as existing in the intermittent stream at the existing outfall location at DP-1 and to limit the pipe size of the downstream network. Design Point 2, DP-2, now only includes two outlet locations, the proposed wet detention basin and the existing outfall adjacent to the off-ramp for I-495 Southbound which both lead to the same wetland area. The other culvert locations have been removed in order to better treat the stormwater before discharging into the wetlands network.

This project qualifies as a limited project under 310 CMR 10.53(3)(f) of the Wetlands Protection Act. This regulation grants limited project status to projects that propose "maintenance and improvement of existing public roadways, but limited to widening less than a single lane, adding shoulders, correcting substandard intersections, and improving inadequate drainage systems.

## **2. Impaired Waters and Total Maximum Daily Loads (TMDLs)**

The portion of Tadmuck Brook which receives surface water runoff from the project area is not listed as an impaired waterbody on the current 303(d) list, therefore no TMDLs are in place within this watershed. Over a mile further downstream of the project area, where Tadmuck Brook crosses Main St. in Westford, there is an impairment for Escherichia Coli (E. Coli) within Tadmuck Brook. While not required, the proposed improvements for this project will offer some improvement over the existing condition and will not create any new point sources for the E. Coli impairment. Any illicit discharge locations encountered when reconstructing the stormwater network will be eliminated. Additionally, stormwater will be routed directly to the Wet Basin SCM so it will no longer flow over the agricultural lands across from the fire station at the south end of the project before entering the wetlands and eventually Tadmuck Brook.

## **3. Stormwater Management Standards**

The DEP Stormwater Management Policy prescribes ten performance standards for site redevelopment projects. The proposed project has been designed in accordance with these standards to the maximum extent practicable. Compliance with the standards is outlined below.

### **1. No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.**

This project does not propose any new untreated stormwater discharges. Temporary and permanent measures have been included as to not cause erosion in the wetlands or waters of the Commonwealth. Treatment trains for each individual outfall location can be found below in the discussion for Standard 4. The proposed design offers several improvements over the existing

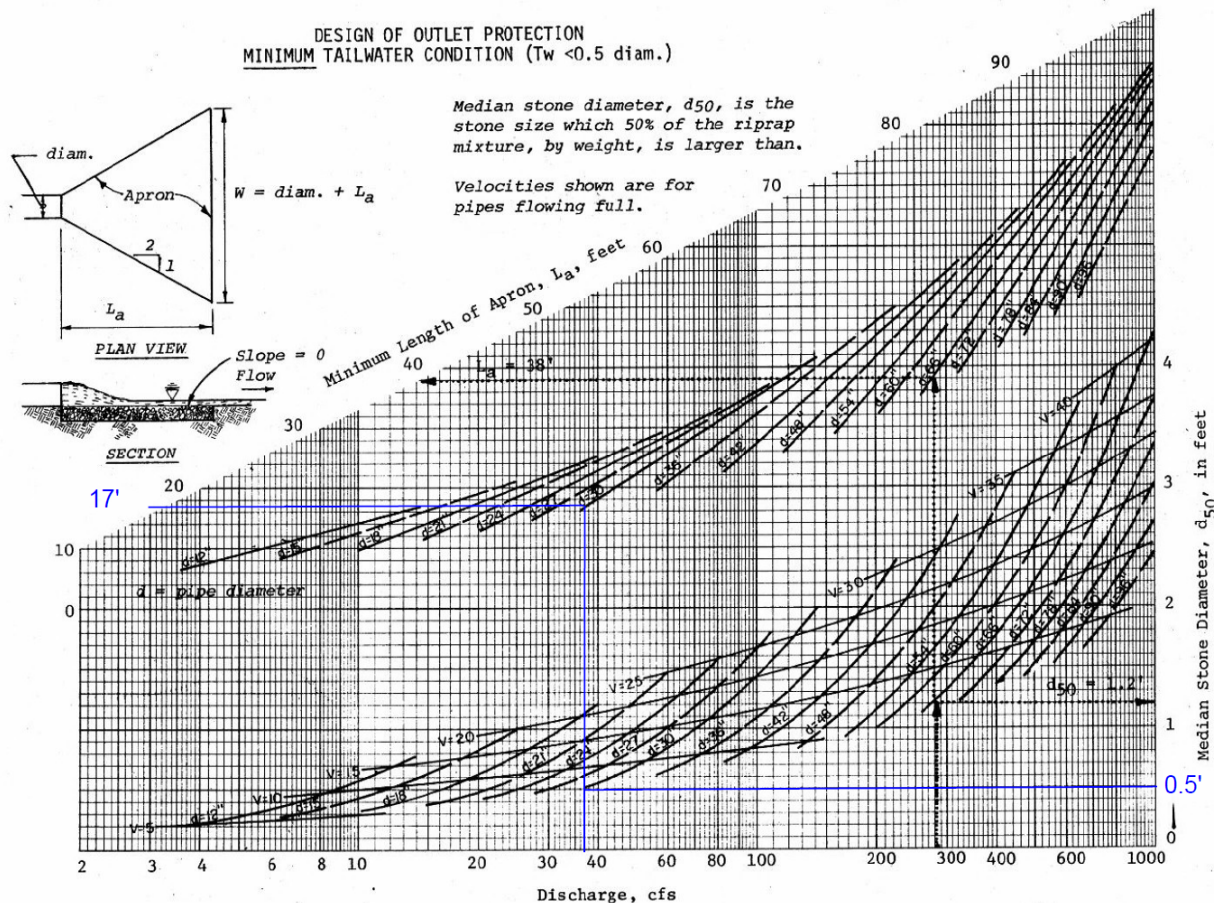
condition that include providing adequately sized energy dissipation, directing stormwater to proposed SCMs, and combining several existing outfalls into a single outlet from the wet basin SCM.

Riprap aprons greater than 24" have been sized based on guidance found in Natural Resources Conservation Service (NRCS) Design Guide 6 where:

- $Q_{10}$  = Peak stormwater flowrate expected during the 10-year storm event measured in cubic feet per second(cfs) – Taken from stormwater modeling data described below for Standard 2.
- $V_{10}$  = Peak stormwater velocity expected during the 10-year storm event measured in feet per second(ft/s) – Taken from stormwater modeling data described below for Standard 2.
- $d_{50}$  = Median stone diameter to be used for riprap apron measured in inches – Taken from NRCS graph included in this section
- Length = Length of riprap apron in feet – Taken from NRCS graph included in this section
- Width = Length of riprap apron in feet – Taken from NRCS graph included in this section

For pipes 24" and less in diameter, riprap aprons have been sized based on MassDOT construction standards.

Rip Rap Apron Sizing Summary							
Pipe	Outfall Location	Pipe Dia.	$Q_{10}$	$V_{10}$	$d_{50}$	length	width
31-out	Outfall just south of Crown Rd.	24"	23.27 cfs	8.16 ft/s	6 in.	5 ft.	6 ft.
Pond Outfall	Outfall from Wet Basin	30"	36.84 cfs	9.45 ft/s	6 in.	17 ft.	19.5 ft.



**2. Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.**

Existing and proposed drainage systems were analyzed using Autodesk Storm and Sanitary Analysis version 13.4.254.0, an SCS TR-55 based program, to calculate existing and proposed peak discharge rates, inlet spread, pipe capacity, structure surcharge, and basin performance. This method takes into account all existing and proposed pervious and impervious areas including soil types, land cover, and hydrologic classifications. The 2, 10, and 100-year, 24-hour storm frequencies were used in the analysis in accordance with MassDEP and local requirements. Curve Number(CN) calculations used within the model can be found on the existing and proposed drainage pattern maps included at figures 2 and 5 respectively. Runoff totals were taken from NOAA Atlas-14 data and are summarized in the table below.

**NOAA Atlas-14 Storm Event Depths)**

Storm Event (return year)	Rainfall Depth (inches)
2	3.17
10	4.9
100	7.65

Model node diagrams and analysis output can be found in Appendix D. As can be seen from the table below, peak flows have been reduced at all locations and storm events:

Design Point	2-Yr Storm		10-Yr Storm		100-Yr Storm	
	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)
DP-1	15.50	15.36	29.83	23.09	41.86	23.11
DP-2	20.09	16.39	49.76	37.37	80.47	73.85
EX32 bypass	0.47	0.16	0.92	0.36	1.78	0.83
EX33 bypass	0.16	0.01	0.34	0.06	0.68	0.18

This standard has been met to the maximum extent practicable.

**3. Loss of annual recharge to groundwater should be minimized through the use of infiltration measures where feasible.**

The construction of the proposed sidewalk along Boston Road would result in additional impervious area over the project area. The additional impervious area created within each hydrologic soil group (HSG) is summarized in the table below:

Impervious Areas(s.f.)	HSG 'B'	HSG 'C'	HSG 'D'
Existing	22,915	181,847	302,362
Proposed	22,915	189,725	330,273
Increase	0	7,878	27,911

The increase in impervious cover from the table above results in required recharge volume calculated in the table below:

NRCS Hydrologic Soil Type	Target Depth Factor - $F$ (inches)	New Impervious Area (square feet)	Recharge Volume - $R_v$ (cubic feet)
A	0.6	0	0
B	0.35	0	0
C	0.25	7,878	164
D	0.1	27,911	233
Total $R_v = F \times$ Impervious Area =			<b>397</b>

There is very little opportunity to introduce infiltration practices along the roadway corridor and soils at the BMP locations are predominantly in hydrologic group ‘D’ and not conducive to infiltration practices. Due to these reasons, no recharge volume is proposed with this project. Test pit logs can be found in Appendix B. This standard has been met to the maximum extent practicable.

**4. For new development, stormwater management systems must be designed to remove 80 percent of Total Suspended Solids.**

Due to the bifurcation of stormwater flow that occurs at structure 31 as discussed in Section 1.03, Proposed Conditions, there are no distinct sub-catchment areas dividing the two Discharge Points. Because of this, and the lack of area to provide treatment at DP-1, the water quality volume will be calculated as a whole and not divided by discharge point. TSS removal will still be calculated for each point where stormwater leaves the system.

**Water Quality Volume:**

New Impervious Area = $A_{IMP}$ =	35,789	ft <sup>2</sup>
Water Quality Depth = $D_{WQ}$ =	0.5	in.
Required Water Quality Volume = $V_{WQ} = D_{WQ} * A_{IMP}$ =	<b>1,491</b>	ft <sup>3</sup>

The water quality volume for a wet basin is calculated as half of the provided wet volume below the overflow spillway. The wet detention basin has a total volume of 110,022 ft<sup>3</sup> within those constraints. This calculates to 55,011 ft<sup>3</sup> of water quality volume which satisfies the requirement for overall water quality volume.

As described within the Project Description, the project will improve the existing 0% TSS removal rate (bi-annual street sweeping only). A 44% TSS removal rate will be achieved for the project area through the introduction of deep sump catch basins with hoods and the use of an outlet sediment trap (DP-1). Higher TSS removal rates will be accomplished at the wet basin within DP-2 at 89% with the wet detention basin and sediment forebay. The remainder of the drainage heading to DP-2 near the I-495 interchange has a TSS removal of 25% with only deep sump catch basins. More information on the maintenance of the SCMs mentioned in this section can be found in the Long Term Pollution Prevention Plan found in Appendix E. This standard has been

met to the maximum extent practicable.

For DP-1, there will be a 44% TSS removal rate with the introduction of deep sump catch basins with hoods along with the addition of the sediment trap at the outfall location.

**TSS Removal Calculation for DP-1**

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Street Sweeping	0	1	0	1
Deep Sump Catch Basins w/ Hoods	0.25	1	0.25	0.75
Outlet Sediment Trap	0.25	0.75	0.19	0.56
<b>Total TSS Removal =</b>				<b>44%</b>

For wet basin outfall at DP-2, there will be an aggregate TSS removal rate of 89% with the proposed treatment train of deep sump catch basins with hoods and wet basin. Prior to entering the wet basin, the deep sump catch basins with hoods and sediment forebay provide the required 44% minimum pretreatment.

**TSS Removal Calculation for DP-2(Wet Basin)**

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Street Sweeping	0	1	0	1
Deep Sump Catch Basins w/ Hoods	0.25	1	0.25	0.75
Sediment Forebay	0.25	0.75	0.19	0.56
Wet Basin	0.8	0.56	0.45	0.11
<b>Total TSS Removal =</b>				<b>89%</b>

For outfall near the I-495 interchange at DP-2, there will be a TSS removal rate of 25% created by the use of Deep Sump Catch Basins.

**TSS Removal Calculation for DP-2(I-495 Outfall)**

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Street Sweeping	0	1	0	1
Deep Sump Catch Basins w/ Hoods	0.25	1	0.25	0.75
<b>Total TSS Removal =</b>				<b>25%</b>

**5. Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs.**

The proposed project is not considered a land use with higher potential pollutant loads.

**6. Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resource Waters, shell fish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies.**

Stormwater from the project ultimately discharges to various nearby wetlands, none of which are identified as critical areas.

**7. Redevelopment of previously developed areas must meet the Stormwater Management Standards to the maximum extent practicable.**

The entire length of this project qualifies as a redevelopment project. Additionally, this project qualifies as a limited project under 310 CMR 10.53(3)(f) of the Wetlands Protection Act. This regulation grants limited project status to projects that propose "maintenance and improvement of existing public roadways, but limited to widening less than a single lane, adding shoulders, correcting substandard intersections, and improving inadequate drainage systems.

Stormwater standards 1-6 have been fully met, with the exception of standard 3 and 4 which have been met to the maximum extent practicable due to the reasons listed above. The proposed project has been designed to improve the quality of runoff using Best Management Practices where feasible. The proposed stormwater management plan meets the Stormwater Management Standards to the maximum extent practicable.

**8. Erosion and sediment controls must be implemented to prevent impacts during construction or land disturbance activities.**

The project has been designed to include erosion and sedimentation controls to prevent impacts to down gradient resource areas. Construction activities will be isolated from down gradient resource areas by installing a sediment control barrier along the limits of work, and silt sacks for existing and proposed deep sump hooded catch basins within the project limits. A Stormwater Pollution Prevention Plan (SWPPP) will be developed and implemented by the Contractor prior to any earth disturbance. This standard has been fully met.

**9. All stormwater management systems must have an operation and maintenance plan to ensure that systems function as designed.**

The Long-Term Operation and Maintenance Plan(O&M) is included in Appendix E.

**10. Illicit Discharges**

Only stormwater will be conveyed to the stormwater management system. No illicit discharges will be permitted as outlined in the Town of Westford's Illicit Discharge Bylaw (Ch. 82 of the General Bylaws). For more information please refer to the LTPPP in Appendix E.

## **APPENDIX**

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**A. MASSDEP CHECKLIST FOR STORMWATER REPORT**

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Massachusetts Department of Environmental Protection  
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## A. Introduction

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the [Massachusetts Stormwater Handbook](#). The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.<sup>1</sup> This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8<sup>2</sup>
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

<sup>1</sup> The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

<sup>2</sup> For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



**Massachusetts Department of Environmental Protection  
Bureau of Resource Protection - Wetlands Program**

# Checklist for Stormwater Report

## B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

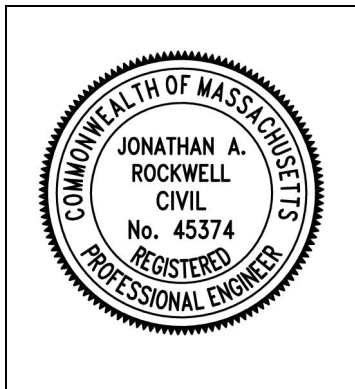
*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

### Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



*Jonathan A. Rockwell*  
Signature and Date

3/21/2023

### Checklist

**Project Type:** Is the application for new development, redevelopment, or a mix of new and redevelopment?

- New development
- Redevelopment
- Mix of New Development and Redevelopment



**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## Checklist (continued)

**LID Measures:** Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- No disturbance to any Wetland Resource Areas
- Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- Reduced Impervious Area (Redevelopment Only)
- Minimizing disturbance to existing trees and shrubs
- LID Site Design Credit Requested:
  - Credit 1
  - Credit 2
  - Credit 3
- Use of “country drainage” versus curb and gutter conveyance and pipe
- Bioretention Cells (includes Rain Gardens)
- Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- Treebox Filter
- Water Quality Swale
- Grass Channel
- Green Roof
- Other (describe): \_\_\_\_\_

### Standard 1: No New Untreated Discharges

- No new untreated discharges
- Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## Checklist (continued)

### Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

### Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.
  - Static
  - Simple Dynamic
  - Dynamic Field<sup>1</sup>
- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
  - Site is comprised solely of C and D soils and/or bedrock at the land surface
  - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
  - Solid Waste Landfill pursuant to 310 CMR 19.000
  - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

<sup>1</sup> 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



Massachusetts Department of Environmental Protection  
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# Checklist for Stormwater Report

## Checklist (continued)

### Standard 3: Recharge (continued)

- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

### Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
  - Provisions for storing materials and waste products inside or under cover;
  - Vehicle washing controls;
  - Requirements for routine inspections and maintenance of stormwater BMPs;
  - Spill prevention and response plans;
  - Provisions for maintenance of lawns, gardens, and other landscaped areas;
  - Requirements for storage and use of fertilizers, herbicides, and pesticides;
  - Pet waste management provisions;
  - Provisions for operation and management of septic systems;
  - Provisions for solid waste management;
  - Snow disposal and plowing plans relative to Wetland Resource Areas;
  - Winter Road Salt and/or Sand Use and Storage restrictions;
  - Street sweeping schedules;
  - Provisions for prevention of illicit discharges to the stormwater management system;
  - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
  - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
  - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
  - Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
    - is within the Zone II or Interim Wellhead Protection Area
    - is near or to other critical areas
    - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
    - involves runoff from land uses with higher potential pollutant loads.
  - The Required Water Quality Volume is reduced through use of the LID site Design Credits.
  - Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Massachusetts Department of Environmental Protection  
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## Checklist (continued)

### Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
  - The ½" or 1" Water Quality Volume or
  - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

### Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does **not** cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

### Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## Checklist (continued)

### Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
- Limited Project
    - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
    - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
    - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
    - Bike Path and/or Foot Path
  - Redevelopment Project
    - Redevelopment portion of mix of new and redevelopment.
  - Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
  - The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

### Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
  - Construction Period Operation and Maintenance Plan;
  - Names of Persons or Entity Responsible for Plan Compliance;
  - Construction Period Pollution Prevention Measures;
  - Erosion and Sedimentation Control Plan Drawings;
  - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
  - Vegetation Planning;
  - Site Development Plan;
  - Construction Sequencing Plan;
  - Sequencing of Erosion and Sedimentation Controls;
  - Operation and Maintenance of Erosion and Sedimentation Controls;
  - Inspection Schedule;
  - Maintenance Schedule;
  - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.





Massachusetts Department of Environmental Protection  
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# Checklist for Stormwater Report

## Checklist (continued)

### Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

### Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
  - Name of the stormwater management system owners;
  - Party responsible for operation and maintenance;
  - Schedule for implementation of routine and non-routine maintenance tasks;
  - Plan showing the location of all stormwater BMPs maintenance access areas;
  - Description and delineation of public safety features;
  - Estimated operation and maintenance budget; and
  - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
  - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
  - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

### Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

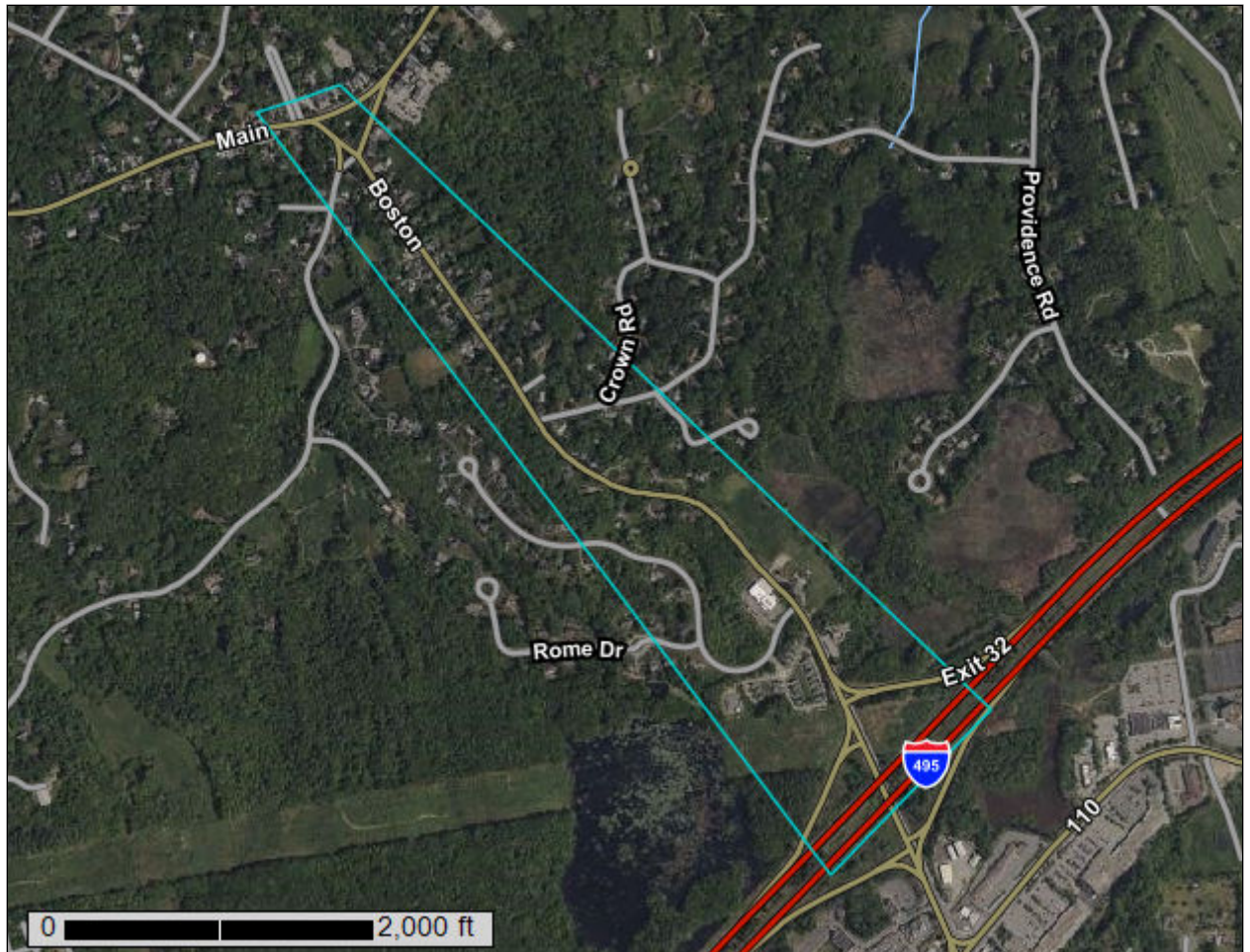
**B. SOILS AND FEMA INFORMATION**

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A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Middlesex County, Massachusetts



# Preface

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Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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## **How Soil Surveys Are Made**

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Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

## Custom Soil Resource Report

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and



Custom Soil Resource Report

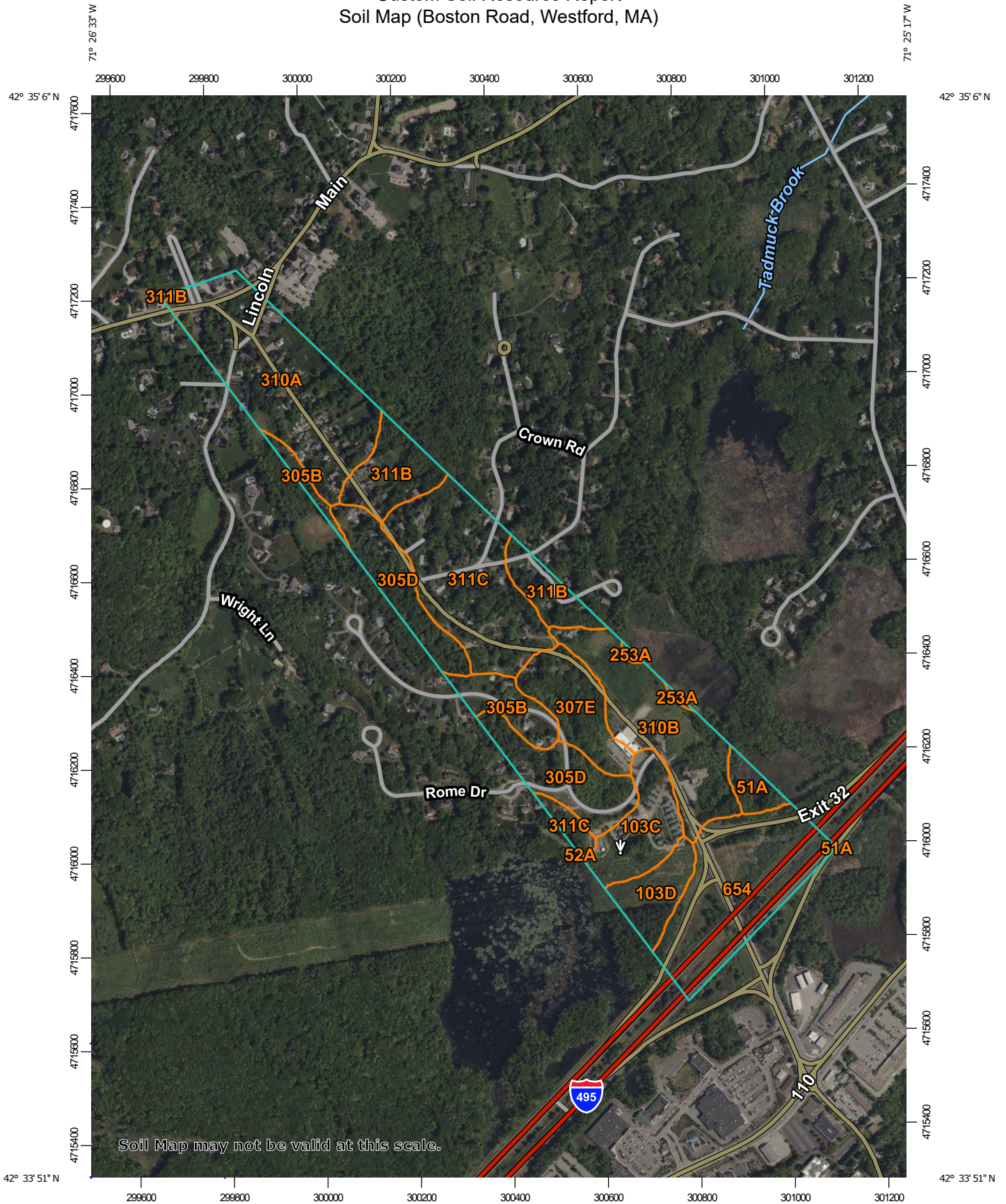
identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

## Soil Map

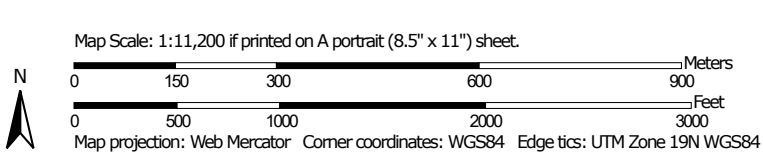
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The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Proposal No. 609035- 126590  
 Custom Soil Resource Report  
 Soil Map (Boston Road, Westford, MA)




Soil Map may not be valid at this scale.




Custom Soil Resource Report


**MAP LEGEND**

**Area of Interest (AOI)**

 Area of Interest (AOI)


**Soils**


 Soil Map Unit Polygons


 Soil Map Unit Lines


 Soil Map Unit Points

**Special Point Features**

 Blowout

 Borrow Pit


 Clay Spot


 Closed Depression

 Gravel Pit


 Gravelly Spot


 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water


 Perennial Water

 Rock Outcrop


 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole

 Slide or Slip


 Sodic Spot


 Spoil Area

 Stony Spot


 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

**Water Features**

 Streams and Canals


**Transportation**

 Rails


 Interstate Highways

 US Routes

 Major Roads

 Local Roads

**Background**

 Aerial Photography

**MAP INFORMATION**

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts  
 Survey Area Data: Version 22, Sep 9, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Map Unit Legend (Boston Road, Westford, MA)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
51A	Swansea muck, 0 to 1 percent slopes	2.3	1.7%
52A	Freetown muck, 0 to 1 percent slopes	0.0	0.0%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	7.9	5.7%
103D	Charlton-Hollis-Rock outcrop complex, 15 to 25 percent slopes	5.1	3.7%
253A	Hinckley loamy sand, 0 to 3 percent slopes	0.4	0.3%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	6.0	4.3%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	16.2	11.7%
307E	Paxton fine sandy loam, 25 to 35 percent slopes, extremely stony	8.1	5.9%
310A	Woodbridge fine sandy loam, 0 to 3 percent slopes	24.6	17.8%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	15.7	11.3%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	10.7	7.7%
311C	Woodbridge fine sandy loam, 8 to 15 percent slopes, very stony	21.6	15.6%
603	Urban land, wet substratum	0.0	0.0%
654	Udorthents, loamy	19.7	14.2%
<b>Totals for Area of Interest</b>		<b>138.5</b>	<b>100.0%</b>

## Map Unit Descriptions (Boston Road, Westford, MA)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

## Custom Soil Resource Report

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps.

Custom Soil Resource Report

The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

## Middlesex County, Massachusetts

### 51A—Swansea muck, 0 to 1 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2trl2  
*Elevation:* 0 to 1,140 feet  
*Mean annual precipitation:* 36 to 71 inches  
*Mean annual air temperature:* 39 to 55 degrees F  
*Frost-free period:* 140 to 240 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Swansea and similar soils:* 80 percent  
*Minor components:* 20 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Swansea

##### Setting

*Landform:* Bogs, swamps  
*Landform position (three-dimensional):* Dip  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Parent material:* Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

##### Typical profile

*Oa1 - 0 to 24 inches:* muck  
*Oa2 - 24 to 34 inches:* muck  
*Cg - 34 to 79 inches:* coarse sand

##### Properties and qualities

*Slope:* 0 to 1 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Very poorly drained  
*Runoff class:* Negligible  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high  
(0.14 to 14.17 in/hr)  
*Depth to water table:* About 0 to 6 inches  
*Frequency of flooding:* Rare  
*Frequency of ponding:* Frequent  
*Available water supply, 0 to 60 inches:* Very high (about 16.5 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 8w  
*Hydrologic Soil Group:* B/D  
*Ecological site:* F144AY043MA - Acidic Organic Wetlands  
*Hydric soil rating:* Yes

#### Minor Components

##### Freetown

*Percent of map unit:* 10 percent  
*Landform:* Bogs, swamps



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*Landform position (three-dimensional):* Dip

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Hydric soil rating:* Yes

**Scarboro**

*Percent of map unit:* 5 percent

*Landform:* Drainageways, depressions

*Landform position (two-dimensional):* Toeslope

*Landform position (three-dimensional):* Base slope, tread, dip

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Hydric soil rating:* Yes

**Whitman**

*Percent of map unit:* 5 percent

*Landform:* Drainageways, depressions

*Landform position (two-dimensional):* Toeslope

*Landform position (three-dimensional):* Base slope

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Hydric soil rating:* Yes

**52A—Freetown muck, 0 to 1 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 2t2q9

*Elevation:* 0 to 1,110 feet

*Mean annual precipitation:* 36 to 71 inches

*Mean annual air temperature:* 39 to 55 degrees F

*Frost-free period:* 140 to 240 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Freetown and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Freetown**

**Setting**

*Landform:* Depressions, depressions, swamps, kettles, marshes, bogs

*Landform position (two-dimensional):* Toeslope

*Landform position (three-dimensional):* Tread, dip

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Parent material:* Highly decomposed organic material

**Typical profile**

*Oe - 0 to 2 inches:* mucky peat

*Oa - 2 to 79 inches:* muck

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**Properties and qualities**

*Slope:* 0 to 1 percent  
*Surface area covered with cobbles, stones or boulders:* 0.0 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Very poorly drained  
*Runoff class:* Negligible  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high  
(0.14 to 14.17 in/hr)  
*Depth to water table:* About 0 to 6 inches  
*Frequency of flooding:* Rare  
*Frequency of ponding:* Frequent  
*Available water supply, 0 to 60 inches:* Very high (about 19.2 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 5w  
*Hydrologic Soil Group:* B/D  
*Ecological site:* F144AY043MA - Acidic Organic Wetlands  
*Hydric soil rating:* Yes

**Minor Components**

**Whitman**

*Percent of map unit:* 5 percent  
*Landform:* Drainageways, depressions  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

**Scarboro**

*Percent of map unit:* 5 percent  
*Landform:* Drainageways, depressions  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope, tread, dip  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

**Swansea**

*Percent of map unit:* 5 percent  
*Landform:* Bogs, swamps, marshes, depressions, depressions, kettles  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Tread, dip  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

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**103C—Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 2wzp1  
*Elevation:* 0 to 1,390 feet  
*Mean annual precipitation:* 36 to 71 inches  
*Mean annual air temperature:* 39 to 55 degrees F  
*Frost-free period:* 140 to 240 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Charlton, extremely stony, and similar soils:* 50 percent  
*Hollis, extremely stony, and similar soils:* 20 percent  
*Rock outcrop:* 10 percent  
*Minor components:* 20 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Charlton, Extremely Stony**

**Setting**

*Landform:* Ridges, hills  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Convex  
*Parent material:* Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

**Typical profile**

*Oe - 0 to 2 inches:* moderately decomposed plant material  
*A - 2 to 4 inches:* fine sandy loam  
*Bw - 4 to 27 inches:* gravelly fine sandy loam  
*C - 27 to 65 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 8 to 15 percent  
*Surface area covered with cobbles, stones or boulders:* 9.0 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high (0.14 to 14.17 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Moderate (about 8.7 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

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*Land capability classification (nonirrigated): 7s*  
*Hydrologic Soil Group: B*  
*Ecological site: F144AY034CT - Well Drained Till Uplands*  
*Hydric soil rating: No*

**Description of Hollis, Extremely Stony**

**Setting**

*Landform: Ridges, hills*  
*Landform position (two-dimensional): Summit, shoulder, backslope*  
*Landform position (three-dimensional): Nose slope, side slope, crest*  
*Down-slope shape: Convex*  
*Across-slope shape: Linear, convex*  
*Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist*

**Typical profile**

*O<sub>i</sub> - 0 to 2 inches: slightly decomposed plant material*  
*A - 2 to 7 inches: gravelly fine sandy loam*  
*B<sub>w</sub> - 7 to 16 inches: gravelly fine sandy loam*  
*2R - 16 to 26 inches: bedrock*

**Properties and qualities**

*Slope: 8 to 15 percent*  
*Surface area covered with cobbles, stones or boulders: 9.0 percent*  
*Depth to restrictive feature: 8 to 23 inches to lithic bedrock*  
*Drainage class: Somewhat excessively drained*  
*Runoff class: Very high*  
*Capacity of the most limiting layer to transmit water (K<sub>sat</sub>): Very low (0.00 to 0.00 in/hr)*  
*Depth to water table: More than 80 inches*  
*Frequency of flooding: None*  
*Frequency of ponding: None*  
*Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)*  
*Available water supply, 0 to 60 inches: Very low (about 2.7 inches)*

**Interpretive groups**

*Land capability classification (irrigated): None specified*  
*Land capability classification (nonirrigated): 7s*  
*Hydrologic Soil Group: D*  
*Ecological site: F144AY033MA - Shallow Dry Till Uplands*  
*Hydric soil rating: No*

**Description of Rock Outcrop**

**Setting**

*Landform: Ridges, hills*  
*Parent material: Igneous and metamorphic rock*

**Typical profile**

*R - 0 to 79 inches: bedrock*

**Properties and qualities**

*Slope: 8 to 15 percent*  
*Depth to restrictive feature: 0 inches to lithic bedrock*  
*Runoff class: Very high*  
*Capacity of the most limiting layer to transmit water (K<sub>sat</sub>): Very low (0.00 to 0.00 in/hr)*

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*Available water supply, 0 to 60 inches:* Very low (about 0.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 8

*Hydrologic Soil Group:* D

*Hydric soil rating:* No

**Minor Components**

**Woodbridge, extremely stony**

*Percent of map unit:* 8 percent

*Landform:* Ground moraines, hills, drumlins

*Landform position (two-dimensional):* Backslope, footslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Convex

*Across-slope shape:* Linear

*Hydric soil rating:* No

**Canton, extremely stony**

*Percent of map unit:* 5 percent

*Landform:* Moraines, hills, ridges

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Convex, linear

*Across-slope shape:* Convex

*Hydric soil rating:* No

**Chatfield, extremely stony**

*Percent of map unit:* 5 percent

*Landform:* Ridges, hills

*Landform position (two-dimensional):* Summit, shoulder, backslope

*Landform position (three-dimensional):* Nose slope, side slope, crest

*Down-slope shape:* Convex

*Across-slope shape:* Linear, convex

*Hydric soil rating:* No

**Ridgebury, extremely stony**

*Percent of map unit:* 2 percent

*Landform:* Hills, drainageways, drumlins, depressions, ground moraines

*Landform position (two-dimensional):* Footslope, toeslope

*Landform position (three-dimensional):* Head slope, base slope

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Hydric soil rating:* Yes

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**103D—Charlton-Hollis-Rock outcrop complex, 15 to 25 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 98yf  
*Elevation:* 0 to 1,560 feet  
*Mean annual precipitation:* 45 to 54 inches  
*Mean annual air temperature:* 43 to 54 degrees F  
*Frost-free period:* 110 to 240 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Charlton and similar soils:* 50 percent  
*Hollis and similar soils:* 25 percent  
*Rock outcrop:* 15 percent  
*Minor components:* 10 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Charlton**

**Setting**

*Landform:* Drumlins, ground moraines  
*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Parent material:* Friable loamy eolian deposits over friable loamy basal till derived from granite and gneiss

**Typical profile**

*H1 - 0 to 5 inches:* fine sandy loam  
*H2 - 5 to 22 inches:* sandy loam  
*H3 - 22 to 65 inches:* gravelly sandy loam

**Properties and qualities**

*Slope:* 15 to 25 percent  
*Surface area covered with cobbles, stones or boulders:* 9.0 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.60 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Moderate (about 7.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

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*Land capability classification (nonirrigated): 6s*  
*Hydrologic Soil Group: A*  
*Ecological site: F144AY034CT - Well Drained Till Uplands*  
*Hydric soil rating: No*

**Description of Hollis**

**Setting**

*Landform: Ridges, hills*  
*Landform position (two-dimensional): Summit, shoulder*  
*Landform position (three-dimensional): Crest*  
*Down-slope shape: Convex*  
*Across-slope shape: Convex*  
*Parent material: Friable, shallow loamy basal till over granite and gneiss*

**Typical profile**

*H1 - 0 to 2 inches: fine sandy loam*  
*H2 - 2 to 14 inches: fine sandy loam*  
*H3 - 14 to 18 inches: unweathered bedrock*

**Properties and qualities**

*Slope: 15 to 25 percent*  
*Surface area covered with cobbles, stones or boulders: 9.0 percent*  
*Depth to restrictive feature: 8 to 20 inches to lithic bedrock*  
*Drainage class: Well drained*  
*Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)*  
*Depth to water table: More than 80 inches*  
*Frequency of flooding: None*  
*Frequency of ponding: None*  
*Available water supply, 0 to 60 inches: Very low (about 2.0 inches)*

**Interpretive groups**

*Land capability classification (irrigated): None specified*  
*Land capability classification (nonirrigated): 6s*  
*Hydrologic Soil Group: D*  
*Ecological site: F144AY033MA - Shallow Dry Till Uplands*  
*Hydric soil rating: No*

**Description of Rock Outcrop**

**Setting**

*Landform: Ledges*  
*Landform position (two-dimensional): Summit*  
*Landform position (three-dimensional): Head slope*  
*Down-slope shape: Concave*  
*Across-slope shape: Concave*  
*Parent material: Granite and gneiss*

**Properties and qualities**

*Slope: 15 to 25 percent*  
*Depth to restrictive feature: 0 inches to lithic bedrock*

**Interpretive groups**

*Land capability classification (irrigated): None specified*  
*Land capability classification (nonirrigated): 8s*

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**Minor Components**

**Canton**

*Percent of map unit:* 2 percent  
*Landform:* Hills  
*Landform position (two-dimensional):* Summit, shoulder  
*Landform position (three-dimensional):* Head slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

**Narragansett**

*Percent of map unit:* 2 percent  
*Landform:* Hills, ridges  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

**Woodbridge**

*Percent of map unit:* 2 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Summit, shoulder, toeslope  
*Landform position (three-dimensional):* Head slope, nose slope, base slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Concave  
*Hydric soil rating:* No

**Unnamed**

*Percent of map unit:* 2 percent

**Montauk**

*Percent of map unit:* 2 percent  
*Landform:* Hillslopes  
*Landform position (two-dimensional):* Summit, shoulder  
*Landform position (three-dimensional):* Head slope, nose slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

**253A—Hinckley loamy sand, 0 to 3 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 2svm7  
*Elevation:* 0 to 1,420 feet  
*Mean annual precipitation:* 36 to 71 inches  
*Mean annual air temperature:* 39 to 55 degrees F



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*Frost-free period:* 140 to 240 days

*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Hinckley and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Hinckley**

**Setting**

*Landform:* Outwash terraces, outwash plains, kame terraces, outwash deltas

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Concave, convex, linear

*Across-slope shape:* Convex, linear, concave

*Parent material:* Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

**Typical profile**

*Oe - 0 to 1 inches:* moderately decomposed plant material

*A - 1 to 8 inches:* loamy sand

*Bw1 - 8 to 11 inches:* gravelly loamy sand

*Bw2 - 11 to 16 inches:* gravelly loamy sand

*BC - 16 to 19 inches:* very gravelly loamy sand

*C - 19 to 65 inches:* very gravelly sand

**Properties and qualities**

*Slope:* 0 to 3 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Excessively drained

*Runoff class:* Negligible

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to very high (1.42 to 99.90 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)

*Available water supply, 0 to 60 inches:* Low (about 3.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3s

*Hydrologic Soil Group:* A

*Ecological site:* F144AY022MA - Dry Outwash

*Hydric soil rating:* No

**Minor Components**

**Windsor**

*Percent of map unit:* 5 percent

*Landform:* Outwash deltas, kame terraces, outwash terraces

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Concave, convex, linear

*Across-slope shape:* Convex, linear, concave

*Hydric soil rating:* No

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**Sudbury**

*Percent of map unit:* 5 percent  
*Landform:* Outwash deltas, outwash terraces, kame terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Concave, convex, linear  
*Across-slope shape:* Convex, linear, concave  
*Hydric soil rating:* No

**Merrimac**

*Percent of map unit:* 5 percent  
*Landform:* Outwash deltas, outwash terraces, kame terraces  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Concave, convex, linear  
*Across-slope shape:* Convex, linear, concave  
*Hydric soil rating:* No

**305B—Paxton fine sandy loam, 3 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 2t2qp  
*Elevation:* 0 to 1,570 feet  
*Mean annual precipitation:* 36 to 71 inches  
*Mean annual air temperature:* 39 to 55 degrees F  
*Frost-free period:* 140 to 240 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Paxton and similar soils:* 80 percent  
*Minor components:* 20 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Paxton**

**Setting**

*Landform:* Ground moraines, drumlins, hills  
*Landform position (two-dimensional):* Summit, shoulder, backslope  
*Landform position (three-dimensional):* Nose slope, side slope, crest  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Convex  
*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

**Typical profile**

*Ap - 0 to 8 inches:* fine sandy loam  
*Bw1 - 8 to 15 inches:* fine sandy loam  
*Bw2 - 15 to 26 inches:* fine sandy loam  
*Cd - 26 to 65 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 3 to 8 percent

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*Depth to restrictive feature:* 18 to 39 inches to densic material  
*Drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)  
*Depth to water table:* About 18 to 37 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Low (about 3.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2s  
*Hydrologic Soil Group:* C  
*Ecological site:* F144AY007CT - Well Drained Dense Till Uplands  
*Hydric soil rating:* No

**Minor Components**

**Woodbridge**

*Percent of map unit:* 9 percent  
*Landform:* Ground moraines, drumlins, hills  
*Landform position (two-dimensional):* Summit, backslope, footslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

**Ridgebury**

*Percent of map unit:* 6 percent  
*Landform:* Depressions, ground moraines, hills, drainageways  
*Landform position (two-dimensional):* Toeslope, backslope, footslope  
*Landform position (three-dimensional):* Base slope, head slope, dip  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

**Charlton**

*Percent of map unit:* 5 percent  
*Landform:* Hills  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

**305D—Paxton fine sandy loam, 15 to 25 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 2w67j  
*Elevation:* 0 to 1,450 feet  
*Mean annual precipitation:* 36 to 71 inches

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*Mean annual air temperature:* 39 to 55 degrees F  
*Frost-free period:* 140 to 240 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Paxton and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Paxton**

**Setting**

*Landform:* Ground moraines, hills, drumlins  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Convex  
*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

**Typical profile**

*Ap - 0 to 8 inches:* fine sandy loam  
*Bw1 - 8 to 15 inches:* fine sandy loam  
*Bw2 - 15 to 26 inches:* fine sandy loam  
*Cd - 26 to 65 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 15 to 25 percent  
*Depth to restrictive feature:* 20 to 39 inches to densic material  
*Drainage class:* Well drained  
*Runoff class:* High  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)  
*Depth to water table:* About 18 to 37 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Low (about 4.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* C  
*Ecological site:* F144AY007CT - Well Drained Dense Till Uplands  
*Hydric soil rating:* No

**Minor Components**

**Charlton**

*Percent of map unit:* 8 percent  
*Landform:* Hills  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

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**Woodbridge**

*Percent of map unit:* 6 percent  
*Landform:* Hills, drumlins, ground moraines  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

**Ridgebury**

*Percent of map unit:* 1 percent  
*Landform:* Drumlins, depressions, ground moraines, hills, drainageways  
*Landform position (two-dimensional):* Footslope, toeslope  
*Landform position (three-dimensional):* Head slope, base slope  
*Down-slope shape:* Concave, linear  
*Across-slope shape:* Concave, linear  
*Hydric soil rating:* Yes

**307E—Paxton fine sandy loam, 25 to 35 percent slopes, extremely stony**

**Map Unit Setting**

*National map unit symbol:* 2w67q  
*Elevation:* 0 to 1,400 feet  
*Mean annual precipitation:* 36 to 71 inches  
*Mean annual air temperature:* 39 to 55 degrees F  
*Frost-free period:* 145 to 240 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Paxton, extremely stony, and similar soils:* 90 percent  
*Minor components:* 10 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Paxton, Extremely Stony**

**Setting**

*Landform:* Ground moraines, hills, drumlins  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Linear, convex  
*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

**Typical profile**

*Oe - 0 to 2 inches:* moderately decomposed plant material  
*A - 2 to 10 inches:* fine sandy loam  
*Bw1 - 10 to 17 inches:* fine sandy loam  
*Bw2 - 17 to 28 inches:* fine sandy loam  
*Cd - 28 to 67 inches:* gravelly fine sandy loam

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**Properties and qualities**

*Slope:* 25 to 35 percent  
*Surface area covered with cobbles, stones or boulders:* 9.0 percent  
*Depth to restrictive feature:* 20 to 43 inches to densic material  
*Drainage class:* Well drained  
*Runoff class:* High  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)  
*Depth to water table:* About 18 to 37 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Low (about 4.7 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 7s  
*Hydrologic Soil Group:* C  
*Ecological site:* F144AY007CT - Well Drained Dense Till Uplands  
*Hydric soil rating:* No

**Minor Components**

**Charlton, extremely stony**

*Percent of map unit:* 8 percent  
*Landform:* Hills  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

**Woodbridge, extremely stony**

*Percent of map unit:* 1 percent  
*Landform:* Hills, drumlins, ground moraines  
*Landform position (two-dimensional):* Backslope, footslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

**Chatfield, extremely stony**

*Percent of map unit:* 1 percent  
*Landform:* Ridges, hills  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

## **310A—Woodbridge fine sandy loam, 0 to 3 percent slopes**

### **Map Unit Setting**

*National map unit symbol:* 2w686  
*Elevation:* 0 to 1,420 feet  
*Mean annual precipitation:* 36 to 71 inches  
*Mean annual air temperature:* 39 to 55 degrees F  
*Frost-free period:* 140 to 240 days  
*Farmland classification:* All areas are prime farmland

### **Map Unit Composition**

*Woodbridge and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### **Description of Woodbridge**

#### **Setting**

*Landform:* Ground moraines, hills, drumlins  
*Landform position (two-dimensional):* Summit, footslope  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Convex  
*Across-slope shape:* Linear  
*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

#### **Typical profile**

*Ap - 0 to 7 inches:* fine sandy loam  
*Bw1 - 7 to 18 inches:* fine sandy loam  
*Bw2 - 18 to 30 inches:* fine sandy loam  
*Cd - 30 to 65 inches:* gravelly fine sandy loam

#### **Properties and qualities**

*Slope:* 0 to 3 percent  
*Depth to restrictive feature:* 20 to 39 inches to densic material  
*Drainage class:* Moderately well drained  
*Runoff class:* Very high  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)  
*Depth to water table:* About 18 to 30 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Low (about 4.7 inches)

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2w  
*Hydrologic Soil Group:* C/D  
*Ecological site:* F144AY037MA - Moist Dense Till Uplands

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*Hydric soil rating:* No

**Minor Components**

**Paxton**

*Percent of map unit:* 7 percent  
*Landform:* Ground moraines, hills, drumlins  
*Landform position (two-dimensional):* Summit, shoulder  
*Landform position (three-dimensional):* Crest  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

**Ridgebury**

*Percent of map unit:* 6 percent  
*Landform:* Depressions, ground moraines, drainageways, drumlins, hills  
*Landform position (two-dimensional):* Footslope, toeslope  
*Landform position (three-dimensional):* Head slope, base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

**Sutton**

*Percent of map unit:* 1 percent  
*Landform:* Ground moraines, hills  
*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

**Whitman, extremely stony**

*Percent of map unit:* 1 percent  
*Landform:* Drainageways, depressions  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

**310B—Woodbridge fine sandy loam, 3 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 2t2ql  
*Elevation:* 0 to 1,470 feet  
*Mean annual precipitation:* 36 to 71 inches  
*Mean annual air temperature:* 39 to 55 degrees F  
*Frost-free period:* 140 to 240 days  
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Woodbridge, fine sandy loam, and similar soils:* 82 percent  
*Minor components:* 18 percent



Custom Soil Resource Report

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Woodbridge, Fine Sandy Loam**

**Setting**

*Landform:* Ground moraines, drumlins, hills  
*Landform position (two-dimensional):* Summit, backslope, footslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

**Typical profile**

*Ap - 0 to 7 inches:* fine sandy loam  
*Bw1 - 7 to 18 inches:* fine sandy loam  
*Bw2 - 18 to 30 inches:* fine sandy loam  
*Cd - 30 to 65 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 3 to 8 percent  
*Depth to restrictive feature:* 20 to 39 inches to densic material  
*Drainage class:* Moderately well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)  
*Depth to water table:* About 18 to 30 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Low (about 3.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2w  
*Hydrologic Soil Group:* C/D  
*Ecological site:* F144AY037MA - Moist Dense Till Uplands  
*Hydric soil rating:* No

**Minor Components**

**Paxton**

*Percent of map unit:* 10 percent  
*Landform:* Drumlins, ground moraines, hills  
*Landform position (two-dimensional):* Summit, shoulder, backslope  
*Landform position (three-dimensional):* Nose slope, side slope, crest  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Convex  
*Hydric soil rating:* No

**Ridgebury**

*Percent of map unit:* 8 percent  
*Landform:* Depressions, ground moraines, hills, drainageways  
*Landform position (two-dimensional):* Toeslope, backslope, footslope  
*Landform position (three-dimensional):* Base slope, head slope, dip  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave

Custom Soil Resource Report

*Hydric soil rating:* Yes

**311B—Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony**

**Map Unit Setting**

*National map unit symbol:* 2t2qr

*Elevation:* 0 to 1,440 feet

*Mean annual precipitation:* 36 to 71 inches

*Mean annual air temperature:* 39 to 55 degrees F

*Frost-free period:* 140 to 240 days

*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Woodbridge, very stony, and similar soils:* 82 percent

*Minor components:* 18 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Woodbridge, Very Stony**

**Setting**

*Landform:* Ground moraines, hills, drumlins

*Landform position (two-dimensional):* Summit, backslope, footslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Concave

*Across-slope shape:* Linear

*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

**Typical profile**

*Oe - 0 to 2 inches:* moderately decomposed plant material

*A - 2 to 9 inches:* fine sandy loam

*Bw1 - 9 to 20 inches:* fine sandy loam

*Bw2 - 20 to 32 inches:* fine sandy loam

*Cd - 32 to 67 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 0 to 8 percent

*Surface area covered with cobbles, stones or boulders:* 1.6 percent

*Depth to restrictive feature:* 20 to 43 inches to densic material

*Drainage class:* Moderately well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)

*Depth to water table:* About 19 to 27 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)

*Available water supply, 0 to 60 inches:* Low (about 4.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

Custom Soil Resource Report

*Land capability classification (nonirrigated): 6s*  
*Hydrologic Soil Group: C/D*  
*Ecological site: F144AY037MA - Moist Dense Till Uplands*  
*Hydric soil rating: No*

**Minor Components**

**Paxton, very stony**

*Percent of map unit: 10 percent*  
*Landform: Ground moraines, hills, drumlins*  
*Landform position (two-dimensional): Summit, shoulder, backslope*  
*Landform position (three-dimensional): Side slope, crest*  
*Down-slope shape: Convex, linear*  
*Across-slope shape: Linear, convex*  
*Hydric soil rating: No*

**Ridgebury, very stony**

*Percent of map unit: 8 percent*  
*Landform: Hills, drainageways, drumlins, depressions, ground moraines*  
*Landform position (two-dimensional): Toeslope*  
*Landform position (three-dimensional): Head slope, base slope*  
*Down-slope shape: Concave*  
*Across-slope shape: Concave*  
*Hydric soil rating: Yes*

**311C—Woodbridge fine sandy loam, 8 to 15 percent slopes, very stony**

**Map Unit Setting**

*National map unit symbol: 2w687*  
*Elevation: 0 to 1,420 feet*  
*Mean annual precipitation: 36 to 71 inches*  
*Mean annual air temperature: 39 to 55 degrees F*  
*Frost-free period: 140 to 240 days*  
*Farmland classification: Farmland of statewide importance*

**Map Unit Composition**

*Woodbridge, very stony, and similar soils: 85 percent*  
*Minor components: 15 percent*  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Woodbridge, Very Stony**

**Setting**

*Landform: Ground moraines, hills, drumlins*  
*Landform position (two-dimensional): Backslope, footslope*  
*Landform position (three-dimensional): Side slope*  
*Down-slope shape: Convex*  
*Across-slope shape: Linear*  
*Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist*

Custom Soil Resource Report

**Typical profile**

*Oe - 0 to 2 inches:* moderately decomposed plant material  
*A - 2 to 9 inches:* fine sandy loam  
*Bw1 - 9 to 20 inches:* fine sandy loam  
*Bw2 - 20 to 32 inches:* fine sandy loam  
*Cd - 32 to 67 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 8 to 15 percent  
*Surface area covered with cobbles, stones or boulders:* 1.6 percent  
*Depth to restrictive feature:* 20 to 43 inches to densic material  
*Drainage class:* Moderately well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)  
*Depth to water table:* About 19 to 27 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Low (about 5.3 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 6s  
*Hydrologic Soil Group:* C/D  
*Ecological site:* F144AY037MA - Moist Dense Till Uplands  
*Hydric soil rating:* No

**Minor Components**

**Paxton, very stony**

*Percent of map unit:* 9 percent  
*Landform:* Ground moraines, hills, drumlins  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Linear, convex  
*Hydric soil rating:* No

**Ridgebury, very stony**

*Percent of map unit:* 4 percent  
*Landform:* Drumlins, depressions, hills, drainageways, ground moraines  
*Landform position (two-dimensional):* Footslope, toeslope  
*Landform position (three-dimensional):* Head slope, base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

**Sutton, very stony**

*Percent of map unit:* 1 percent  
*Landform:* Ground moraines, hills  
*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Linear  
*Hydric soil rating:* No

Custom Soil Resource Report

**Whitman, very stony**

*Percent of map unit:* 1 percent  
*Landform:* Drainageways, depressions  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

**603—Urban land, wet substratum**

**Map Unit Setting**

*National map unit symbol:* 9951  
*Mean annual precipitation:* 32 to 50 inches  
*Mean annual air temperature:* 45 to 50 degrees F  
*Frost-free period:* 110 to 200 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Urban land:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Urban Land**

**Setting**

*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Excavated and filled land over alluvium and/or marine deposits

**Minor Components**

**Udorthents, loamy**

*Percent of map unit:* 10 percent  
*Hydric soil rating:* No

**Rock outcrop**

*Percent of map unit:* 5 percent  
*Landform:* Ledges  
*Landform position (two-dimensional):* Summit  
*Landform position (three-dimensional):* Head slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave

## 654—Udorthents, loamy

### Map Unit Setting

*National map unit symbol:* vr11  
*Elevation:* 0 to 3,000 feet  
*Mean annual precipitation:* 32 to 50 inches  
*Mean annual air temperature:* 45 to 50 degrees F  
*Frost-free period:* 110 to 200 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Udorthents, loamy, and similar soils:* 80 percent  
*Minor components:* 20 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Udorthents, Loamy

#### Setting

*Parent material:* Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

#### Properties and qualities

*Depth to restrictive feature:* More than 80 inches  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None

### Minor Components

#### Udorthents, sandy

*Percent of map unit:* 10 percent  
*Hydric soil rating:* No

#### Urban land

*Percent of map unit:* 5 percent  
*Landform position (two-dimensional):* Footslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear

#### Udorthents, wet substratum

*Percent of map unit:* 5 percent  
*Hydric soil rating:* Yes

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**Location:** Boston Road  
 Westford, MA

**Client:** Town of Westford  
**Address:** 28 North Street, Westford, MA 01886  
**Telephone:** 978-692-5537

**Date:** 4/15/2021    **Wetlands:** >100'    **Zone II:** N/A    **Soil Symbol:** 310B    **Soil Name:** Woodbridge    **Soil Class:** C/D

**Test Pit:** TP-1    **Elevation:** 254.00

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10	Ap	10 YR 3/2				Sandy Loam			Massive	Friable	
10-18	Bw	10 YR 4/4				Sandy Loam			Massive	Friable	
18-32	C1	10 YR 5/6				Sandy Loam			Massive	Friable	
32-84	C2	10 YR 6/4				Loamy Sand	5-10	5-10	Massive	Friable	

**Parent Material:** lodgement till    **Depth to Bedrock:** N/A    **Standing Water:** 84"    **ESHWG:** 84"

**Additional Notes:** Test pits excavation performed by Town of Westford. Jeremy Downs witnessed test pits with TEC. There was no evidence of redoximorphic features present on the side walls of the test pits. Weeping was observed at 84".

**Test Pit Performed by:** Peter Ellison

**Soil Evaluator Number:** 13866



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**Location:** Boston Road  
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**Client:** Town of Westford  
**Address:** 28 North Street, Westford, MA 01886  
**Telephone:** 978-692-5537

**Date:** 4/15/2021    **Wetlands:** 88'    **Zone II:** N/A    **Soil Symbol:** 310B    **Soil Name:** Woodbridge    **Soil Class:** C/D

**Test Pit:** TP-2    **Elevation:** 257.00

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6	Ap	10 YR 3/2				Sandy Loam			Massive	Friable	
6-22	Bw	10 YR 4/4				Sandy Loam			Massive	Friable	
22-70	C1	10 YR 5/6				Loamy Sand	5-10	5-10	Massive	Friable	
70-96	C2	10 YR 6/4				Coarse Sand	20-30	20-30	Massive	Friable	

**Parent Material:** lodgement till    **Depth to Bedrock:** N/A    **Standing Water:** N/A    **ESHWG:** N/A

**Additional Notes:** Test pits excavation performed by Town of Westford. Jeremy Downs witnessed test pits with TEC. Test pit was terminated at 96" depth because this was the maximum capability of the backhoe onsite.

**Test Pit Performed by:** Peter Ellison

**Soil Evaluator Number:** 13866



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**Location:** Boston Road  
 Westford, MA

**Client:** Town of Westford  
**Address:** 28 North Street, Westford, MA 01886  
**Telephone:** 978-692-5537

**Date:** 4/15/2021    **Wetlands:** 91'    **Zone II:** N/A    **Soil Symbol:** 310B    **Soil Name:** Woodbridge    **Soil Class:** C/D

**Test Pit:** TP-3    **Elevation:** 258.00

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-9	Ap	10 YR 3/2				Sandy Loam			Massive	Friable	
9-16	Bw	10 YR 4/6				Sandy Loam			Massive	Friable	
16-104	C1	10 YR 6/4				Coarse Sand	10-20	10-20	Massive	Friable	

**Parent Material:** lodgement till    **Depth to Bedrock:** N/A    **Standing Water:** N/A    **ESHWG:** N/A

**Additional Notes:** Test pits excavation performed by Town of Westford. Jeremy Downs witnessed test pits with TEC. Test pit was terminated at 104" depth because this was the maximum capability of the backhoe onsite.

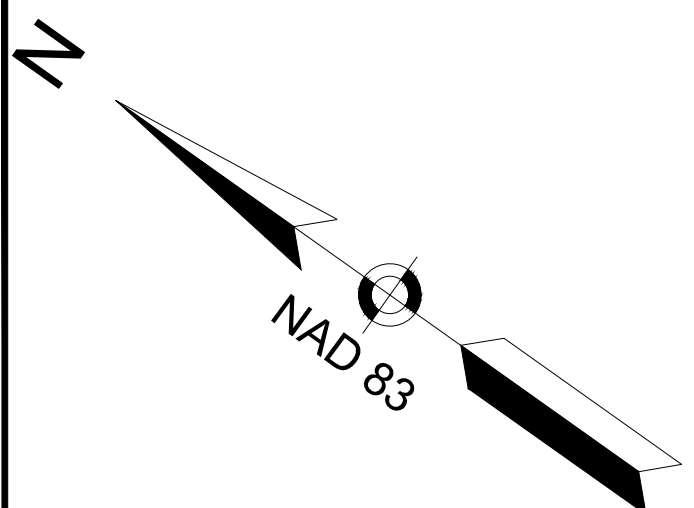
**Test Pit Performed by:** Peter Ellison

**Soil Evaluator Number:** 13866

### WESTFORD BOSTON ROAD

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	1	1
PROJECT FILE NO. 609035			

#### Test Pit Plan



HIGHWAY GUARD DETAILS

NONE

TRAFFIC SIGNAL CONDUIT

NONE

WATER SUPPLY ALTERATIONS

NONE

DRAINAGE DETAILS

SEE SHEET 57

N/F  
TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0016  
BK-PG 6117-0304

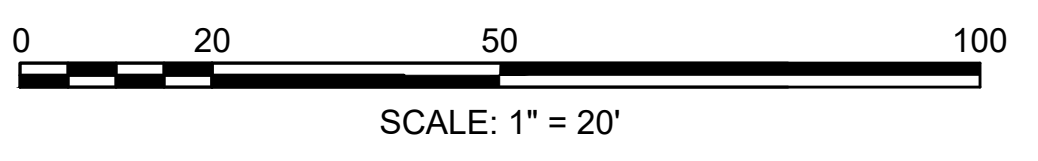
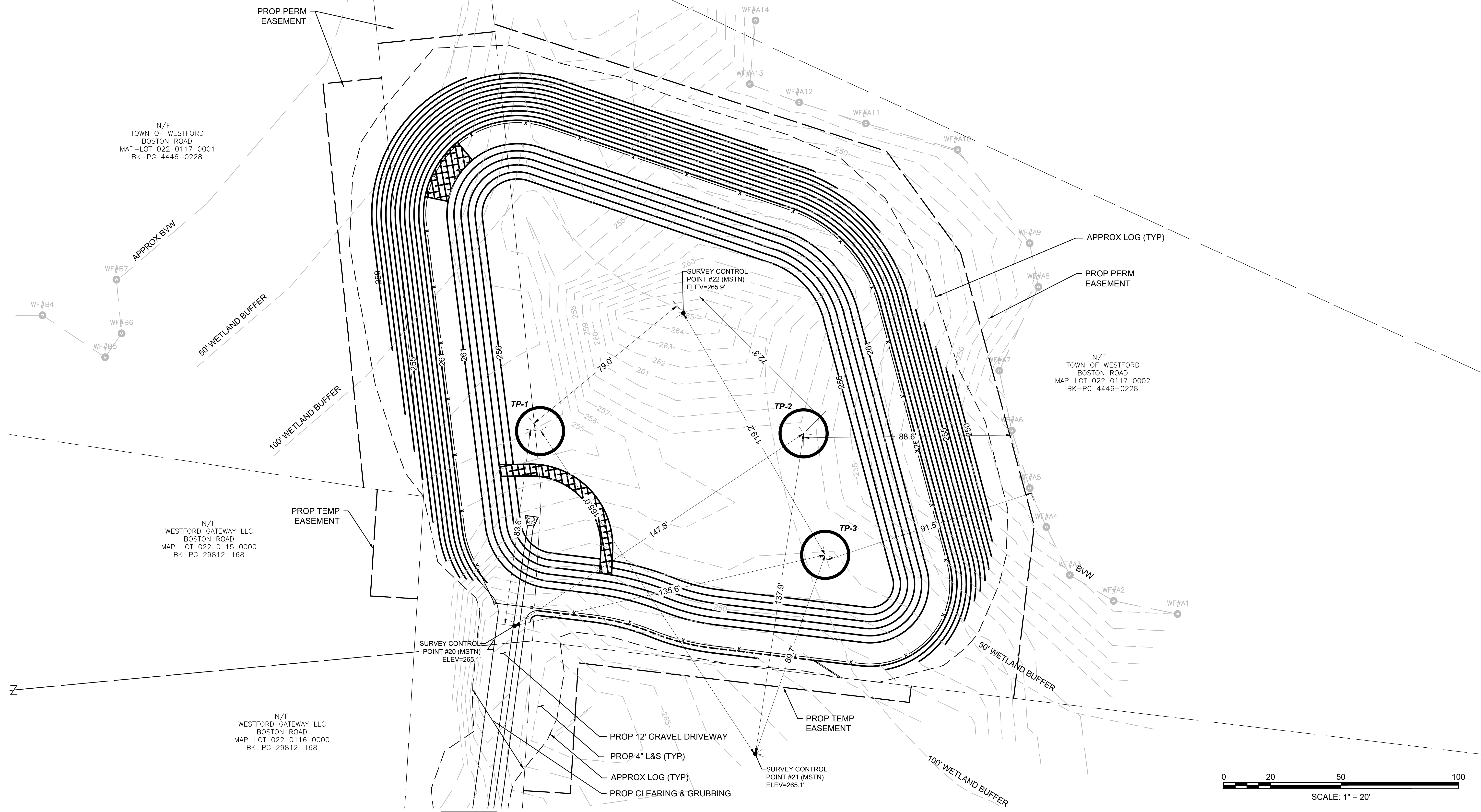
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TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0001  
BK-PG 4446-0228

N/F  
TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0002  
BK-PG 4446-0228

N/F  
WESTFORD GATEWAY LLC  
BOSTON ROAD  
MAP-LOT 022 0115 0000  
BK-PG 29812-168

N/F  
WESTFORD GATEWAY LLC  
BOSTON ROAD  
MAP-LOT 022 0116 0000  
BK-PG 29812-168

CONTINUED ON  
SHEET NO. 14





**FLOOD HAZARD INFORMATION**

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT FIRM PANEL LAYOUT

	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway
	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee See Notes Zone X
	Area with Flood Risk due to Levee Zone D
	NO SCREEN Area of Minimal Flood Hazard Zone X
	Effective LOMRs
	Area of Undetermined Flood Hazard Zone D
	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
	20.2 Cross Sections with 1% Annual Chance
	17.5 Water Surface Elevation
	8 Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

**NOTES TO USERS**

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-6627) or visit the FEMA Flood Map Service Center website at <https://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

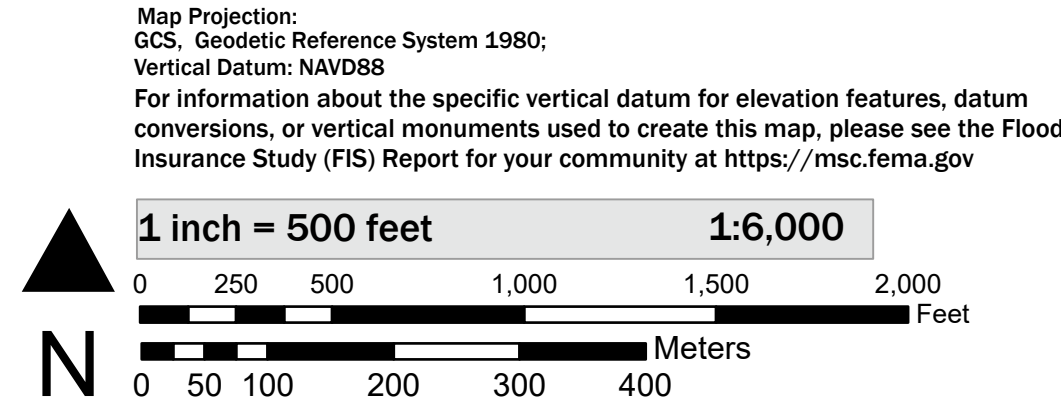
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by the United States Geological Survey (USGS). The basemap shown is the USGS National Map: Orthoimagery, Last refreshed October, 2020.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **1/13/2023 1:06 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at <https://www.fema.gov/media-library/assets/documents/118418>

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards. This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

**SCALE**



**NATIONAL FLOOD INSURANCE PROGRAM**  
FLOOD INSURANCE RATE MAP

PANEL 229 OF 654

Panel Contains:

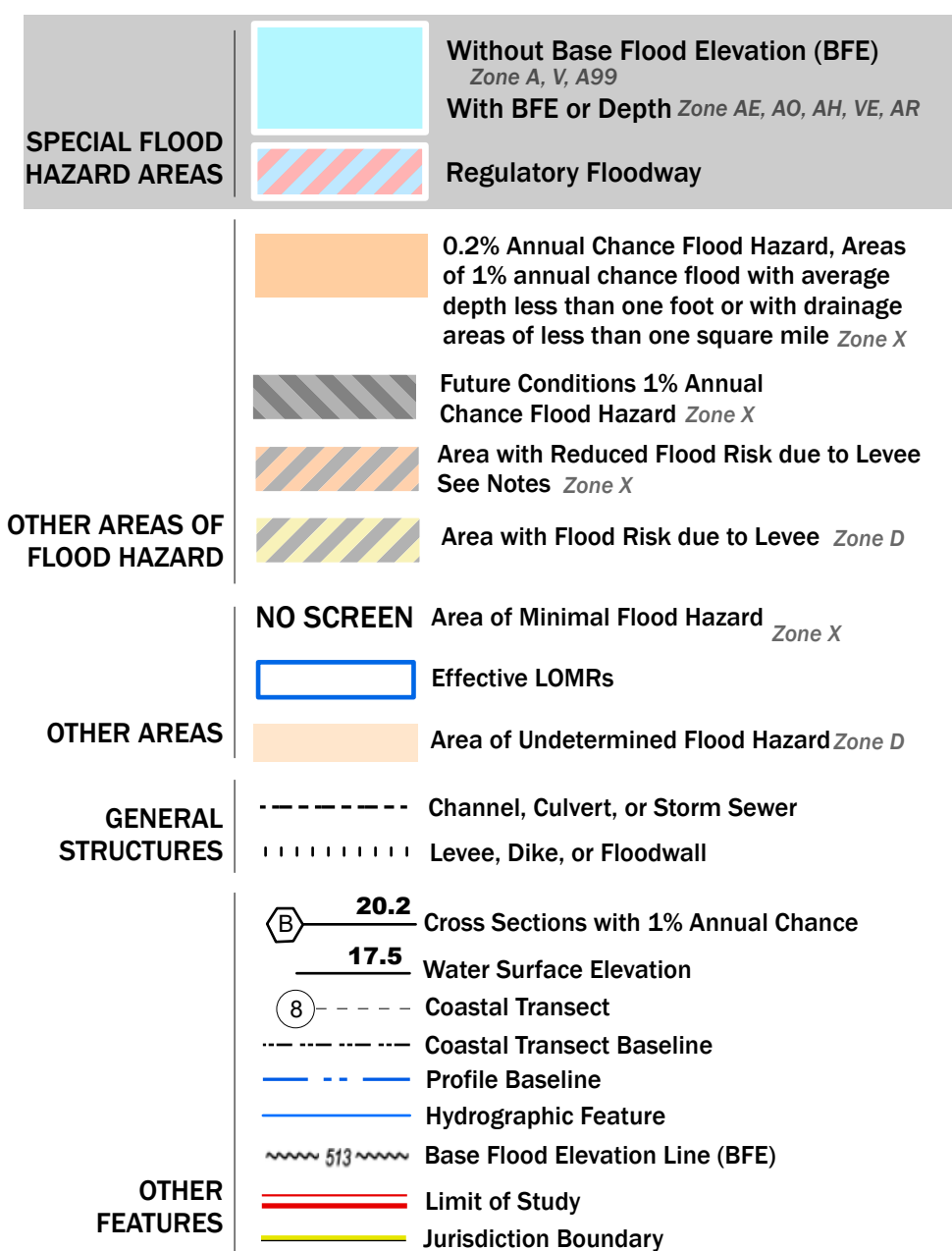
COMMUNITY	NUMBER	PANEL
TOWN OF WESTFORD	250225	0229





**FLOOD HAZARD INFORMATION**

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT FIRM PANEL LAYOUT



**NOTES TO USERS**

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For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

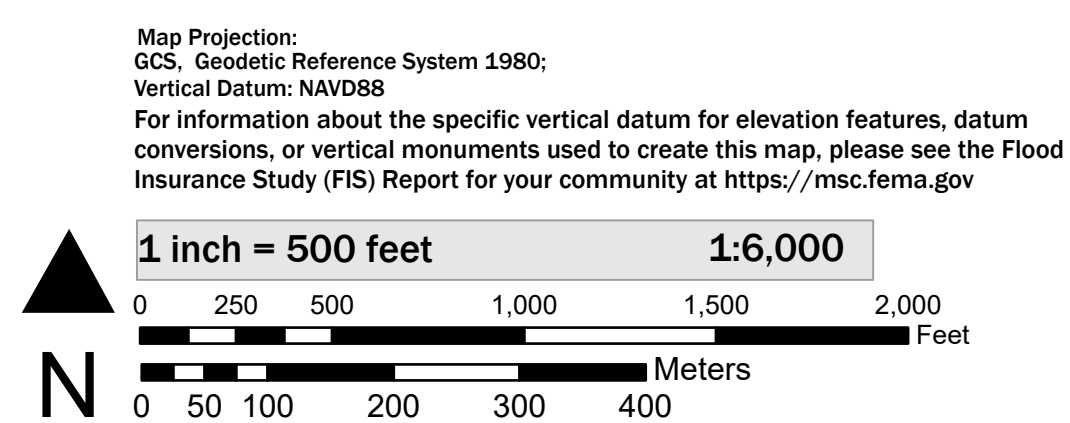
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by the United States Geological Survey (USGS). The basemap shown is the USGS National Map: Orthoimagery. Last refreshed October, 2020.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **1/13/2023 12:40 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at <https://www.fema.gov/media-library/assets/documents/118418>

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards. This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

**SCALE**



**NATIONAL FLOOD INSURANCE PROGRAM**  
FLOOD INSURANCE RATE MAP

PANEL 233 OF 654

Panel Contains:  
COMMUNITY TOWN OF WESTFORD  
NUMBER 250225  
PANEL 0233

MAP NUMBER 25017C0233F  
EFFECTIVE DATE July 07, 2014

## **C. SUPPORTING CALCULATIONS**

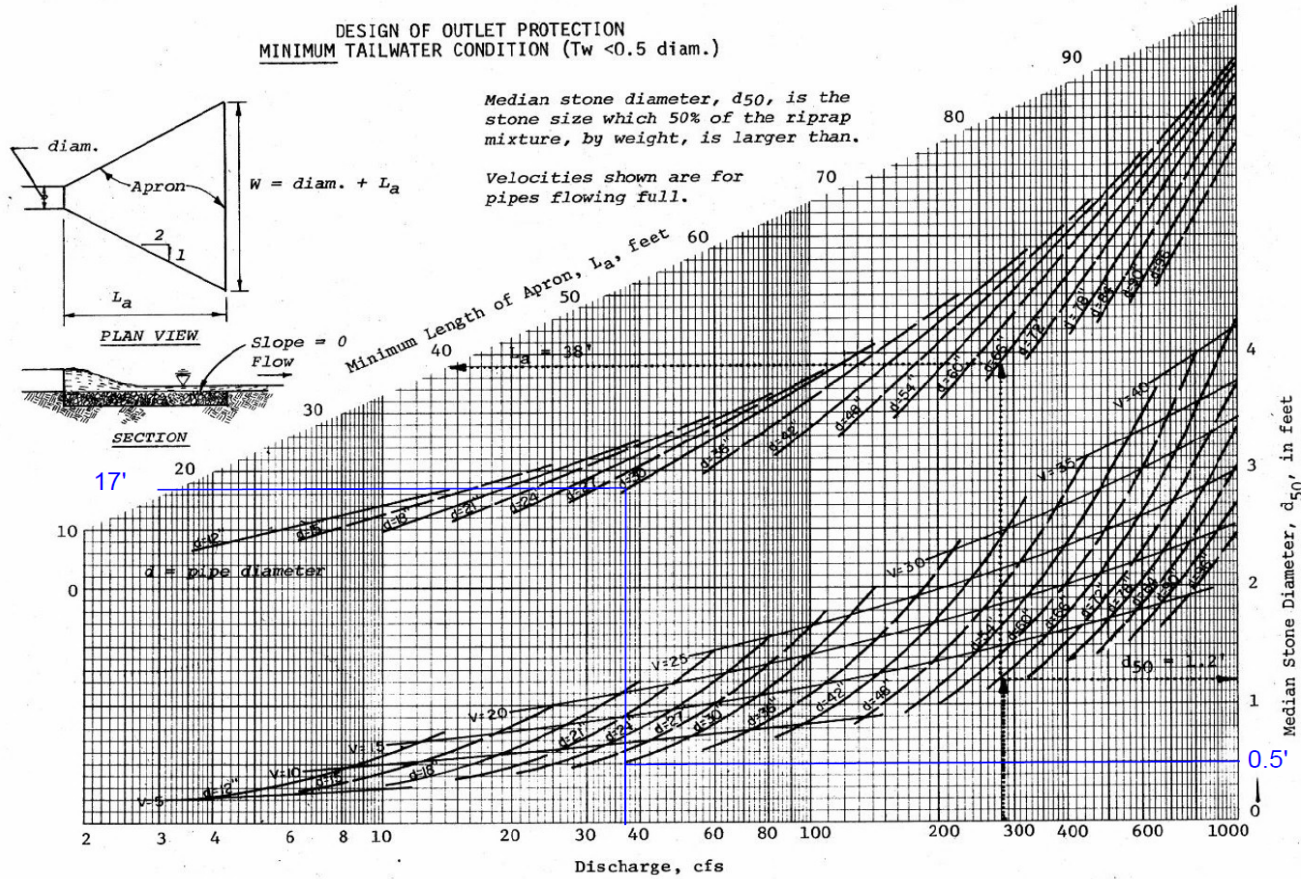
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282 Merrimack St.  
Lawrence, MA 01813  
978.794.1792  
TheEngineeringCorp.com  
Create | Design | Innovate

Project: Boston Road  
Location: Westford, MA

Date: 3/13/2023



Rip Rap Apron Sizing Summary							
Pipe	Outfall Location	Pipe Dia.	$Q_{10}$	$V_{10}$	$d_{50}$	length	width
31-out*	Outfall just south of Crown Rd.	24"	23.27 cfs	8.16 ft/s	6 in.	5 ft.	6 ft.
Pond Outfall	Outfall from Wet Basin	30"	36.84 cfs	9.45 ft/s	6 in.	17 ft.	19.5 ft.

\* sizing based on MassDOT standard drawing E 206.7, "Stone Pipe Ends for Pipes 24" and Less in Dia."





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**Standard 3. Groundwater Recharge(Static Method)**

NRCS Hydrologic Soil Type	Target Depth Factor - F (inches)	New Impervious Area (square feet)	Recharge Volume - $R_v$ (cubic feet)
A	0.6	0	0
B	0.35	0	0
C	0.25	7,878	164
D	0.1	27,911	233
Total $R_v = F \times$ Impervious Area =			<b>397</b> ft <sup>3</sup>

BMP #	Volume below lowest outfall (cubic feet)
Recharge Volume Provided =	<b>0</b>



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**Standard 4. Water Quality**

Infiltration Basin #1

New Impervious Area = $A_{IMP}$ =	35,789	ft <sup>2</sup>
Water Quality Depth = $D_{WQ}$ =	0.5	in.

Required Water Quality Volume =  $V_{WQ} = D_{WQ} * A_{IMP} =$ 

1,491	ft <sup>3</sup>
-------	-----------------

BMP #	Volume Provided
Wet Pond	55,011
Water Quality Volume Provided =	<b>55,011</b>



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**DP-1**

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Street Sweeping	0	1	0	1
Deep Sump Catch Basins w/ Hoods	0.25	1	0.25	0.75
Outlet Sediment Trap	0.25	0.75	0.19	0.56
<b>Total TSS Removal =</b>				<b>44%</b>

**DP-2(Wet Basin)**

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Street Sweeping	0	1	0	1
Deep Sump Catch Basins w/ Hoods	0.25	1	0.25	0.75
Sediment Forebay	0.25	0.75	0.19	0.56
Wet Basin	0.8	0.56	0.45	0.11
<b>Total TSS Removal =</b>				<b>89%</b>

**DP-2(I-495 Outfall)**

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (B*C)	Remaining Load (C-D)
Street Sweeping	0	1	0	1
Deep Sump Catch Basins w/ Hoods	0.25	1	0.25	0.75
<b>Total TSS Removal =</b>				<b>25%</b>

## **D. HYDRAULIC AND HYDROLOGIC INFORMATION**

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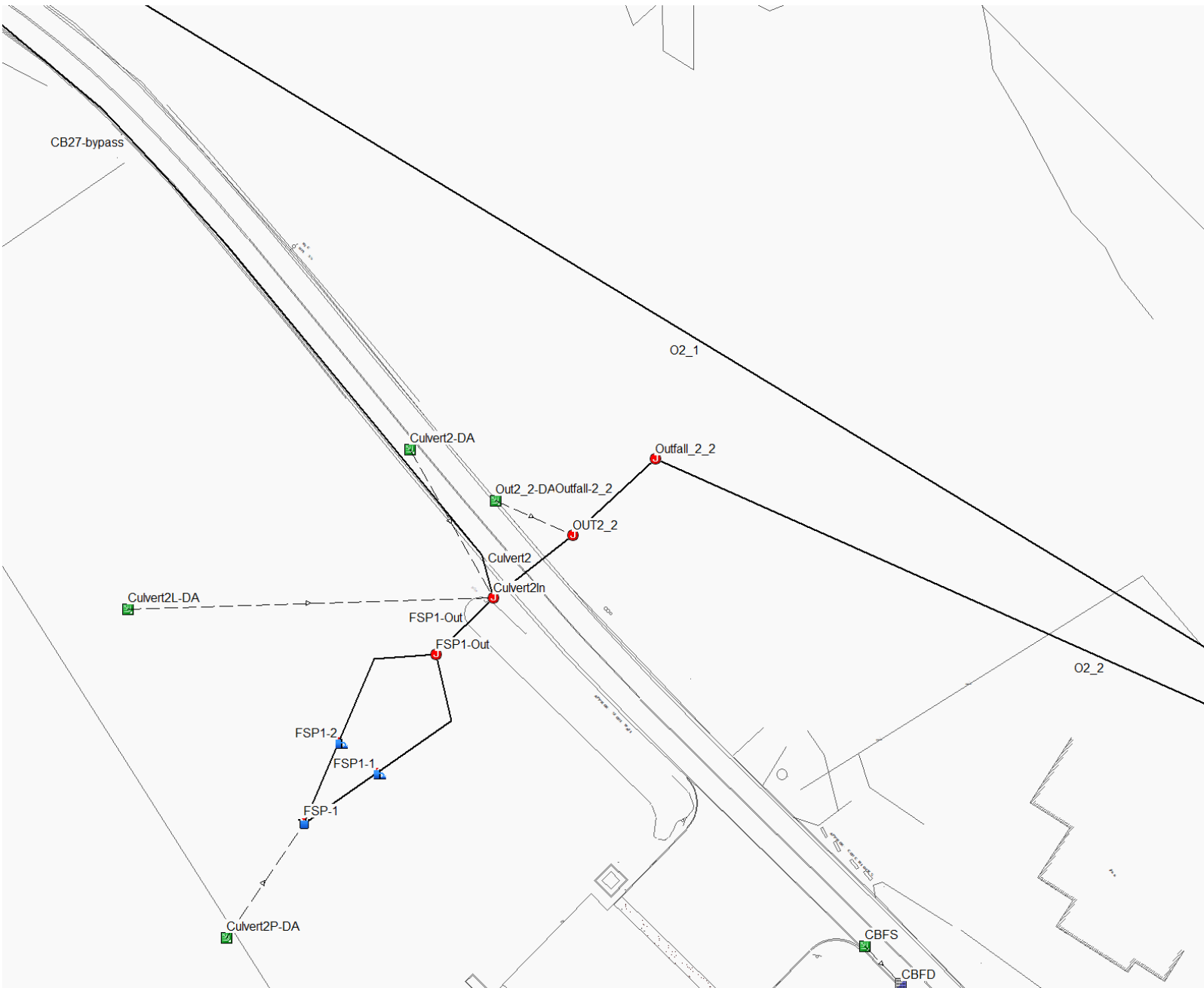




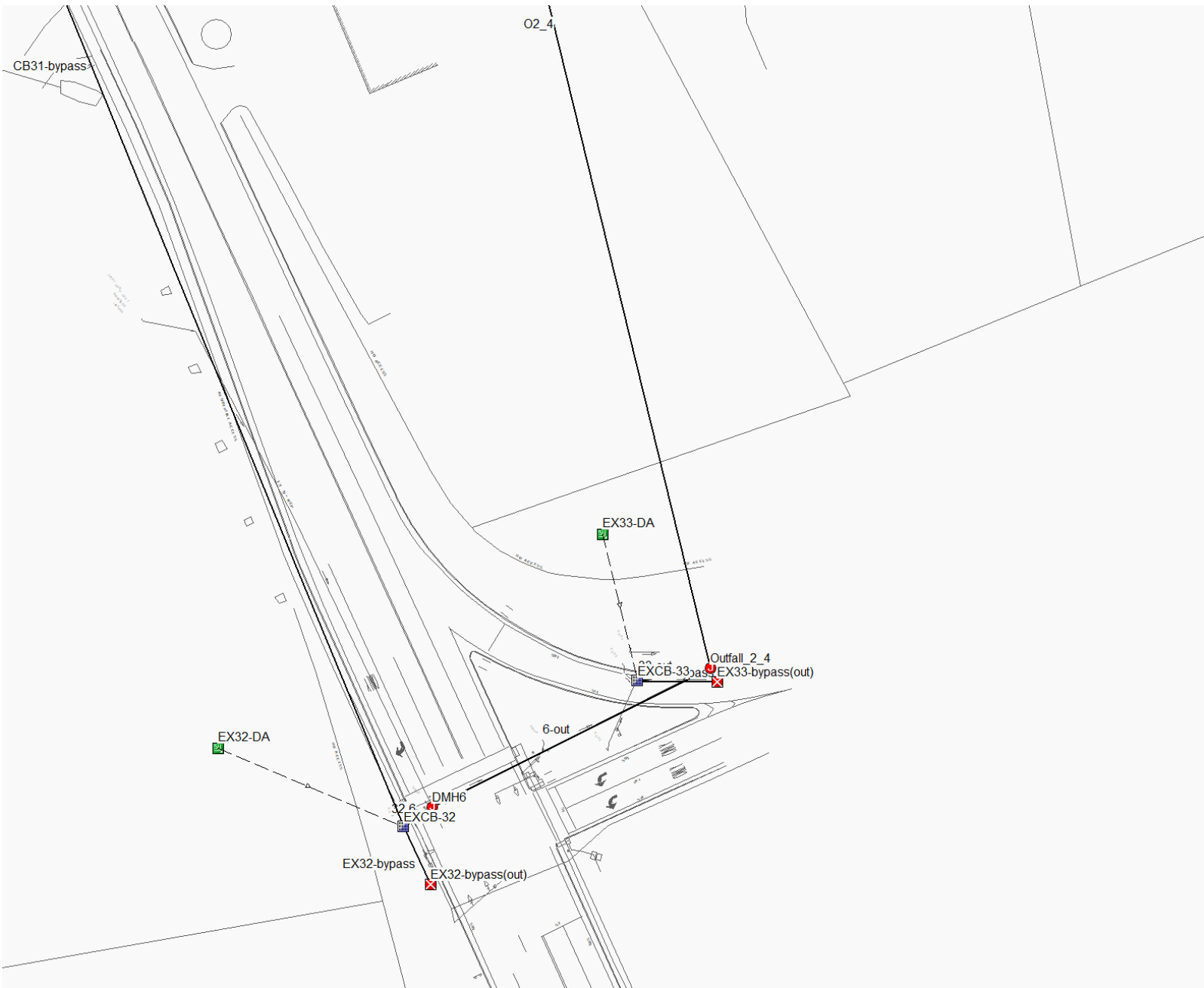












**Project Description**

File Name ..... Boston Rd - Pre Dev - 20221215.SPF

**Project Options**

Flow Units ..... CFS  
 Elevation Type ..... Elevation  
 Hydrology Method ..... SCS TR-55  
 Time of Concentration (TOC) Method ..... SCS TR-55  
 Link Routing Method ..... Kinematic Wave  
 Enable Overflow Ponding at Nodes ..... YES  
 Skip Steady State Analysis Time Periods ... YES

**Analysis Options**

Start Analysis On ..... 00:00:00      0:00:00  
 End Analysis On ..... 00:00:00      0:00:00  
 Start Reporting On ..... 00:00:00      0:00:00  
 Antecedent Dry Days ..... 0      days  
 Runoff (Dry Weather) Time Step ..... 0 01:00:00      days hh:mm:ss  
 Runoff (Wet Weather) Time Step ..... 0 00:05:00      days hh:mm:ss  
 Reporting Time Step ..... 0 00:00:10      days hh:mm:ss  
 Routing Time Step ..... 10      seconds

**Number of Elements**

Qty  
 Rain Gages ..... 1  
 Subbasins ..... 53  
 Nodes ..... 58  
     *Junctions* ..... 23  
     *Outfalls* ..... 4  
     *Flow Diversions* ..... 0  
     *Inlets* ..... 29  
     *Storage Nodes* ..... 2  
 Links ..... 83  
     *Channels* ..... 30  
     *Pipes* ..... 48  
     *Pumps* ..... 0  
     *Orifices* ..... 5  
     *Weirs* ..... 0  
     *Outlets* ..... 0  
 Pollutants ..... 0  
 Land Uses ..... 0

**Rainfall Details**

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	002-yr	Cumulative	inches	Massachusetts	Middlesex	2.00	3.17	SCS Type III 24-hr

**Subbasin Summary**

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Blake1P	2.66	484.00	78.70	3.17	1.30	3.44	3.44	0 00:07:38
2	Blake2	0.31	484.00	82.10	3.17	1.52	0.47	0.50	0 00:05:00
3	CB10-DA	0.09	484.00	96.90	3.17	2.81	0.26	0.23	0 00:05:00
4	CB10L-DA	0.93	484.00	80.20	3.17	1.39	1.30	0.90	0 00:26:57
5	CB11-DA	0.09	484.00	95.60	3.17	2.67	0.25	0.23	0 00:05:00
6	CB11L-DA	2.77	484.00	79.00	3.17	1.31	3.64	2.46	0 00:28:39
7	CB12-DA	0.40	484.00	95.50	3.17	2.67	1.08	1.02	0 00:05:00
8	CB13-DA	0.19	484.00	98.00	3.17	2.94	0.56	0.51	0 00:05:00
9	CB13L-DA	7.68	484.00	76.90	3.17	1.18	9.09	5.22	0 00:39:38
10	CB14-DA	0.21	484.00	95.60	3.17	2.68	0.56	0.54	0 00:05:00
11	CB15-DA	0.07	484.00	98.00	3.17	2.92	0.20	0.17	0 00:05:00
12	CB15L-DA	4.60	484.00	73.70	3.17	1.00	4.61	2.77	0 00:33:56
13	CB16-DA	0.05	484.00	98.00	3.17	2.91	0.15	0.14	0 00:05:00
14	CB16L-DA	2.01	484.00	76.40	3.17	1.16	2.33	1.48	0 00:31:25
15	CB17-DA	0.17	484.00	95.70	3.17	2.69	0.45	0.42	0 00:05:00
16	CB18-DA	0.03	484.00	98.00	3.17	2.73	0.07	0.07	0 00:05:00
17	CB18L-DA	0.50	484.00	73.70	3.17	1.00	0.50	0.35	0 00:23:57
18	CB19-DA	0.09	484.00	98.00	3.17	2.93	0.25	0.22	0 00:05:00
19	CB19L-DA	2.56	484.00	72.10	3.17	0.92	2.35	2.01	0 00:12:16
20	CB20-DA	0.12	484.00	96.20	3.17	2.74	0.32	0.30	0 00:05:00
21	CB21-DA	1.31	484.00	74.60	3.17	1.05	1.38	1.25	0 00:10:50
22	CB22-DA	0.13	484.00	95.50	3.17	2.66	0.34	0.32	0 00:05:00
23	CB23-DA	2.06	484.00	75.50	3.17	1.10	2.27	2.05	0 00:11:28
24	CB24-DA	2.61	484.00	76.30	3.17	1.15	3.00	2.92	0 00:08:30
25	CB25-DA	0.43	484.00	92.40	3.17	2.36	1.02	1.02	0 00:05:00
26	CB26-DA	0.07	484.00	96.80	3.17	2.79	0.18	0.17	0 00:05:00
27	CB26L-DA	3.73	484.00	77.20	3.17	1.20	4.49	4.17	0 00:10:45
28	CB27-DA	0.05	484.00	96.80	3.17	2.78	0.14	0.13	0 00:05:00
29	CB27L-DA	0.78	484.00	72.20	3.17	0.92	0.72	0.69	0 00:07:30
30	CB28-DA	0.23	484.00	84.30	3.17	1.68	0.38	0.41	0 00:05:00
31	CB31-DA	0.26	484.00	91.10	3.17	2.24	0.58	0.58	0 00:05:00
32	CB3-DA	1.14	484.00	83.20	3.17	1.60	1.82	1.64	0 00:13:13
33	CB5-DA	0.14	484.00	98.00	3.17	2.93	0.41	0.37	0 00:05:00
34	CB6-DA	0.25	484.00	91.60	3.17	2.28	0.56	0.56	0 00:05:00
35	CB7-DA	0.18	484.00	97.50	3.17	2.88	0.52	0.47	0 00:05:00
36	CB8-DA	0.04	484.00	98.00	3.17	2.90	0.11	0.10	0 00:05:00
37	CB8L-DA	0.64	484.00	83.60	3.17	1.63	1.05	0.76	0 00:25:26
38	CB9-DA	0.03	484.00	98.00	3.17	2.84	0.09	0.08	0 00:05:00
39	CB9L-DA	0.58	484.00	84.90	3.17	1.72	0.99	0.70	0 00:27:09
40	CBFS	0.26	484.00	95.60	3.17	2.68	0.69	0.65	0 00:05:00
41	CD7L-DA	0.63	484.00	83.00	3.17	1.58	1.00	0.89	0 00:14:12
42	Culvert1-DA	0.16	484.00	97.90	3.17	2.92	0.48	0.44	0 00:05:00
43	Culvert1L-DA	6.61	484.00	74.30	3.17	1.03	6.84	5.43	0 00:16:50
44	Culvert2-DA	0.26	484.00	96.90	3.17	2.82	0.74	0.68	0 00:05:00
45	Culvert2L-DA	3.78	484.00	71.50	3.17	0.89	3.34	3.20	0 00:07:29
46	Culvert2P-DA	2.87	484.00	73.50	3.17	0.99	2.84	2.76	0 00:07:33
47	EX32-DA	0.49	484.00	98.00	3.17	2.94	1.45	1.30	0 00:05:00
48	EX33-DA	0.27	484.00	93.80	3.17	2.49	0.67	0.66	0 00:05:00
49	Hildreth-DA	2.35	484.00	87.00	3.17	1.89	4.43	3.81	0 00:15:35
50	Out1-DA	0.36	484.00	95.30	3.17	2.65	0.94	0.91	0 00:05:00
51	Out2_1-DA	0.09	484.00	86.80	3.17	1.87	0.17	0.17	0 00:05:00
52	Out2_2-DA	0.25	484.00	85.50	3.17	1.77	0.43	0.45	0 00:05:00
53	Out2_3-DA	0.26	484.00	89.00	3.17	2.05	0.54	0.55	0 00:05:00

**Node Summary**

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft <sup>2</sup> )	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert1In	Junction	332.72	336.00	0.00	336.00	0.00	6.72	333.24	0.00	2.76	0 00:00	0.00	0.00
2	Culvert2In	Junction	270.70	274.00	0.00	0.00	0.00	5.57	272.80	0.00	1.20	0 00:00	0.00	0.00
3	DMH1	Junction	396.00	399.76	0.00	399.76	0.00	1.64	399.76	0.00	0.00	0 12:10	0.08	18.00
4	DMH101	Junction	394.70	399.00	0.00	399.00	0.00	3.32	399.00	0.00	0.00	0 12:04	0.96	52.00
5	DMH102	Junction	371.90	375.50	0.00	375.50	0.00	6.70	375.50	0.00	0.00	0 12:27	0.55	47.00
6	DMH2	Junction	354.80	358.51	0.00	358.51	0.00	8.60	355.80	0.00	2.71	0 00:00	0.00	0.00
7	DMH3	Junction	268.70	271.83	0.00	271.83	0.00	2.52	269.80	0.00	2.03	0 00:00	0.00	0.00
8	DMH4	Junction	268.10	271.22	0.00	271.22	0.00	2.52	268.73	0.00	2.49	0 00:00	0.00	0.00
9	DMH5	Junction	265.90	269.46	0.00	269.46	0.00	2.82	266.31	0.00	3.15	0 00:00	0.00	0.00
10	DMH6	Junction	253.60	258.48	0.00	258.48	0.00	0.85	254.39	0.00	4.09	0 00:00	0.00	0.00
11	DMH8	Junction	268.80	272.80	0.00	272.80	0.00	0.46	272.80	0.00	0.00	0 12:06	0.08	35.00
12	DMH9	Junction	268.90	271.70	0.00	271.70	0.00	2.13	269.39	0.00	2.31	0 00:00	0.00	0.00
13	FSP1-Out	Junction	273.00	276.00	0.00	276.00	7794.00	0.51	273.20	0.00	2.92	0 00:00	0.00	0.00
14	FSP2-Out	Junction	272.00	276.00	0.00	276.00	3746.00	1.90	272.38	0.00	4.37	0 00:00	0.00	0.00
15	HILDRETH	Junction	395.90	399.00	395.90	395.90	0.00	3.81	399.00	0.00	0.00	0 12:11	0.10	13.00
16	OUT1	Junction	329.09	336.00	0.00	336.00	0.00	15.50	332.06	0.00	3.94	0 00:00	0.00	0.00
17	OUT2_1	Junction	295.20	301.00	0.00	301.00	0.00	10.50	300.86	0.00	0.24	0 00:00	0.00	0.00
18	OUT2_2	Junction	268.32	274.00	0.00	0.00	0.00	5.98	268.98	0.00	5.02	0 00:00	0.00	0.00
19	OUT2_3	Junction	264.50	269.00	0.00	269.00	0.00	3.07	264.91	0.00	4.09	0 00:00	0.00	0.00
20	Outfall_2_1	Junction	294.00	300.00	294.00	300.00	0.00	10.50	294.97	0.00	5.03	0 00:00	0.00	0.00
21	Outfall_2_2	Junction	266.00	272.00	266.00	272.00	0.00	5.98	266.66	0.00	5.34	0 00:00	0.00	0.00
22	Outfall_2_3	Junction	262.00	268.00	262.00	268.00	0.00	3.07	262.40	0.00	5.60	0 00:00	0.00	0.00
23	Outfall_2_4	Junction	250.00	256.00	250.00	256.00	0.00	1.34	250.27	0.00	5.73	0 00:00	0.00	0.00
24	DP_1	Outfall	286.00					15.50	286.70					
25	DP_2	Outfall	249.00					20.09	294.00					
26	EX32-bypass(out)	Outfall	255.47					0.47	255.58					
27	EX33-bypass(out)	Outfall	255.70					0.16	255.77					
28	FSP-1	Storage Node	272.00	276.00	272.00		0.00	2.76	274.30				0.00	0.00
29	FSP-2	Storage Node	270.00	276.00	270.00		0.00	3.44	273.64				0.00	0.00



Proposal No. 609035- 126590

Pre-Development

2-yr

Boston Rd. 609035  
Westford, MA

March 13, 2023

**Link Summary**

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Reported (min)	Surcharged Condition
1	11-Oct	Pipe	CB10	CB11	190.10	390.40	386.00	2.3100	12.000	0.0110	3.85	6.41	0.60	8.53	0.56	0.56	0.00	Calculated
2	101-7	Pipe	DMH101	CB7	198.47	394.70	394.20	0.2500	12.000	0.0150	1.67	1.55	1.08	2.37	1.00	1.00	49.00	SURCHARGED
3	102-17	Pipe	DMH102	CB17	166.34	371.90	366.60	3.1900	12.000	0.0150	5.96	5.51	1.08	8.18	1.00	1.00	35.00	SURCHARGED
4	12-Nov	Pipe	CB11	CB12	57.91	385.90	384.60	2.2400	12.000	0.0110	5.42	6.31	0.86	9.03	0.71	0.71	0.00	Calculated
5	14-Dec	Pipe	CB12	CB14	434.45	384.20	374.40	2.2600	12.000	0.0150	5.02	4.64	1.08	6.97	1.00	1.00	28.00	SURCHARGED
6	13-14	Pipe	CB13	CB14	34.67	376.40	374.70	4.9000	12.000	0.0150	2.76	6.84	0.40	8.24	0.44	0.44	0.00	Calculated
7	14-102	Pipe	CB14	DMH102	152.21	374.40	372.00	1.5800	12.000	0.0150	4.19	3.88	1.08	5.77	1.00	1.00	69.00	SURCHARGED
8	5-Jan	Pipe	DMH1	CB5	110.54	396.00	395.30	0.6300	8.000	0.0110	1.23	1.14	1.08	3.83	0.67	1.00	15.00	SURCHARGED
9	15-102	Pipe	CB15	DMH102	32.43	372.30	372.00	0.9300	12.000	0.0150	2.82	2.97	0.95	4.30	0.78	0.78	0.00	Calculated
10	16-17	Pipe	CB16	CB17	60.89	368.30	365.50	4.6000	18.000	0.0150	2.38	19.52	0.12	7.46	0.35	0.24	0.00	Calculated
11	17-2	Pipe	CB17	DMH2	244.52	365.40	354.80	4.3400	12.000	0.0150	6.95	6.43	1.08	9.56	1.00	1.00	58.00	SURCHARGED
12	18-17	Pipe	CB18	CB17	38.21	366.80	366.50	0.7900	8.000	0.0150	0.99	0.93	1.07	3.10	0.67	1.00	40.00	SURCHARGED
13	19-2	Pipe	CB19	DMH2	30.83	356.70	354.80	6.1600	18.000	0.0150	1.63	22.60	0.07	7.45	0.27	0.18	0.00	Calculated
14	20-2	Pipe	CB20	DMH2	8.74	355.20	354.90	3.4300	12.000	0.0150	0.38	5.72	0.07	4.12	0.18	0.18	0.00	Calculated
15	21-22	Pipe	CB21	CB22	113.00	330.30	327.80	2.2100	12.000	0.0130	1.26	5.30	0.24	5.54	0.33	0.33	0.00	Calculated
16	22-23	Pipe	CB22	CB23	113.71	327.70	324.50	2.8100	12.000	0.0130	1.47	5.98	0.25	6.29	0.34	0.34	0.00	Calculated
17	23-24	Pipe	CB23	CB24	115.91	323.90	320.20	3.1900	12.000	0.0130	2.66	6.37	0.42	7.74	0.45	0.45	0.00	Calculated
18	24-25	Pipe	CB24	CB25	276.64	320.10	306.00	5.1000	12.000	0.0130	4.55	8.04	0.57	10.57	0.54	0.54	0.00	Calculated
19	25-26	Pipe	CB25	CB26	138.90	306.00	299.10	4.9700	18.000	0.0130	5.26	23.41	0.22	10.69	0.48	0.32	0.00	Calculated
20	26-27	Pipe	CB26	CB27	68.30	298.90	295.60	4.8300	24.000	0.0130	7.94	49.73	0.16	11.59	0.54	0.27	0.00	Calculated
21	27-OUT2_1	Pipe	CB27	OUT2_1	35.92	295.50	294.50	2.7800	24.000	0.0130	10.11	20.67	0.49	6.54	0.99	0.49	0.00	Calculated
22	28-3	Pipe	CB28	DMH3	26.48	268.90	268.80	0.3800	12.000	0.0150	0.46	1.90	0.24	1.99	0.33	0.33	0.00	Calculated
23	2-OUT1	Pipe	DMH2	OUT1	530.29	354.80	331.40	4.4100	15.000	0.0110	8.67	16.04	0.54	13.66	0.65	0.52	0.00	Calculated
24	1-Mar	Pipe	CB3	DMH1	16.51	397.50	397.20	1.8200	8.000	0.0110	1.64	1.93	0.85	6.19	0.47	0.71	0.00	Calculated
25	31-5	Pipe	CB31	DMH5	10.81	267.20	266.00	11.1000	12.000	0.0130	0.68	11.87	0.06	8.20	0.16	0.16	0.00	Calculated
26	32-6	Pipe	EXCB-32	DMH6	18.00	255.00	254.20	4.4400	6.000	0.0110	0.85	2.80	0.30	6.24	0.19	0.38	0.00	Calculated
27	33-out	Pipe	EXCB-33	Outfall_2_4	40.00	253.10	250.00	7.7500	12.000	0.0130	0.49	9.92	0.05	6.58	0.15	0.15	0.00	Calculated
28	4-Mar	Pipe	DMH3	DMH4	62.53	268.70	268.20	0.8000	18.000	0.0130	2.52	9.39	0.27	4.50	0.53	0.35	0.00	Calculated
29	5-Apr	Pipe	DMH4	DMH5	21.75	268.10	266.00	9.6600	18.000	0.0130	2.52	32.64	0.08	10.96	0.28	0.19	0.00	Calculated
30	5-101	Pipe	CB5	DMH101	26.79	395.20	394.80	1.4900	12.000	0.0150	1.51	3.77	0.40	4.55	0.44	0.44	0.00	Calculated
31	5-OUT2_3	Pipe	DMH5	OUT2_3	51.22	265.90	264.50	2.7300	18.000	0.0130	2.82	17.37	0.16	7.22	0.41	0.27	0.00	Calculated
32	6-101	Pipe	CB6	DMH101	28.90	394.90	394.80	0.3500	12.000	0.0150	1.93	1.82	1.06	2.69	1.00	1.00	33.00	SURCHARGED
33	6-out	Pipe	DMH6	Outfall_2_4	165.00	253.60	250.00	2.1800	12.000	0.0130	0.85	5.26	0.16	4.93	0.27	0.27	0.00	Calculated
34	8-Jul	Pipe	CB7	CB8	99.78	394.20	393.60	0.6000	12.000	0.0150	2.32	2.39	0.97	3.48	0.79	0.79	0.00	Calculated
35	3-Aug	Pipe	DMH8	DMH3	59.07	268.80	268.80	0.0000	12.000	0.0110	0.19	0.17	1.08	0.28	1.00	1.00	28.00	SURCHARGED
36	9-Aug	Pipe	CB8	CB9	84.19	393.60	393.20	0.4800	12.000	0.0150	2.30	2.13	1.08	3.17	1.00	1.00	42.00	SURCHARGED
37	10-Sep	Pipe	CB9	CB10	194.56	393.20	390.40	1.4400	12.000	0.0150	3.01	3.70	0.81	5.35	0.68	0.68	0.00	Calculated
38	Blake-3	Pipe	DMH9	DMH3	20.00	268.90	268.70	1.0000	18.000	0.0150	2.13	9.10	0.23	4.20	0.49	0.33	0.00	Calculated
39	Culvert1	Pipe	Culvert1In	OUT1	45.16	332.72	329.09	8.0400	18.000	0.0150	6.72	25.81	0.26	12.28	0.52	0.35	0.00	Calculated
40	Culvert2	Pipe	Culvert2In	OUT2_2	55.47	270.70	268.32	4.2900	24.000	0.0130	5.57	46.86	0.12	10.01	0.47	0.23	0.00	Calculated
41	FH-8	Pipe	CBFD	DMH8	60.93	269.10	268.80	0.4900	12.000	0.0150	0.46	2.17	0.21	2.19	0.31	0.31	0.00	Calculated
42	FSP1-Out	Pipe	FSP1-Out	Culvert2In	20.00	273.00	272.60	2.0000	12.000	0.0110	0.51	5.95	0.09	4.63	0.20	0.20	0.00	Calculated
43	FSP2-Out	Pipe	FSP2-Out	DMH9	178.00	272.00	269.00	1.6900	18.000	0.0130	1.90	13.64	0.14	5.43	0.38	0.25	0.00	Calculated
44	HILDRETH	Pipe	HILDRETH	CB6	100.00	395.90	394.90	1.0000	12.000	0.0150	3.34	3.09	1.08	4.63	1.00	1.00	10.00	SURCHARGED
45	O2_1	Pipe	Outfall_2_1	DP_2	1093.34	294.00	294.00	0.0000	0.000	0.0150	10.50	0.00	1.08	0.00	1.00	1.00	10.00	SURCHARGED
46	O2_2	Pipe	Outfall_2_2	DP_2	539.72	266.00	266.00	0.0000	0.000	0.0150	5.98	0.00	1.08	0.00	1.00	1.00	10.00	SURCHARGED
47	O2_3	Pipe	Outfall_2_3	DP_2	246.53	262.00	262.00	0.0000	0.000	0.0150	3.07	0.00	1.08	0.00	1.00	1.00	10.00	SURCHARGED

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged Condition (min)
48	O2_4	Pipe	Outfall_2_4	DP_2	714.54	250.00	250.00	0.0000	0.000	0.0150	1.34	0.00	1.08	0.00	1.00	1.00	10.00 SURCHARGED
49	CB10-bypass	Channel	CB10	CB11	191.61	393.46	389.50	2.0700	3.600	0.0130	0.44	12.94	0.03	2.00	0.08	0.28	0.00
50	CB11-bypass	Channel	CB11	CB13	478.43	389.50	378.90	2.2200	3.600	0.0130	1.40	13.40	0.10	2.76	0.13	0.43	0.00
51	CB12-bypass	Channel	CB12	CB14	425.00	388.11	378.76	2.2000	3.600	0.0130	0.34	13.35	0.03	2.16	0.08	0.25	0.00
52	CB13-bypass	Channel	CB13	CB15	155.71	378.90	375.33	2.2900	3.600	0.0130	3.88	13.63	0.28	3.57	0.19	0.62	0.00
53	CB14-bypass	Channel	CB14	CB17	318.79	378.76	370.30	2.6500	3.600	0.0130	0.24	14.66	0.02	2.07	0.06	0.21	0.00
54	CB15-bypass	Channel	CB15	CB16	115.44	375.33	372.17	2.7400	3.600	0.0130	3.86	14.89	0.26	3.81	0.18	0.60	0.00
55	CB16-bypass	Channel	CB16	CB18	71.28	372.17	369.76	3.3800	3.600	0.0130	2.98	16.55	0.18	3.86	0.16	0.53	0.00
56	CB17-bypass	Channel	CB17	CB20	236.23	370.30	358.78	4.8800	3.600	0.0130	0.15	19.87	0.01	2.24	0.05	0.16	0.00
57	CB18-bypass	Channel	CB18	CB19	213.88	369.76	359.82	4.6500	3.600	0.0130	1.45	19.40	0.07	3.64	0.11	0.38	0.00
58	CB19-bypass	Channel	CB19	Culvert1In	528.55	359.82	332.72	5.1300	3.600	0.0130	1.13	20.38	0.06	3.57	0.10	0.34	0.00
59	CB20-bypass	Channel	CB20	OUT1	541.70	358.78	329.09	5.4800	3.600	0.0130	0.06	21.07	0.00	1.93	0.03	0.11	0.00
60	CB22-bypass	Channel	CB22	CB25	495.92	330.74	311.32	3.9200	3.600	0.0130	0.06	17.81	0.00	1.75	0.04	0.12	0.00
61	CB23-bypass	Channel	CB23	CB24	115.97	328.70	325.59	2.6800	3.600	0.0130	0.86	14.74	0.06	2.60	0.10	0.34	0.00
62	CB24-bypass	Channel	CB24	CB26	416.71	325.59	303.57	5.2800	3.600	0.0130	1.81	20.69	0.09	4.11	0.12	0.40	0.00
63	CB25-bypass	Channel	CB25	OUT2_1	230.21	311.32	300.80	4.5700	3.600	0.0130	0.27	19.24	0.01	2.47	0.06	0.20	0.00
64	CB26-bypass	Channel	CB26	CB27	68.43	303.57	300.38	4.6600	3.600	0.0130	3.41	19.43	0.18	4.51	0.16	0.52	0.00
65	CB27-bypass	Channel	CB27	Culvert2In	566.65	300.38	270.70	5.2400	3.600	0.0130	1.98	20.60	0.10	4.25	0.12	0.41	0.00
66	CB28-bypass	Channel	CB28	CB31	89.54	270.47	269.04	1.6000	3.600	0.0130	0.14	9.06	0.02	1.48	0.06	0.21	0.00
67	CB31-bypass	Channel	CB31	EXCB-32	611.00	269.04	257.18	1.9400	3.600	0.0130	0.03	9.99	0.00	1.39	0.03	0.11	0.00
68	CB5-bypass	Channel	CB5	CB12	842.80	398.31	388.11	1.2100	3.600	0.0130	0.09	7.89	0.01	1.34	0.05	0.18	0.00
69	CB7-bypass	Channel	CB7	CB8	102.09	397.14	396.62	0.5100	3.600	0.0130	0.51	7.35	0.07	1.23	0.10	0.34	0.00
70	CB8-bypass	Channel	CB8	CB9	84.93	396.62	396.20	0.4900	3.600	0.0130	0.45	6.33	0.07	1.18	0.11	0.37	0.00
71	CB9-bypass	Channel	CB9	CB10	195.58	396.20	393.46	1.4000	3.600	0.0130	0.29	10.65	0.03	1.56	0.08	0.26	0.00
72	CBFD-bypass	Channel	CBFD	CB28	102.51	271.90	270.47	1.3900	3.600	0.0130	0.19	8.47	0.02	1.52	0.07	0.24	0.00
73	EX32-bypass	Channel	EXCB-32	EX32-bypass(out)	156.00	257.18	255.47	1.1000	3.600	0.0130	0.47	7.51	0.06	1.76	0.11	0.35	0.00
74	EX33-bypass	Channel	EXCB-33	EX33-bypass(out)	70.00	256.90	255.70	1.7100	3.600	0.0130	0.16	9.39	0.02	1.54	0.07	0.22	0.00
75	Outfall-1	Channel	OUT1	DP_1	333.49	329.09	286.00	12.9200	36.000	0.0320	15.50	450.45	0.03	9.18	0.70	0.23	0.00
76	Outfall-2_1	Channel	OUT2_1	Outfall_2_1	50.00	294.50	294.00	1.0000	24.000	0.0320	10.50	62.70	0.17	4.46	0.97	0.48	0.00
77	Outfall-2_2	Channel	OUT2_2	Outfall_2_2	50.00	268.32	266.00	4.6400	18.000	0.0320	5.98	42.51	0.14	4.96	0.66	0.44	0.00
78	Outfall-2_3	Channel	OUT2_3	Outfall_2_3	50.00	264.50	262.00	5.0000	36.000	0.0320	3.07	280.21	0.01	4.22	0.40	0.13	0.00
79	FSP1-1	Orifice	FSP-1	FSP1-Out		272.00	273.00		8.000		0.30						
80	FSP1-2	Orifice	FSP-1	FSP1-Out		272.00	273.00		12.000		0.21						
81	FSP2-1	Orifice	FSP-2	FSP2-Out		270.00	272.00		8.000		0.91						
82	FSP2-2	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		0.81						
83	FSP2-3	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		0.17						

**Inlet Summary**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft²)	Peak Flow (cfs)	Peak Flow Intercepted (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
1	CB10	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.40	393.46	0.00	N/A	1.29	0.85	0.43	66.27	7.00	6.36	393.59
2	CB11	FHWA HEC-22 GENERIC	N/A	On Grade	1	385.90	389.50	0.00	N/A	2.98	1.57	1.40	52.90	7.00	8.68	389.67
3	CB12	FHWA HEC-22 GENERIC	N/A	On Grade	1	384.20	388.11	0.00	N/A	1.09	0.75	0.34	69.14	7.00	5.96	388.23
4	CB13	FHWA HEC-22 GENERIC	N/A	On Grade	1	376.40	378.90	0.00	N/A	6.63	2.75	3.88	41.50	7.00	11.76	379.14
5	CB14	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.40	378.76	0.00	N/A	0.86	0.63	0.23	73.08	7.00	5.45	378.87
6	CB15	FHWA HEC-22 GENERIC	N/A	On Grade	1	372.30	375.33	0.00	N/A	6.69	2.83	3.86	42.29	7.00	11.38	375.56
7	CB16	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.30	372.17	0.00	N/A	5.36	2.38	2.98	44.42	7.00	10.82	372.39
8	CB17	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.40	370.30	0.00	N/A	0.65	0.50	0.14	77.71	7.00	4.91	370.40
9	CB18	FHWA HEC-22 GENERIC	N/A	On Grade	1	366.80	369.76	0.00	N/A	3.31	1.87	1.45	56.31	7.00	7.74	369.91
10	CB19	FHWA HEC-22 GENERIC	N/A	On Grade	1	356.70	359.82	0.00	N/A	2.76	1.64	1.12	59.32	7.00	7.21	359.96
11	CB20	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.20	358.78	0.00	N/A	0.44	0.39	0.05	89.00	7.00	3.63	358.85
12	CB21	FHWA HEC-22 GENERIC	N/A	On Sag	1	330.30	333.30	0.00	0.00	1.25	N/A	N/A	N/A	7.00	9.46	333.46
13	CB22	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.70	330.74	0.00	N/A	0.32	0.29	0.04	87.75	7.00	3.86	330.82
14	CB23	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.90	328.70	0.00	N/A	2.05	1.19	0.86	58.16	7.00	7.70	328.85
15	CB24	FHWA HEC-22 GENERIC	N/A	On Grade	1	320.10	325.59	0.00	N/A	3.73	1.91	1.82	51.26	7.00	8.91	325.77
16	CB25	FHWA HEC-22 GENERIC	N/A	On Grade	1	306.00	311.32	0.00	N/A	1.08	0.81	0.26	75.56	7.00	5.00	311.42
17	CB26	FHWA HEC-22 GENERIC	N/A	On Grade	1	298.90	303.57	0.00	N/A	6.10	2.68	3.42	44.01	7.00	9.72	303.76
18	CB27	FHWA HEC-22 GENERIC	N/A	On Grade	1	295.50	300.38	0.00	N/A	4.18	2.17	2.01	51.89	7.00	8.42	300.55
19	CB28	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.90	270.47	0.00	N/A	0.60	0.46	0.13	77.49	7.00	5.00	270.57
20	CB3	FHWA HEC-22 GENERIC	N/A	On Sag	1	397.50	399.24	0.00	0.00	1.64	N/A	N/A	N/A	7.00	11.11	399.43
21	CB31	FHWA HEC-22 GENERIC	N/A	On Grade	1	267.20	269.04	0.00	N/A	0.58	0.55	0.03	95.11	7.00	3.96	269.20
22	CB5	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.20	398.31	0.00	N/A	0.37	0.30	0.07	79.90	7.00	5.25	398.42
23	CB6	FHWA HEC-22 GENERIC	N/A	On Sag	1	394.90	398.92	0.00	0.00	0.56	N/A	N/A	N/A	7.00	5.92	399.02
24	CB7	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.20	397.14	0.00	N/A	1.28	0.77	0.50	60.55	7.00	8.35	397.31
25	CB8	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.60	396.62	0.00	N/A	1.19	0.74	0.45	62.19	7.00	7.73	396.77
26	CB9	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.20	396.20	0.00	N/A	1.17	0.88	0.29	75.45	7.00	5.00	396.30
27	CBFD	FHWA HEC-22 GENERIC	N/A	On Grade	1	0.00	271.90	269.00	N/A	0.65	0.46	0.19	71.23	7.00	6.49	272.03
28	EXCB-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	0.00	N/A	1.32	0.85	0.47	64.40	7.00	6.73	257.31
29	EXCB-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	0.00	N/A	0.66	0.50	0.16	76.11	7.00	5.16	257.00

## Subbasin Hydrology

### Subbasin : Blake1P

#### Input Data

Area (ac) ..... 2.66  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 78.7  
 Rain Gage ID ..... \*

#### Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.66	-	78.7
Composite Area & Weighted CN	2.66		78.7

#### Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

T<sub>c</sub> = Time of Concentration (hr)  
 n = Manning's roughness  
 L<sub>f</sub> = Flow Length (ft)  
 P = 2 yr, 24 hr Rainfall (inches)  
 S<sub>f</sub> = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 \* (S<sub>f</sub><sup>0.5</sup>) (unpaved surface)  
 V = 20.3282 \* (S<sub>f</sub><sup>0.5</sup>) (paved surface)  
 V = 15.0 \* (S<sub>f</sub><sup>0.5</sup>) (grassed waterway surface)  
 V = 10.0 \* (S<sub>f</sub><sup>0.5</sup>) (nearly bare & untilled surface)  
 V = 9.0 \* (S<sub>f</sub><sup>0.5</sup>) (cultivated straight rows surface)  
 V = 7.0 \* (S<sub>f</sub><sup>0.5</sup>) (short grass pasture surface)  
 V = 5.0 \* (S<sub>f</sub><sup>0.5</sup>) (woodland surface)  
 V = 2.5 \* (S<sub>f</sub><sup>0.5</sup>) (forest w/heavy litter surface)  
 T<sub>c</sub> = (L<sub>f</sub> / V) / (3600 sec/hr)

Where:

T<sub>c</sub> = Time of Concentration (hr)  
 L<sub>f</sub> = Flow Length (ft)  
 V = Velocity (ft/sec)  
 S<sub>f</sub> = Slope (ft/ft)

Channel Flow Equation :

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

$$R = A_q / W_p$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where :

T<sub>c</sub> = Time of Concentration (hr)  
 L<sub>f</sub> = Flow Length (ft)  
 R = Hydraulic Radius (ft)  
 A<sub>q</sub> = Flow Area (ft<sup>2</sup>)  
 W<sub>p</sub> = Wetted Perimeter (ft)  
 V = Velocity (ft/sec)  
 S<sub>f</sub> = Slope (ft/ft)  
 n = Manning's roughness

	Subarea A	Subarea B	Subarea C
<b>Sheet Flow Computations</b>			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0
<b>Shallow Concentrated Flow Computations</b>			
Flow Length (ft) :	346	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	7.64		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.3
Peak Runoff (cfs) .....	3.44
Weighted Curve Number .....	78.7
Time of Concentration (days hh:mm:ss) .....	0 00:07:38

**Subbasin : Blake2**

**Input Data**

Area (ac) ..... 0.31  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 82.1  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.31	-	82.1
Composite Area & Weighted CN	0.31		82.1

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 1.52  
Peak Runoff (cfs) ..... 0.5  
Weighted Curve Number ..... 82.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB10-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.9  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	96.9
Composite Area & Weighted CN	0.09		96.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.81  
Peak Runoff (cfs) ..... 0.23  
Weighted Curve Number ..... 96.9  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB10L-DA**

**Input Data**

Area (ac) .....	0.93
Peak Rate Factor .....	484
Weighted Curve Number .....	80.2
Rain Gage ID .....	*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.93	-	80.2
Composite Area & Weighted CN	0.93		80.2

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.1	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.16	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	347	0	0
Slope (%) :	2.1	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.01	0	0
Computed Flow Time (min) :	5.73	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	56	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.08	0	0
Total TOC (min) .....	26.96		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.39
Peak Runoff (cfs) .....	0.9
Weighted Curve Number .....	80.2
Time of Concentration (days hh:mm:ss) .....	0 00:26:58



**Subbasin : CB11-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.6  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	95.6
Composite Area & Weighted CN	0.09		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.67  
Peak Runoff (cfs) ..... 0.23  
Weighted Curve Number ..... 95.6  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB11L-DA**

**Input Data**

Area (ac) ..... 2.77  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 79  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.77	-	79
Composite Area & Weighted CN	2.77		79

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	409	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	6.89	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	140	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.2	0	0
Total TOC (min) .....	28.66		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 1.31  
 Peak Runoff (cfs) ..... 2.46  
 Weighted Curve Number ..... 79  
 Time of Concentration (days hh:mm:ss) ..... 0 00:28:40

**Subbasin : CB12-DA**

**Input Data**

Area (ac) ..... 0.4  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.5  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.4	-	95.5
Composite Area & Weighted CN	0.4		95.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.67  
Peak Runoff (cfs) ..... 1.02  
Weighted Curve Number ..... 95.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB13-DA**

**Input Data**

Area (ac) ..... 0.19  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.19	-	98
Composite Area & Weighted CN	0.19		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.51  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB13L-DA**

**Input Data**

Area (ac) ..... 7.68  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 76.9  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	7.68	-	76.9
Composite Area & Weighted CN	7.68		76.9

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.4	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.03	0	0
Computed Flow Time (min) :	24.88	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	744	0	0
Slope (%) :	1.5	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.86	0	0
Computed Flow Time (min) :	14.42	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	243	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.34	0	0
Total TOC (min) .....	39.64		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 1.18  
 Peak Runoff (cfs) ..... 5.22  
 Weighted Curve Number ..... 76.9  
 Time of Concentration (days hh:mm:ss) ..... 0 00:39:38

**Subbasin : CB14-DA**

**Input Data**

Area (ac) ..... 0.21  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.6  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.21	-	95.6
Composite Area & Weighted CN	0.21		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.68  
Peak Runoff (cfs) ..... 0.54  
Weighted Curve Number ..... 95.6  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB15-DA**

**Input Data**

Area (ac) ..... 0.07  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.07	-	98
Composite Area & Weighted CN	0.07		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.92  
Peak Runoff (cfs) ..... 0.17  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB15L-DA**

**Input Data**

Area (ac) ..... 4.6  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 73.7  
Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	4.6	-	73.7
Composite Area & Weighted CN	4.6		73.7

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	706	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.89	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	35	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	33.94		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 1  
Peak Runoff (cfs) ..... 2.77  
Weighted Curve Number ..... 73.7  
Time of Concentration (days hh:mm:ss) ..... 0 00:33:56



**Subbasin : CB16-DA**

**Input Data**

Area (ac) ..... 0.05  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.05	-	98
Composite Area & Weighted CN	0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.91  
Peak Runoff (cfs) ..... 0.14  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB16L-DA**

**Input Data**

Area (ac) ..... 2.01  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 76.4  
Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	2.01	-	76.4
Composite Area & Weighted CN	2.01		76.4

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	20.77	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	659	0	0
Slope (%) :	2.2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.04	0	0
Computed Flow Time (min) :	10.56	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	104	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.1	0	0
Total TOC (min) .....	31.43		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 1.16  
Peak Runoff (cfs) ..... 1.48  
Weighted Curve Number ..... 76.4  
Time of Concentration (days hh:mm:ss) ..... 0 00:31:26

**Subbasin : CB17-DA**

**Input Data**

Area (ac) ..... 0.17  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.7  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.17	-	95.7
Composite Area & Weighted CN	0.17		95.7

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.69  
Peak Runoff (cfs) ..... 0.42  
Weighted Curve Number ..... 95.7  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB18-DA**

**Input Data**

Area (ac) ..... 0.03  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.03	-	98
Composite Area & Weighted CN	0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.73  
Peak Runoff (cfs) ..... 0.07  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB18L-DA**

**Input Data**

Area (ac) ..... 0.5  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 73.7  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.5	-	73.7
Composite Area & Weighted CN	0.5		73.7

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.05	0	0
Computed Flow Time (min) :	18.35	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	406	0	0
Slope (%) :	3	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.21	0	0
Computed Flow Time (min) :	5.59	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	20	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	23.96		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 1  
Peak Runoff (cfs) ..... 0.35  
Weighted Curve Number ..... 73.7  
Time of Concentration (days hh:mm:ss) ..... 0 00:23:58

**Subbasin : CB19-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	98
Composite Area & Weighted CN	0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.93  
Peak Runoff (cfs) ..... 0.22  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB19L-DA**

**Input Data**

Area (ac) ..... 2.56  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 72.1  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.56	-	72.1
Composite Area & Weighted CN	2.56		72.1

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	498	0	0
Slope (%) :	3.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.15	0	0
Computed Flow Time (min) :	2.63	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	59	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.05	0	0
Total TOC (min) .....	12.28		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 0.92  
 Peak Runoff (cfs) ..... 2.01  
 Weighted Curve Number ..... 72.1  
 Time of Concentration (days hh:mm:ss) ..... 0 00:12:17

**Subbasin : CB20-DA**

**Input Data**

Area (ac) ..... 0.12  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.2  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.12	-	96.2
Composite Area & Weighted CN	0.12		96.2

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.74  
Peak Runoff (cfs) ..... 0.3  
Weighted Curve Number ..... 96.2  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : CB21-DA**

**Input Data**

Area (ac) ..... 1.31  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 74.6  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.31	-	74.6
Composite Area & Weighted CN	1.31		74.6

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	403	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.26	0	0
Total TOC (min) .....	10.84		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 1.05  
 Peak Runoff (cfs) ..... 1.25  
 Weighted Curve Number ..... 74.6  
 Time of Concentration (days hh:mm:ss) ..... 0 00:10:50

**Subbasin : CB22-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.5  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	95.5
Composite Area & Weighted CN	0.13		95.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.66  
Peak Runoff (cfs) ..... 0.32  
Weighted Curve Number ..... 95.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB23-DA**

**Input Data**

Area (ac) .....	2.06
Peak Rate Factor .....	484
Weighted Curve Number .....	75.5
Rain Gage ID .....	*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.06	-	75.5
Composite Area & Weighted CN	2.06		75.5

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.69	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	575	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.79	0	0
Total TOC (min) .....	11.48		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.1
Peak Runoff (cfs) .....	2.05
Weighted Curve Number .....	75.5
Time of Concentration (days hh:mm:ss) .....	0 00:11:29

**Subbasin : CB24-DA**

**Input Data**

Area (ac) ..... 2.61  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 76.3  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.61	-	76.3
Composite Area & Weighted CN	2.61		76.3

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.12	0	0
Computed Flow Time (min) :	6.79	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	552	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.72	0	0
Total TOC (min) .....	8.51		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 1.15  
 Peak Runoff (cfs) ..... 2.92  
 Weighted Curve Number ..... 76.3  
 Time of Concentration (days hh:mm:ss) ..... 0 00:08:31

**Subbasin : CB25-DA**

**Input Data**

Area (ac) ..... 0.43  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 92.4  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.43	-	92.4
Composite Area & Weighted CN		0.43		92.4

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.36  
Peak Runoff (cfs) ..... 1.02  
Weighted Curve Number ..... 92.4  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB26-DA**

**Input Data**

Area (ac) .....	0.07
Peak Rate Factor .....	484
Weighted Curve Number .....	96.8
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.07	-	96.8
Composite Area & Weighted CN		0.07		96.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.79
Peak Runoff (cfs) .....	0.17
Weighted Curve Number .....	96.8
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB26L-DA**

**Input Data**

Area (ac) .....	3.73
Peak Rate Factor .....	484
Weighted Curve Number .....	77.2
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		3.73	-	77.2
Composite Area & Weighted CN		3.73		77.2

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	8.59	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	628	0	0
Slope (%) :	9.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.05	0	0
Computed Flow Time (min) :	2.07	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	109	0	0
Channel Slope (%) :	5.9	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	19.49	0	0
Computed Flow Time (min) :	0.09	0	0
Total TOC (min) .....	10.76		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.2
Peak Runoff (cfs) .....	4.17
Weighted Curve Number .....	77.2
Time of Concentration (days hh:mm:ss) .....	0 00:10:46

**Subbasin : CB27-DA**

**Input Data**

Area (ac) .....	0.05
Peak Rate Factor .....	484
Weighted Curve Number .....	96.8
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.05	-	96.8
Composite Area & Weighted CN		0.05		96.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.78
Peak Runoff (cfs) .....	0.13
Weighted Curve Number .....	96.8
Time of Concentration (days hh:mm:ss) .....	0 00:05:00



**Subbasin : CB27L-DA**

**Input Data**

Area (ac) .....	0.78
Peak Rate Factor .....	484
Weighted Curve Number .....	72.2
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.78	-	72.2
Composite Area & Weighted CN		0.78		72.2

**Time of Concentration**

	Subarea		
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

	Subarea		
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	389	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.21	0	0

	Subarea		
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	37	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	7.51		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	0.92
Peak Runoff (cfs) .....	0.69
Weighted Curve Number .....	72.2
Time of Concentration (days hh:mm:ss) .....	0 00:07:31

**Subbasin : CB28-DA**

**Input Data**

Area (ac) .....	0.23
Peak Rate Factor .....	484
Weighted Curve Number .....	84.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.23	-	84.3
Composite Area & Weighted CN		0.23		84.3

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.68
Peak Runoff (cfs) .....	0.41
Weighted Curve Number .....	84.3
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB31-DA**

**Input Data**

Area (ac) ..... 0.26  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 91.1  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	91.1
Composite Area & Weighted CN		0.26		91.1

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.24  
Peak Runoff (cfs) ..... 0.58  
Weighted Curve Number ..... 91.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB3-DA**

**Input Data**

Area (ac) .....	1.14
Peak Rate Factor .....	484
Weighted Curve Number .....	83.2
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		1.14	-	83.2
Composite Area & Weighted CN		1.14		83.2

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.07	0	0
Computed Flow Time (min) :	12.39	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	135	0	0
Slope (%) :	5	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.61	0	0
Computed Flow Time (min) :	0.62	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	205	0	0
Channel Slope (%) :	4	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	16.05	0	0
Computed Flow Time (min) :	0.21	0	0
Total TOC (min) .....	13.23		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.6
Peak Runoff (cfs) .....	1.64
Weighted Curve Number .....	83.2
Time of Concentration (days hh:mm:ss) .....	0 00:13:14

**Subbasin : CB5-DA**

**Input Data**

Area (ac) .....	0.14
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.93
Peak Runoff (cfs) .....	0.37
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB6-DA**

**Input Data**

Area (ac) .....	0.25
Peak Rate Factor .....	484
Weighted Curve Number .....	91.6
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.25	-	91.6
Composite Area & Weighted CN		0.25		91.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.28
Peak Runoff (cfs) .....	0.56
Weighted Curve Number .....	91.6
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB7-DA**

**Input Data**

Area (ac) .....	0.18
Peak Rate Factor .....	484
Weighted Curve Number .....	97.5
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.18	-	97.5
Composite Area & Weighted CN		0.18		97.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.88
Peak Runoff (cfs) .....	0.47
Weighted Curve Number .....	97.5
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB8-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.9
Peak Runoff (cfs) .....	0.1
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00



**Subbasin : CB8L-DA**

**Input Data**

Area (ac) .....	0.64
Peak Rate Factor .....	484
Weighted Curve Number .....	83.6
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.64	-	83.6
Composite Area & Weighted CN		0.64		83.6

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	23.02	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	125	0
Slope (%) :	1.7	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.91	0	0
Computed Flow Time (min) :	2.29	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	93	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.13	0	0
Total TOC (min) .....	25.44		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.63
Peak Runoff (cfs) .....	0.76
Weighted Curve Number .....	83.6
Time of Concentration (days hh:mm:ss) .....	0 00:25:26

**Subbasin : CB9-DA**

**Input Data**

Area (ac) .....	0.03
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.84
Peak Runoff (cfs) .....	0.08
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB9L-DA**

**Input Data**

Area (ac) .....	0.58
Peak Rate Factor .....	484
Weighted Curve Number .....	84.9
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.58	-	84.9
Composite Area & Weighted CN		0.58		84.9

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	293	0
Slope (%) :	1.9	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.96	0	0
Computed Flow Time (min) :	5.09	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	17	0	0
Channel Slope (%) :	0.65	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	6.47	0	0
Computed Flow Time (min) :	0.04	0	0
Total TOC (min) .....	27.15		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.72
Peak Runoff (cfs) .....	0.7
Weighted Curve Number .....	84.9
Time of Concentration (days hh:mm:ss) .....	0 00:27:09

**Subbasin : CBFS**

**Input Data**

Area (ac) ..... 0.26  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.6  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	95.6
Composite Area & Weighted CN		0.26		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.68  
Peak Runoff (cfs) ..... 0.65  
Weighted Curve Number ..... 95.6  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CD7L-DA**

**Input Data**

Area (ac) .....	0.63
Peak Rate Factor .....	484
Weighted Curve Number .....	83
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.63	-	83
Composite Area & Weighted CN		0.63		83

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.22	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	84	0
Slope (%) :	1.7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.1	0	0
Computed Flow Time (min) :	0.67	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	110	0	0
Channel Slope (%) :	0.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	5.67	0	0
Computed Flow Time (min) :	0.32	0	0
Total TOC (min) .....	14.21		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.58
Peak Runoff (cfs) .....	0.89
Weighted Curve Number .....	83
Time of Concentration (days hh:mm:ss) .....	0 00:14:13

**Subbasin : Culvert1-DA**

**Input Data**

Area (ac) .....	0.16
Peak Rate Factor .....	484
Weighted Curve Number .....	97.9
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.16	-	97.9
Composite Area & Weighted CN		0.16		97.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.92
Peak Runoff (cfs) .....	0.44
Weighted Curve Number .....	97.9
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Culvert1L-DA**

**Input Data**

Area (ac) .....	6.61
Peak Rate Factor .....	484
Weighted Curve Number .....	74.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		6.61	-	74.3
Composite Area & Weighted CN		6.61		74.3

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	12.93	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	623	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	3.59	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	344	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.32	0	0
Total TOC (min) .....	16.84		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.03
Peak Runoff (cfs) .....	5.43
Weighted Curve Number .....	74.3
Time of Concentration (days hh:mm:ss) .....	0 00:16:50

**Subbasin : Culvert2-DA**

**Input Data**

Area (ac) ..... 0.26  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.9  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	96.9
Composite Area & Weighted CN		0.26		96.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.82  
Peak Runoff (cfs) ..... 0.68  
Weighted Curve Number ..... 96.9  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Culvert2L-DA**

**Input Data**

Area (ac) .....	3.78
Peak Rate Factor .....	484
Weighted Curve Number .....	71.5
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		3.78	-	71.5
Composite Area & Weighted CN		3.78		71.5

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	392	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.22	0	0
Total TOC (min) .....	7.49		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	0.89
Peak Runoff (cfs) .....	3.2
Weighted Curve Number .....	71.5
Time of Concentration (days hh:mm:ss) .....	0 00:07:29

**Subbasin : Culvert2P-DA**

**Input Data**

Area (ac) .....	2.87
Peak Rate Factor .....	484
Weighted Curve Number .....	73.5
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.87	-	73.5
Composite Area & Weighted CN		2.87		73.5

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	317	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.04	0	0
Total TOC (min) .....	7.55		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	0.99
Peak Runoff (cfs) .....	2.76
Weighted Curve Number .....	73.5
Time of Concentration (days hh:mm:ss) .....	0 00:07:33

**Subbasin : EX32-DA**

**Input Data**

Area (ac) .....	0.49
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.49	-	98
Composite Area & Weighted CN		0.49		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.94
Peak Runoff (cfs) .....	1.3
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : EX33-DA**

**Input Data**

Area (ac) .....	0.27
Peak Rate Factor .....	484
Weighted Curve Number .....	93.8
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.27	-	93.8
Composite Area & Weighted CN		0.27		93.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.49
Peak Runoff (cfs) .....	0.66
Weighted Curve Number .....	93.8
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Hildreth-DA**

**Input Data**

Area (ac) .....	2.35
Peak Rate Factor .....	484
Weighted Curve Number .....	87
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		2.35	-	87
Composite Area & Weighted CN		2.35		87

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	96	0	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	0.55	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.013	0	0
Flow Length (ft) :	553	0	0
Channel Slope (%) :	3	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.785	0	0
Wetted Perimeter (ft) :	3	0	0
Velocity (ft/sec) :	8.12	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	15.59		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.89
Peak Runoff (cfs) .....	3.81
Weighted Curve Number .....	87
Time of Concentration (days hh:mm:ss) .....	0 00:15:35

**Subbasin : Out1-DA**

**Input Data**

Area (ac) ..... 0.36  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.3  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.36	-	95.3
Composite Area & Weighted CN		0.36		95.3

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.65  
Peak Runoff (cfs) ..... 0.91  
Weighted Curve Number ..... 95.3  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Out2\_1-DA**

**Input Data**

Area (ac) .....	0.09
Peak Rate Factor .....	484
Weighted Curve Number .....	86.8
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	86.8
Composite Area & Weighted CN		0.09		86.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.87
Peak Runoff (cfs) .....	0.17
Weighted Curve Number .....	86.8
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Out2\_2-DA**

**Input Data**

Area (ac) .....	0.25
Peak Rate Factor .....	484
Weighted Curve Number .....	85.5
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.25	-	85.5
Composite Area & Weighted CN		0.25		85.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.77
Peak Runoff (cfs) .....	0.45
Weighted Curve Number .....	85.5
Time of Concentration (days hh:mm:ss) .....	0 00:05:00



**Subbasin : Out2\_3-DA**

**Input Data**

Area (ac) ..... 0.26  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 89  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	89
Composite Area & Weighted CN		0.26		89

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.05  
Peak Runoff (cfs) ..... 0.55  
Weighted Curve Number ..... 89  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Junction Input**

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Culvert1In	332.72	336.00	3.28	0.00	-332.72	336.00	0.00	0.00	0.00
2	Culvert2In	270.70	274.00	3.30	0.00	-270.70	0.00	-274.00	0.00	0.00
3	DMH1	396.00	399.76	3.76	0.00	-396.00	399.76	0.00	0.00	0.00
4	DMH101	394.70	399.00	4.30	0.00	-394.70	399.00	0.00	0.00	0.00
5	DMH102	371.90	375.50	3.60	0.00	-371.90	375.50	0.00	0.00	0.00
6	DMH2	354.80	358.51	3.71	0.00	-354.80	358.51	0.00	0.00	0.00
7	DMH3	268.70	271.83	3.13	0.00	-268.70	271.83	0.00	0.00	0.00
8	DMH4	268.10	271.22	3.12	0.00	-268.10	271.22	0.00	0.00	0.00
9	DMH5	265.90	269.46	3.56	0.00	-265.90	269.46	0.00	0.00	0.00
10	DMH6	253.60	258.48	4.88	0.00	-253.60	258.48	0.00	0.00	0.00
11	DMH8	268.80	272.80	4.00	0.00	-268.80	272.80	0.00	0.00	0.00
12	DMH9	268.90	271.70	2.80	0.00	-268.90	271.70	0.00	0.00	0.00
13	FSP1-Out	273.00	276.00	3.00	0.00	-273.00	276.00	0.00	7794.00	0.00
14	FSP2-Out	272.00	276.00	4.00	0.00	-272.00	276.00	0.00	3746.00	0.00
15	HILDRETH	395.90	399.00	3.10	395.90	0.00	395.90	-3.10	0.00	0.00
16	OUT1	329.09	336.00	6.91	0.00	-329.09	336.00	0.00	0.00	0.00
17	OUT2_1	295.20	301.00	5.80	0.00	-295.20	301.00	0.00	0.00	0.00
18	OUT2_2	268.32	274.00	5.68	0.00	-268.32	0.00	-274.00	0.00	0.00
19	OUT2_3	264.50	269.00	4.50	0.00	-264.50	269.00	0.00	0.00	0.00
20	Outfall_2_1	294.00	300.00	6.00	294.00	0.00	300.00	0.00	0.00	0.00
21	Outfall_2_2	266.00	272.00	6.00	266.00	0.00	272.00	0.00	0.00	0.00
22	Outfall_2_3	262.00	268.00	6.00	262.00	0.00	268.00	0.00	0.00	0.00
23	Outfall_2_4	250.00	256.00	6.00	250.00	0.00	256.00	0.00	0.00	0.00

**Junction Results**

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert1In	6.72	5.68	333.24	0.52	0.00	2.76	332.75	0.03	0 12:14	0 00:00	0.00	0.00
2	Culvert2In	5.57	3.84	272.80	2.10	0.00	1.20	272.61	1.91	0 12:36	0 00:00	0.00	0.00
3	DMH1	1.64	0.00	399.76	3.76	0.00	0.00	397.23	1.23	0 12:02	0 12:10	0.08	18.00
4	DMH101	3.32	0.00	399.00	4.30	0.00	0.00	394.90	0.20	0 11:48	0 12:04	0.96	52.00
5	DMH102	6.70	0.00	375.50	3.60	0.00	0.00	372.11	0.21	0 12:08	0 12:27	0.55	47.00
6	DMH2	8.60	0.00	355.80	1.00	0.00	2.71	354.95	0.15	0 12:05	0 00:00	0.00	0.00
7	DMH3	2.52	0.00	269.80	1.10	0.00	2.03	268.86	0.16	0 11:54	0 00:00	0.00	0.00
8	DMH4	2.52	0.00	268.73	0.63	0.00	2.49	268.23	0.13	0 12:18	0 00:00	0.00	0.00
9	DMH5	2.82	0.00	266.31	0.41	0.00	3.15	266.02	0.12	0 12:17	0 00:00	0.00	0.00
10	DMH6	0.85	0.00	254.39	0.79	0.00	4.09	254.21	0.61	0 12:06	0 00:00	0.00	0.00
11	DMH8	0.46	0.00	272.80	4.00	0.00	0.00	268.89	0.09	0 11:47	0 12:06	0.08	35.00
12	DMH9	2.13	0.50	269.39	0.49	0.00	2.31	269.02	0.12	0 12:18	0 00:00	0.00	0.00
13	FSP1-Out	0.51	0.00	273.20	0.20	0.00	2.92	273.01	0.01	0 12:36	0 00:00	0.00	0.00
14	FSP2-Out	1.90	0.00	272.38	0.38	0.00	4.37	272.02	0.02	0 12:18	0 00:00	0.00	0.00
15	HILDRETH	3.81	3.81	399.00	3.10	0.00	0.00	395.95	0.05	0 12:05	0 12:11	0.10	13.00
16	OUT1	15.50	0.91	332.06	2.97	0.00	3.94	331.46	2.37	0 12:05	0 00:00	0.00	0.00
17	OUT2_1	10.50	0.17	300.86	5.66	0.00	0.24	300.80	5.60	0 12:07	0 00:00	0.00	0.00
18	OUT2_2	5.98	0.45	268.98	0.66	0.00	5.02	268.35	0.03	0 12:08	0 00:00	0.00	0.00
19	OUT2_3	3.07	0.55	264.91	0.41	0.00	4.09	264.52	0.02	0 12:17	0 00:00	0.00	0.00
20	Outfall_2_1	10.50	0.00	294.97	0.97	0.00	5.03	294.06	0.06	0 12:09	0 00:00	0.00	0.00
21	Outfall_2_2	5.98	0.00	266.66	0.66	0.00	5.34	266.03	0.03	0 12:08	0 00:00	0.00	0.00
22	Outfall_2_3	3.07	0.00	262.40	0.40	0.00	5.60	262.02	0.02	0 12:17	0 00:00	0.00	0.00
23	Outfall_2_4	1.34	0.00	250.27	0.27	0.00	5.73	250.02	0.02	0 12:06	0 00:00	0.00	0.00

**Channel Input**

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Shape Slope (%)	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 CB10-bypass	191.61	393.46	3.06	389.50	3.60	3.96	2.0700 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
2 CB11-bypass	478.43	389.50	3.60	378.90	2.50	10.60	2.2200 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
3 CB12-bypass	425.00	388.11	3.91	378.76	4.36	9.35	2.2000 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
4 CB13-bypass	155.71	378.90	2.50	375.33	3.03	3.57	2.2900 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
5 CB14-bypass	318.79	378.76	4.36	370.30	4.90	8.46	2.6500 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
6 CB15-bypass	115.44	375.33	3.03	372.17	3.87	3.16	2.7400 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
7 CB16-bypass	71.28	372.17	3.87	369.76	2.96	2.41	3.3800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
8 CB17-bypass	236.23	370.30	4.90	358.78	3.58	11.52	4.8800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
9 CB18-bypass	213.88	369.76	2.96	359.82	3.12	9.94	4.6500 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
10 CB19-bypass	528.55	359.82	3.12	332.72	0.00	27.10	5.1300 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
11 CB20-bypass	541.70	358.78	3.58	329.09	0.00	29.69	5.4800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
12 CB22-bypass	495.92	330.74	3.04	311.32	5.32	19.42	3.9200 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
13 CB23-bypass	115.97	328.70	4.80	325.59	5.49	3.11	2.6800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
14 CB24-bypass	416.71	325.59	5.49	303.57	4.67	22.02	5.2800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
15 CB25-bypass	230.21	311.32	5.32	300.80	5.60	10.52	4.5700 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
16 CB26-bypass	68.43	303.57	4.67	300.38	4.88	3.19	4.6600 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
17 CB27-bypass	566.65	300.38	4.88	270.70	0.00	29.68	5.2400 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
18 CB28-bypass	89.54	270.47	1.57	269.04	1.84	1.43	1.6000 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
19 CB31-bypass	611.00	269.04	1.84	257.18	2.18	11.86	1.9400 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
20 CB5-bypass	842.80	398.31	3.11	388.11	3.91	10.20	1.2100 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
21 CB7-bypass	102.09	397.14	2.94	396.62	3.02	0.52	0.5100 Trapezoidal	0.300	19.600	0.0130	0.5000	0.5000	0.0000	0.00	No
22 CB8-bypass	84.93	396.62	3.02	396.20	3.00	0.42	0.4900 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
23 CB9-bypass	195.58	396.20	3.00	393.46	3.06	2.74	1.4000 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
24 Cbfd-bypass	102.51	271.90	271.90	270.47	1.57	1.43	1.3900 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
25 EX32-bypass	156.00	257.18	2.18	255.47	0.00	1.71	1.1000 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
26 EX33-bypass	70.00	256.90	3.80	255.70	0.00	1.20	1.7100 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
27 Outfall-1	333.49	329.09	0.00	286.00	0.00	43.09	12.9200 Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No
28 Outfall-2_1	50.00	294.50	-0.70	294.00	0.00	0.50	1.0000 Trapezoidal	2.000	8.500	0.0320	0.5000	0.5000	0.0000	0.00	No
29 Outfall-2_2	50.00	268.32	0.00	266.00	0.00	2.32	4.6400 Trapezoidal	1.500	6.500	0.0320	0.5000	0.5000	0.0000	0.00	No
30 Outfall-2_3	50.00	264.50	0.00	262.00	0.00	2.50	5.0000 Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No

**Channel Results**

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	CB10-bypass	0.44	0 12:20	12.94	0.03	2.00	1.60	0.08	0.28	0.00		
2	CB11-bypass	1.40	0 12:23	13.40	0.10	2.76	2.89	0.13	0.43	0.00		
3	CB12-bypass	0.34	0 12:08	13.35	0.03	2.16	3.28	0.08	0.25	0.00		
4	CB13-bypass	3.88	0 12:27	13.63	0.28	3.57	0.73	0.19	0.62	0.00		
5	CB14-bypass	0.24	0 12:08	14.66	0.02	2.07	2.57	0.06	0.21	0.00		
6	CB15-bypass	3.86	0 12:27	14.89	0.26	3.81	0.50	0.18	0.60	0.00		
7	CB16-bypass	2.98	0 12:26	16.55	0.18	3.86	0.31	0.16	0.53	0.00		
8	CB17-bypass	0.15	0 12:08	19.87	0.01	2.24	1.76	0.05	0.16	0.00		
9	CB18-bypass	1.45	0 12:27	19.40	0.07	3.64	0.98	0.11	0.38	0.00		
10	CB19-bypass	1.13	0 12:23	20.38	0.06	3.57	2.47	0.10	0.34	0.00		
11	CB20-bypass	0.06	0 12:09	21.07	0.00	1.93	4.68	0.03	0.11	0.00		
12	CB22-bypass	0.06	0 12:08	17.81	0.00	1.75	4.72	0.04	0.12	0.00		
13	CB23-bypass	0.86	0 12:10	14.74	0.06	2.60	0.74	0.10	0.34	0.00		
14	CB24-bypass	1.81	0 12:10	20.69	0.09	4.11	1.69	0.12	0.40	0.00		
15	CB25-bypass	0.27	0 12:07	19.24	0.01	2.47	1.55	0.06	0.20	0.00		
16	CB26-bypass	3.41	0 12:09	19.43	0.18	4.51	0.25	0.16	0.52	0.00		
17	CB27-bypass	1.98	0 12:11	20.60	0.10	4.25	2.22	0.12	0.41	0.00		
18	CB28-bypass	0.14	0 12:07	9.06	0.02	1.48	1.01	0.06	0.21	0.00		
19	CB31-bypass	0.03	0 12:08	9.99	0.00	1.39	7.33	0.03	0.11	0.00		
20	CB5-bypass	0.09	0 12:10	7.89	0.01	1.34	10.48	0.05	0.18	0.00		
21	CB7-bypass	0.51	0 12:08	7.35	0.07	1.23	1.38	0.10	0.34	0.00		
22	CB8-bypass	0.45	0 12:14	6.33	0.07	1.18	1.20	0.11	0.37	0.00		
23	CB9-bypass	0.29	0 12:18	10.65	0.03	1.56	2.09	0.08	0.26	0.00		
24	CBFD-bypass	0.19	0 12:07	8.47	0.02	1.52	1.12	0.07	0.24	0.00		
25	EX32-bypass	0.47	0 12:07	7.51	0.06	1.76	1.48	0.11	0.35	0.00		
26	EX33-bypass	0.16	0 12:06	9.39	0.02	1.54	0.76	0.07	0.22	0.00		
27	Outfall-1	15.50	0 12:13	450.45	0.03	9.18	0.61	0.70	0.23	0.00		
28	Outfall-2_1	10.50	0 12:09	62.70	0.17	4.46	0.19	0.97	0.48	0.00		
29	Outfall-2_2	5.98	0 12:08	42.51	0.14	4.96	0.17	0.66	0.44	0.00		
30	Outfall-2_3	3.07	0 12:17	280.21	0.01	4.22	0.20	0.40	0.13	0.00		

### Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 11-Oct	190.10	390.40	0.00	386.00	0.10	4.40	2.3100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
2 101-7	198.47	394.70	0.00	394.20	0.00	0.50	0.2500	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
3 102-17	166.34	371.90	0.00	366.60	1.20	5.30	3.1900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
4 12-Nov	57.91	385.90	0.00	384.60	0.40	1.30	2.2400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
5 14-Dec	434.45	384.20	0.00	374.40	0.00	9.80	2.2600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
6 13-14	34.67	376.40	0.00	374.70	0.30	1.70	4.9000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
7 14-102	152.21	374.40	0.00	372.00	0.10	2.40	1.5800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
8 5-Jan	110.54	396.00	0.00	395.30	0.10	0.70	0.6300	CIRCULAR	8.040	8.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
9 15-102	32.43	372.30	0.00	372.00	0.10	0.30	0.9300	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
10 16-17	60.89	368.30	0.00	365.50	0.10	2.80	4.6000	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
11 17-2	244.52	365.40	0.00	354.80	0.00	10.60	4.3400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
12 18-17	38.21	366.80	0.00	366.50	1.10	0.30	0.7900	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No	1
13 19-2	30.83	356.70	0.00	354.80	0.00	1.90	6.1600	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
14 20-2	8.74	355.20	0.00	354.90	0.10	0.30	3.4300	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
15 21-22	113.00	330.30	0.00	327.80	0.10	2.50	2.2100	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
16 22-23	113.71	327.70	0.00	324.50	0.60	3.20	2.8100	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
17 23-24	115.91	323.90	0.00	320.20	0.10	3.70	3.1900	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
18 24-25	276.64	320.10	0.00	306.00	0.00	14.10	5.1000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
19 25-26	138.90	306.00	0.00	299.10	0.20	6.90	4.9700	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
20 26-27	68.30	298.90	0.00	295.60	0.10	3.30	4.8300	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
21 27-OUT2_1	35.92	295.50	0.00	294.50	-0.70	1.00	2.7800	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
22 28-3	26.48	268.90	0.00	268.80	0.10	0.10	0.3800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
23 2-OUT1	530.29	354.80	0.00	331.40	2.31	23.40	4.4100	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
24 1-Mar	16.51	397.50	0.00	397.20	1.20	0.30	1.8200	CIRCULAR	8.040	8.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
25 31-5	10.81	267.20	0.00	266.00	0.10	1.20	11.1000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
26 32-6	18.00	255.00	0.00	254.20	0.60	0.80	4.4400	CIRCULAR	6.000	6.000	0.0110	0.5000	0.5000	0.0000	0.00	No	2
27 33-out	40.00	253.10	0.00	250.00	0.00	3.10	7.7500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
28 4-Mar	62.53	268.70	0.00	268.20	0.10	0.50	0.8000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
29 5-Apr	21.75	268.10	0.00	266.00	0.10	2.10	9.6600	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
30 5-101	26.79	395.20	0.00	394.80	0.10	0.40	1.4900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
31 5-OUT2_3	51.22	265.90	0.00	264.50	0.00	1.40	2.7300	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
32 6-101	28.90	394.90	0.00	394.80	0.10	0.10	0.3500	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
33 6-out	165.00	253.60	0.00	250.00	0.00	3.60	2.1800	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
34 8-Jul	99.78	394.20	0.00	393.60	0.00	0.60	0.6000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
35 3-Aug	59.07	268.80	0.00	268.80	0.10	0.00	0.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
36 9-Aug	84.19	393.60	0.00	393.20	0.00	0.40	0.4800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
37 10-Sep	194.56	393.20	0.00	390.40	0.00	2.80	1.4400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
38 Blake-3	20.00	268.90	0.00	268.70	0.00	0.20	1.0000	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
39 Culvert1	45.16	332.72	0.00	329.09	0.00	3.63	8.0400	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
40 Culvert2	55.47	270.70	0.00	268.32	0.00	2.38	4.2900	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
41 FH-8	60.93	269.10	269.10	268.80	0.00	0.30	0.4900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
42 FSP1-Out	20.00	273.00	0.00	272.60	1.90	0.40	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
43 FSP2-Out	178.00	272.00	0.00	269.00	0.10	3.00	1.6900	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
44 HILDRETH	100.00	395.90	0.00	394.90	0.00	1.00	1.0000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
45 O2_1	1093.34	294.00	0.00	294.00	45.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
46 O2_2	539.72	266.00	0.00	266.00	17.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
47 O2_3	246.53	262.00	0.00	262.00	13.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
48 O2_4	714.54	250.00	0.00	250.00	1.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

**Pipe Results**

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 11-Oct	3.85	0 12:18	6.41	0.60	8.53	0.37	0.56	0.56	0.00		Calculated
2 101-7	1.67	0 12:42	1.55	1.08	2.37	1.40	1.00	1.00	49.00		SURCHARGED
3 102-17	5.96	0 12:17	5.51	1.08	8.18	0.34	1.00	1.00	35.00		SURCHARGED
4 12-Nov	5.42	0 12:19	6.31	0.86	9.03	0.11	0.71	0.71	0.00		Calculated
5 14-Dec	5.02	0 12:07	4.64	1.08	6.97	1.04	1.00	1.00	28.00		SURCHARGED
6 13-14	2.76	0 12:26	6.84	0.40	8.24	0.07	0.44	0.44	0.00		Calculated
7 14-102	4.19	0 11:53	3.88	1.08	5.77	0.44	1.00	1.00	69.00		SURCHARGED
8 5-Jan	1.23	0 12:04	1.14	1.08	3.83	0.48	0.67	1.00	15.00		SURCHARGED
9 15-102	2.82	0 12:26	2.97	0.95	4.30	0.13	0.78	0.78	0.00		Calculated
10 16-17	2.38	0 12:26	19.52	0.12	7.46	0.14	0.35	0.24	0.00		Calculated
11 17-2	6.95	0 12:05	6.43	1.08	9.56	0.43	1.00	1.00	58.00		SURCHARGED
12 18-17	0.99	0 12:10	0.93	1.07	3.10	0.21	0.67	1.00	40.00		SURCHARGED
13 19-2	1.63	0 12:21	22.60	0.07	7.45	0.07	0.27	0.18	0.00		Calculated
14 20-2	0.38	0 12:07	5.72	0.07	4.12	0.04	0.18	0.18	0.00		Calculated
15 21-22	1.26	0 12:09	5.30	0.24	5.54	0.34	0.33	0.33	0.00		Calculated
16 22-23	1.47	0 12:09	5.98	0.25	6.29	0.30	0.34	0.34	0.00		Calculated
17 23-24	2.66	0 12:09	6.37	0.42	7.74	0.25	0.45	0.45	0.00		Calculated
18 24-25	4.55	0 12:09	8.04	0.57	10.57	0.44	0.54	0.54	0.00		Calculated
19 25-26	5.26	0 12:08	23.41	0.22	10.69	0.22	0.48	0.32	0.00		Calculated
20 26-27	7.94	0 12:09	49.73	0.16	11.59	0.10	0.54	0.27	0.00		Calculated
21 27-OUT2_1	10.11	0 12:09	20.67	0.49	6.54	0.09	0.99	0.49	0.00		Calculated
22 28-3	0.46	0 12:07	1.90	0.24	1.99	0.22	0.33	0.33	0.00		Calculated
23 2-OUT1	8.67	0 12:05	16.04	0.54	13.66	0.65	0.65	0.52	0.00		Calculated
24 1-Mar	1.64	0 12:10	1.93	0.85	6.19	0.04	0.47	0.71	0.00		Calculated
25 31-5	0.68	0 12:06	11.87	0.06	8.20	0.02	0.16	0.16	0.00		Calculated
26 32-6	0.85	0 12:06	2.80	0.30	6.24	0.05	0.19	0.38	0.00		Calculated
27 33-out	0.49	0 12:06	9.92	0.05	6.58	0.10	0.15	0.15	0.00		Calculated
28 4-Mar	2.52	0 12:18	9.39	0.27	4.50	0.23	0.53	0.35	0.00		Calculated
29 5-Apr	2.52	0 12:18	32.64	0.08	10.96	0.03	0.28	0.19	0.00		Calculated
30 5-101	1.51	0 12:04	3.77	0.40	4.55	0.10	0.44	0.44	0.00		Calculated
31 5-OUT2_3	2.82	0 12:17	17.37	0.16	7.22	0.12	0.41	0.27	0.00		Calculated
32 6-101	1.93	0 12:31	1.82	1.06	2.69	0.18	1.00	1.00	33.00		SURCHARGED
33 6-out	0.85	0 12:06	5.26	0.16	4.93	0.56	0.27	0.27	0.00		Calculated
34 8-Jul	2.32	0 12:08	2.39	0.97	3.48	0.48	0.79	0.79	0.00		Calculated
35 3-Aug	0.19	0 12:24	0.17	1.08	0.28	3.52	1.00	1.00	28.00		SURCHARGED
36 9-Aug	2.30	0 11:58	2.13	1.08	3.17	0.44	1.00	1.00	42.00		SURCHARGED
37 10-Sep	3.01	0 12:17	3.70	0.81	5.35	0.61	0.68	0.68	0.00		Calculated
38 Blake-3	2.13	0 12:18	9.10	0.23	4.20	0.08	0.49	0.33	0.00		Calculated
39 Culvert1	6.72	0 12:14	25.81	0.26	12.28	0.06	0.52	0.35	0.00		Calculated
40 Culvert2	5.57	0 12:08	46.86	0.12	10.01	0.09	0.47	0.23	0.00		Calculated
41 FH-8	0.46	0 12:06	2.17	0.21	2.19	0.46	0.31	0.31	0.00		Calculated
42 FSP1-Out	0.51	0 12:36	5.95	0.09	4.63	0.07	0.20	0.20	0.00		Calculated
43 FSP2-Out	1.90	0 12:18	13.64	0.14	5.43	0.55	0.38	0.25	0.00		Calculated
44 HILDRETH	3.34	0 12:08	3.09	1.08	4.63	0.36	1.00	1.00	10.00		SURCHARGED
45 O2_1	10.50	0 12:09	0.00	1.08	0.00		1.00	1.00	10.00		SURCHARGED
46 O2_2	5.98	0 12:08	0.00	1.08	0.00		1.00	1.00	10.00		SURCHARGED
47 O2_3	3.07	0 12:17	0.00	1.08	0.00		1.00	1.00	10.00		SURCHARGED
48 O2_4	1.34	0 12:06	0.00	1.08	0.00		1.00	1.00	10.00		SURCHARGED

**Inlet Input**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft <sup>2</sup> )	Grate Clogging Factor (%)
1	CB10	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.40	393.46	3.06	0.00	0.00	N/A	0.00
2	CB11	FHWA HEC-22 GENERIC	N/A	On Grade	1	385.90	389.50	3.60	0.00	0.00	N/A	0.00
3	CB12	FHWA HEC-22 GENERIC	N/A	On Grade	1	384.20	388.11	3.91	0.00	0.00	N/A	0.00
4	CB13	FHWA HEC-22 GENERIC	N/A	On Grade	1	376.40	378.90	2.50	0.00	0.00	N/A	0.00
5	CB14	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.40	378.76	4.36	0.00	0.00	N/A	0.00
6	CB15	FHWA HEC-22 GENERIC	N/A	On Grade	1	372.30	375.33	3.03	0.00	0.00	N/A	0.00
7	CB16	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.30	372.17	3.87	0.00	0.00	N/A	0.00
8	CB17	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.40	370.30	4.90	0.00	0.00	N/A	0.00
9	CB18	FHWA HEC-22 GENERIC	N/A	On Grade	1	366.80	369.76	2.96	0.00	0.00	N/A	0.00
10	CB19	FHWA HEC-22 GENERIC	N/A	On Grade	1	356.70	359.82	3.12	0.00	0.00	N/A	0.00
11	CB20	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.20	358.78	3.58	0.00	0.00	N/A	0.00
12	CB21	FHWA HEC-22 GENERIC	N/A	On Sag	1	330.30	333.30	3.00	0.00	0.00	0.00	0.00
13	CB22	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.70	330.74	3.04	0.00	0.00	N/A	0.00
14	CB23	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.90	328.70	4.80	0.00	0.00	N/A	0.00
15	CB24	FHWA HEC-22 GENERIC	N/A	On Grade	1	320.10	325.59	5.49	0.00	0.00	N/A	0.00
16	CB25	FHWA HEC-22 GENERIC	N/A	On Grade	1	306.00	311.32	5.32	0.00	0.00	N/A	0.00
17	CB26	FHWA HEC-22 GENERIC	N/A	On Grade	1	298.90	303.57	4.67	0.00	0.00	N/A	0.00
18	CB27	FHWA HEC-22 GENERIC	N/A	On Grade	1	295.50	300.38	4.88	0.00	0.00	N/A	0.00
19	CB28	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.90	270.47	1.57	0.00	0.00	N/A	0.00
20	CB3	FHWA HEC-22 GENERIC	N/A	On Sag	1	397.50	399.24	1.74	0.00	0.00	0.00	0.00
21	CB31	FHWA HEC-22 GENERIC	N/A	On Grade	1	267.20	269.04	1.84	0.00	0.00	N/A	0.00
22	CB5	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.20	398.31	3.11	0.00	0.00	N/A	0.00
23	CB6	FHWA HEC-22 GENERIC	N/A	On Sag	1	394.90	398.92	4.02	0.00	0.00	0.00	0.00
24	CB7	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.20	397.14	2.94	0.00	0.00	N/A	0.00
25	CB8	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.60	396.62	3.02	0.00	0.00	N/A	0.00
26	CB9	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.20	396.20	3.00	0.00	0.00	N/A	0.00
27	CBFD	FHWA HEC-22 GENERIC	N/A	On Grade	1	0.00	271.90	271.90	269.00	269.00	N/A	0.00
28	EXCB-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	2.18	0.00	0.00	N/A	0.00
29	EXCB-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	3.80	0.00	0.00	N/A	0.00



**Roadway & Gutter Input**

SN Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1 CB10	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
2 CB11	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
3 CB12	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
4 CB13	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
5 CB14	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
6 CB15	0.0260	0.0200	0.0130	0.0200	3.00	0.0000	7.00
7 CB16	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
8 CB17	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
9 CB18	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
10 CB19	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
11 CB20	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
12 CB21	N/A	0.0200	0.0130	0.0200	3.00	0.0000	7.00
13 CB22	0.0200	0.0200	0.0130	0.0200	3.00	0.0000	7.00
14 CB23	0.0200	0.0200	0.0130	0.0200	3.00	0.0000	7.00
15 CB24	0.0300	0.0200	0.0130	0.0200	3.00	0.0000	7.00
16 CB25	0.0550	0.0200	0.0130	0.0200	3.00	0.0000	7.00
17 CB26	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
18 CB27	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
19 CB28	0.0170	0.0200	0.0130	0.0200	3.00	0.0000	7.00
20 CB3	N/A	0.0200	0.0130	0.0200	3.00	0.0000	7.00
21 CB31	0.0100	0.0200	0.0130	0.0620	2.00	0.0656	7.00
22 CB5	0.0050	0.0200	0.0130	0.0200	2.00	0.0000	7.00
23 CB6	N/A	0.0200	0.0160	0.0200	2.00	0.0000	7.00
24 CB7	0.0050	0.0200	0.0130	0.0200	3.00	0.0000	7.00
25 CB8	0.0065	0.0200	0.0130	0.0200	3.00	0.0000	7.00
26 CB9	0.0650	0.0200	0.0130	0.0200	3.00	0.0000	7.00
27 CBFD	0.0050	0.0200	0.0130	0.0200	3.00	0.0000	7.00
28 EXCB-32	0.0170	0.0200	0.0130	0.0200	3.00	0.0328	7.00
29 EXCB-33	0.0170	0.0200	0.0130	0.0200	2.00	0.0000	7.00

**Inlet Results**

SN	Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Time of Max Depth Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	CB10	1.29	1.00	0.85	0.43	66.27	6.36	393.59	0.13	0 12:17	0.00	0.00
2	CB11	2.98	2.54	1.57	1.40	52.90	8.68	389.67	0.17	0 12:19	0.00	0.00
3	CB12	1.09	1.02	0.75	0.34	69.14	5.96	388.23	0.12	0 12:02	0.42	34.00
4	CB13	6.63	5.33	2.75	3.88	41.50	11.76	379.14	0.24	0 12:26	0.00	0.00
5	CB14	0.86	0.54	0.63	0.23	73.08	5.45	378.87	0.11	0 11:51	2.88	72.00
6	CB15	6.69	2.82	2.83	3.86	42.29	11.38	375.56	0.23	0 12:26	0.00	0.00
7	CB16	5.36	1.53	2.38	2.98	44.42	10.82	372.39	0.22	0 12:26	0.00	0.00
8	CB17	0.65	0.42	0.50	0.14	77.71	4.91	370.40	0.10	0 12:01	1.84	65.00
9	CB18	3.31	0.38	1.87	1.45	56.31	7.74	369.91	0.15	0 12:08	0.39	43.00
10	CB19	2.76	2.16	1.64	1.12	59.32	7.21	359.96	0.14	0 12:21	0.00	0.00
11	CB20	0.44	0.30	0.39	0.05	89.00	3.63	358.85	0.07	0 12:07	0.00	0.00
12	CB21	1.25	1.25	N/A	N/A	N/A	9.46	333.46	0.16	0 12:09	0.00	0.00
13	CB22	0.32	0.32	0.29	0.04	87.75	3.86	330.82	0.08	0 12:09	0.00	0.00
14	CB23	2.05	2.05	1.19	0.86	58.16	7.70	328.85	0.15	0 12:09	0.00	0.00
15	CB24	3.73	2.91	1.91	1.82	51.26	8.91	325.77	0.18	0 12:09	0.00	0.00
16	CB25	1.08	1.02	0.81	0.26	75.56	5.00	311.42	0.10	0 12:09	0.00	0.00
17	CB26	6.10	4.30	2.68	3.42	44.01	9.72	303.76	0.19	0 12:08	0.00	0.00
18	CB27	4.18	0.81	2.17	2.01	51.89	8.42	300.55	0.17	0 12:09	0.00	0.00
19	CB28	0.60	0.41	0.46	0.13	77.49	5.00	270.57	0.10	0 12:06	0.00	0.00
20	CB3	1.64	1.64	N/A	N/A	N/A	11.11	399.43	0.19	0 12:10	0.00	0.00
21	CB31	0.58	0.58	0.55	0.03	95.11	3.96	269.20	0.16	0 12:07	0.00	0.00
22	CB5	0.37	0.37	0.30	0.07	79.90	5.25	398.42	0.11	0 12:05	0.00	0.00
23	CB6	0.56	0.56	N/A	N/A	N/A	5.92	399.02	0.10	0 11:56	0.00	0.00
24	CB7	1.28	1.28	0.77	0.50	60.55	8.35	397.31	0.17	0 11:52	0.00	0.00
25	CB8	1.19	0.80	0.74	0.45	62.19	7.73	396.77	0.15	0 11:51	0.39	51.00
26	CB9	1.17	0.73	0.88	0.29	75.45	5.00	396.30	0.10	0 11:58	0.00	0.00
27	CBFD	0.65	0.65	0.46	0.19	71.23	6.49	272.03	0.13	0 12:06	0.00	0.00
28	EXCB-32	1.32	1.30	0.85	0.47	64.40	6.73	257.31	0.13	0 12:06	0.00	0.00
29	EXCB-33	0.66	0.66	0.50	0.16	76.11	5.16	257.00	0.10	0 12:06	0.00	0.00

## Storage Nodes

### Storage Node : FSP-1

#### Input Data

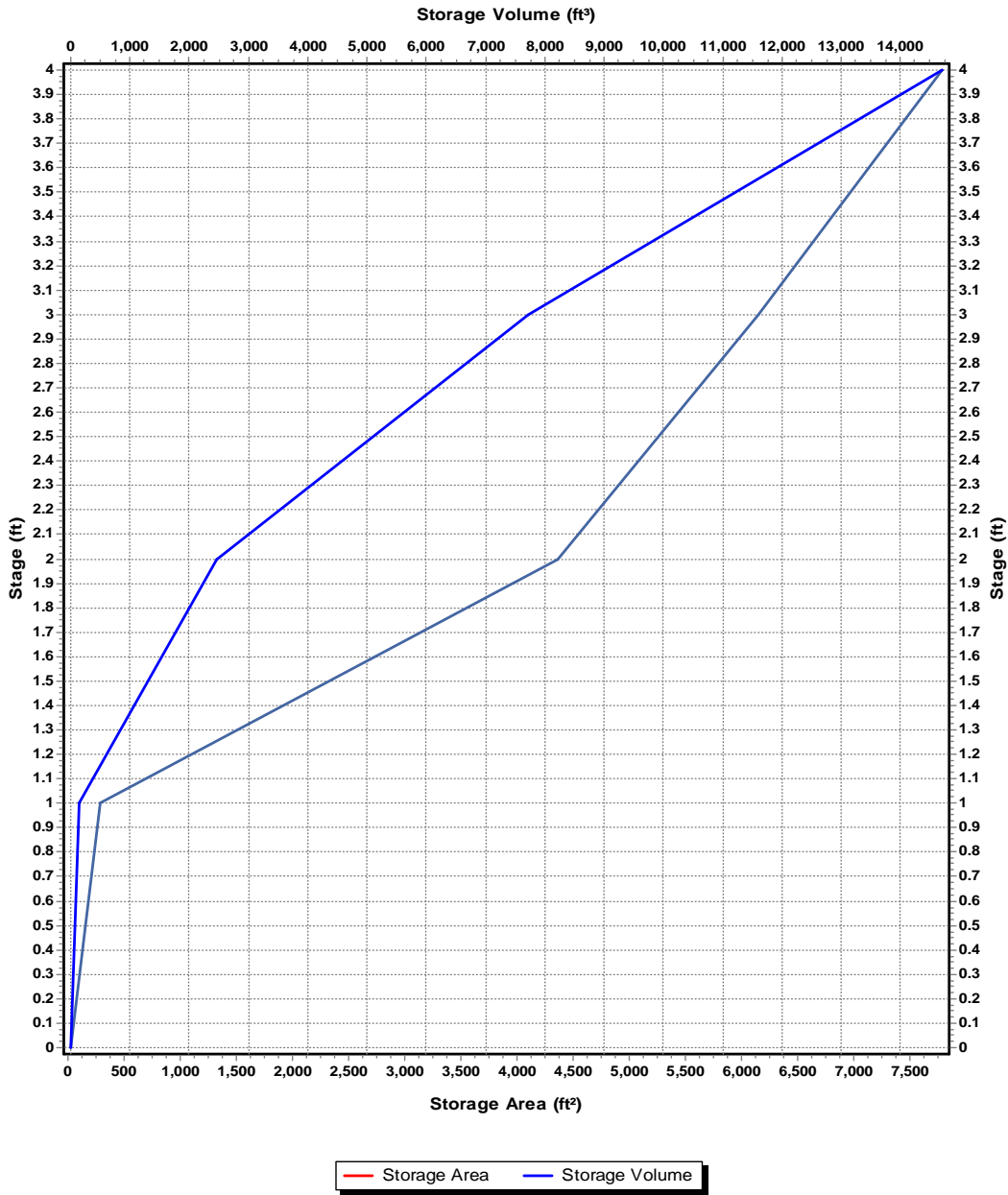
Invert Elevation (ft) ..... 272  
Max (Rim) Elevation (ft) ..... 276  
Max (Rim) Offset (ft) ..... 4  
Initial Water Elevation (ft) ..... 272  
Initial Water Depth (ft) ..... 0  
Ponded Area (ft<sup>2</sup>) ..... 0  
Evaporation Loss ..... 0

#### Storage Area Volume Curves

Storage Curve : FH-Pond1

Stage	Storage Area	Storage Volume
(ft)	(ft <sup>2</sup> )	(ft <sup>3</sup> )
0	20	0
1	277	148.5
2	4361	2467.5
3	6157	7726.5
4	7794	14702

### Storage Area Volume Curves



**Storage Node : FSP-1 (continued)**

**Outflow Orifices**

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	FSP1-1	Side	CIRCULAR	No	8.00			274.00	0.60
2	FSP1-2	Side	CIRCULAR	No	12.00			274.12	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	2.76
Peak Lateral Inflow (cfs) .....	2.76
Peak Outflow (cfs) .....	0.51
Peak Exfiltration Flow Rate (cfm) .....	6.95
Max HGL Elevation Attained (ft) .....	274.3
Max HGL Depth Attained (ft) .....	2.3
Average HGL Elevation Attained (ft) .....	272.43
Average HGL Depth Attained (ft) .....	0.43
Time of Max HGL Occurrence (days hh:mm) .....	0 12:36
Total Exfiltration Volume (1000-ft <sup>3</sup> ) .....	6.712
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : FSP-2**

**Input Data**

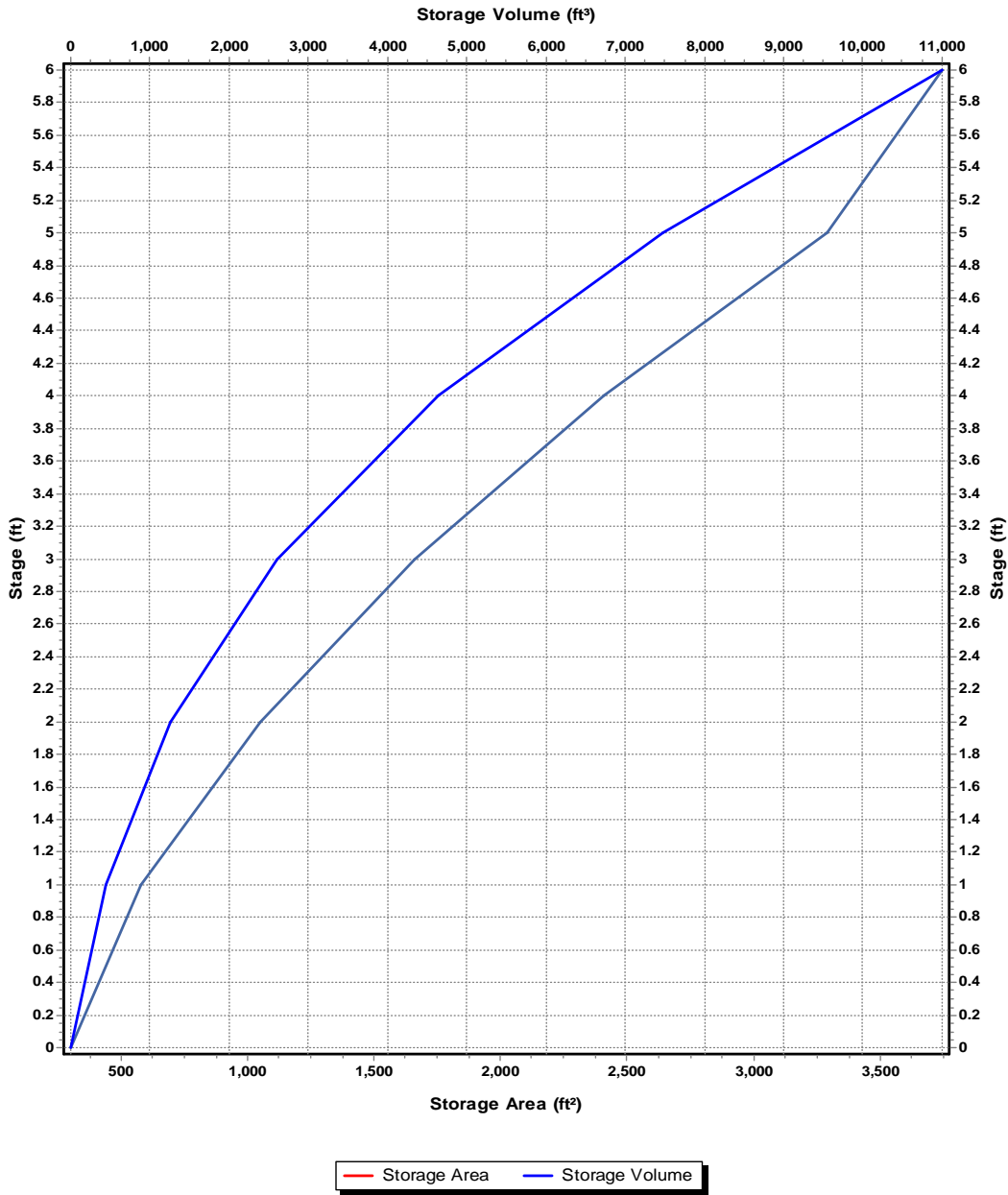
Invert Elevation (ft) .....	270
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	6
Initial Water Elevation (ft) .....	270
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	0
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : FH-Pond2

Stage (ft)	Storage Area (ft <sup>2</sup> )	Storage Volume (ft <sup>3</sup> )
0	300	0
1	578	439
2	1048	1252
3	1659	2605.5
4	2406	4638
5	3289	7485.5
6	3746	11003

### Storage Area Volume Curves



**Storage Node : FSP-2 (continued)**

**Outflow Orifices**

SN ID	Element Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	FSP2-1	Side	CIRCULAR No	8.00			273.00	0.60
2	FSP2-2	Side	CIRCULAR No	15.00			273.25	0.60
3	FSP2-3	Side	CIRCULAR No	15.00			273.50	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	3.44
Peak Lateral Inflow (cfs) .....	3.44
Peak Outflow (cfs) .....	1.9
Peak Exfiltration Flow Rate (cfm) .....	3.03
Max HGL Elevation Attained (ft) .....	273.64
Max HGL Depth Attained (ft) .....	3.64
Average HGL Elevation Attained (ft) .....	270.93
Average HGL Depth Attained (ft) .....	0.93
Time of Max HGL Occurrence (days hh:mm) .....	0 12:18
Total Exfiltration Volume (1000-ft³) .....	4.928
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0



### Project Description

File Name ..... Boston Rd - Pre Dev - 20221215.SPF

### Project Options

Flow Units ..... CFS  
 Elevation Type ..... Elevation  
 Hydrology Method ..... SCS TR-55  
 Time of Concentration (TOC) Method ..... SCS TR-55  
 Link Routing Method ..... Kinematic Wave  
 Enable Overflow Ponding at Nodes ..... YES  
 Skip Steady State Analysis Time Periods ... YES

### Analysis Options

Start Analysis On ..... 00:00:00      0:00:00  
 End Analysis On ..... 00:00:00      0:00:00  
 Start Reporting On ..... 00:00:00      0:00:00  
 Antecedent Dry Days ..... 0      days  
 Runoff (Dry Weather) Time Step ..... 0 01:00:00      days hh:mm:ss  
 Runoff (Wet Weather) Time Step ..... 0 00:05:00      days hh:mm:ss  
 Reporting Time Step ..... 0 00:00:10      days hh:mm:ss  
 Routing Time Step ..... 10      seconds

### Number of Elements

	Qty
Rain Gages .....	1
Subbasins .....	53
Nodes.....	58
<i>Junctions</i> .....	23
<i>Outfalls</i> .....	4
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	29
<i>Storage Nodes</i> .....	2
Links.....	83
<i>Channels</i> .....	30
<i>Pipes</i> .....	48
<i>Pumps</i> .....	0
<i>Orifices</i> .....	5
<i>Weirs</i> .....	0
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

### Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	010-yr	Cumulative	inches	Massachusetts	Middlesex	10.00	4.90	SCS Type III 24-hr

**Subbasin Summary**

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Blake1P	2.66	484.00	78.70	4.90	2.69	7.15	7.18	0 00:07:38
2	Blake2	0.31	484.00	82.10	4.90	3.00	0.93	0.97	0 00:05:00
3	CB10-DA	0.09	484.00	96.90	4.90	4.53	0.42	0.37	0 00:05:00
4	CB10L-DA	0.93	484.00	80.20	4.90	2.82	2.63	1.86	0 00:26:57
5	CB11-DA	0.09	484.00	95.60	4.90	4.38	0.40	0.36	0 00:05:00
6	CB11L-DA	2.77	484.00	79.00	4.90	2.72	7.53	5.17	0 00:28:39
7	CB12-DA	0.40	484.00	95.50	4.90	4.38	1.77	1.63	0 00:05:00
8	CB13-DA	0.19	484.00	98.00	4.90	4.66	0.89	0.79	0 00:05:00
9	CB13L-DA	7.68	484.00	76.90	4.90	2.53	19.43	11.49	0 00:39:38
10	CB14-DA	0.21	484.00	95.60	4.90	4.39	0.92	0.85	0 00:05:00
11	CB15-DA	0.07	484.00	98.00	4.90	4.66	0.31	0.26	0 00:05:00
12	CB15L-DA	4.60	484.00	73.70	4.90	2.26	10.40	6.57	0 00:33:56
13	CB16-DA	0.05	484.00	98.00	4.90	4.65	0.24	0.21	0 00:05:00
14	CB16L-DA	2.01	484.00	76.40	4.90	2.49	5.01	3.30	0 00:31:25
15	CB17-DA	0.17	484.00	95.70	4.90	4.40	0.73	0.67	0 00:05:00
16	CB18-DA	0.03	484.00	98.00	4.90	4.61	0.12	0.11	0 00:05:00
17	CB18L-DA	0.50	484.00	73.70	4.90	2.26	1.14	0.84	0 00:23:57
18	CB19-DA	0.09	484.00	98.00	4.90	4.66	0.40	0.34	0 00:05:00
19	CB19L-DA	2.56	484.00	72.10	4.90	2.13	5.46	4.97	0 00:12:16
20	CB20-DA	0.12	484.00	96.20	4.90	4.45	0.52	0.47	0 00:05:00
21	CB21-DA	1.31	484.00	74.60	4.90	2.34	3.06	2.89	0 00:10:50
22	CB22-DA	0.13	484.00	95.50	4.90	4.37	0.55	0.52	0 00:05:00
23	CB23-DA	2.06	484.00	75.50	4.90	2.41	4.96	4.63	0 00:11:28
24	CB24-DA	2.61	484.00	76.30	4.90	2.48	6.47	6.41	0 00:08:30
25	CB25-DA	0.43	484.00	92.40	4.90	4.03	1.75	1.69	0 00:05:00
26	CB26-DA	0.07	484.00	96.80	4.90	4.51	0.29	0.26	0 00:05:00
27	CB26L-DA	3.73	484.00	77.20	4.90	2.56	9.55	9.04	0 00:10:45
28	CB27-DA	0.05	484.00	96.80	4.90	4.51	0.23	0.21	0 00:05:00
29	CB27L-DA	0.78	484.00	72.20	4.90	2.14	1.66	1.67	0 00:07:30
30	CB28-DA	0.23	484.00	84.30	4.90	3.21	0.73	0.76	0 00:05:00
31	CB31-DA	0.26	484.00	91.10	4.90	3.90	1.00	0.97	0 00:05:00
32	CB3-DA	1.14	484.00	83.20	4.90	3.10	3.54	3.17	0 00:13:13
33	CB5-DA	0.14	484.00	98.00	4.90	4.66	0.66	0.58	0 00:05:00
34	CB6-DA	0.25	484.00	91.60	4.90	3.95	0.97	0.93	0 00:05:00
35	CB7-DA	0.18	484.00	97.50	4.90	4.60	0.82	0.74	0 00:05:00
36	CB8-DA	0.04	484.00	98.00	4.90	4.64	0.18	0.16	0 00:05:00
37	CB8L-DA	0.64	484.00	83.60	4.90	3.14	2.02	1.46	0 00:25:26
38	CB9-DA	0.03	484.00	98.00	4.90	4.63	0.15	0.13	0 00:05:00
39	CB9L-DA	0.58	484.00	84.90	4.90	3.27	1.88	1.31	0 00:27:09
40	CBFS	0.26	484.00	95.60	4.90	4.39	1.13	1.03	0 00:05:00
41	CD7L-DA	0.63	484.00	83.00	4.90	3.08	1.95	1.72	0 00:14:12
42	Culvert1-DA	0.16	484.00	97.90	4.90	4.65	0.76	0.68	0 00:05:00
43	Culvert1L-DA	6.61	484.00	74.30	4.90	2.31	15.28	12.74	0 00:16:50
44	Culvert2-DA	0.26	484.00	96.90	4.90	4.54	1.20	1.07	0 00:05:00
45	Culvert2L-DA	3.78	484.00	71.50	4.90	2.08	7.86	7.90	0 00:07:29
46	Culvert2P-DA	2.87	484.00	73.50	4.90	2.24	6.44	6.48	0 00:07:33
47	EX32-DA	0.49	484.00	98.00	4.90	4.66	2.29	2.03	0 00:05:00
48	EX33-DA	0.27	484.00	93.80	4.90	4.19	1.13	1.06	0 00:05:00
49	Hildreth-DA	2.35	484.00	87.00	4.90	3.47	8.16	6.90	0 00:15:35
50	Out1-DA	0.36	484.00	95.30	4.90	4.35	1.55	1.44	0 00:05:00
51	Out2_1-DA	0.09	484.00	86.80	4.90	3.45	0.32	0.31	0 00:05:00
52	Out2_2-DA	0.25	484.00	85.50	4.90	3.32	0.81	0.82	0 00:05:00
53	Out2_3-DA	0.26	484.00	89.00	4.90	3.68	0.96	0.96	0 00:05:00

**Node Summary**

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft <sup>2</sup> )	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert1In	Junction	332.72	336.00	0.00	336.00	0.00	18.78	333.67	0.00	2.33	0 00:00	0.00	0.00
2	Culvert2In	Junction	270.70	274.00	0.00	0.00	0.00	19.02	273.10	0.00	0.90	0 00:00	0.00	0.00
3	DMH1	Junction	396.00	399.76	0.00	399.76	0.00	2.07	399.76	0.00	0.00	0 12:02	0.38	39.00
4	DMH101	Junction	394.70	399.00	0.00	399.00	0.00	3.37	399.00	0.00	0.00	0 12:06	1.60	83.00
5	DMH102	Junction	371.90	375.50	0.00	375.50	0.00	7.07	375.50	0.00	0.00	0 12:53	1.47	89.00
6	DMH2	Junction	354.80	358.51	0.00	358.51	0.00	10.24	355.80	0.00	2.71	0 00:00	0.00	0.00
7	DMH3	Junction	268.70	271.83	0.00	271.83	0.00	7.89	269.80	0.00	2.03	0 00:00	0.00	0.00
8	DMH4	Junction	268.10	271.22	0.00	271.22	0.00	7.89	269.25	0.00	1.97	0 00:00	0.00	0.00
9	DMH5	Junction	265.90	269.46	0.00	269.46	0.00	8.97	266.66	0.00	2.80	0 00:00	0.00	0.00
10	DMH6	Junction	253.60	258.48	0.00	258.48	0.00	1.21	254.43	0.00	4.05	0 00:00	0.00	0.00
11	DMH8	Junction	268.80	272.80	0.00	272.80	0.00	0.66	272.80	0.00	0.00	0 12:06	0.18	50.00
12	DMH9	Junction	268.90	271.70	0.00	271.70	0.00	7.06	269.89	0.00	1.81	0 00:00	0.00	0.00
13	FSP1-Out	Junction	273.00	276.00	0.00	276.00	7794.00	3.01	273.50	0.00	2.62	0 00:00	0.00	0.00
14	FSP2-Out	Junction	272.00	276.00	0.00	276.00	3746.00	6.36	272.72	0.00	4.03	0 00:00	0.00	0.00
15	HILDRETH	Junction	395.90	399.00	395.90	395.90	0.00	6.90	399.00	0.00	0.00	0 12:11	1.10	33.00
16	OUT1	Junction	329.09	336.00	0.00	336.00	0.00	29.83	332.13	0.00	3.87	0 00:00	0.00	0.00
17	OUT2_1	Junction	295.20	301.00	0.00	301.00	0.00	18.45	300.88	0.00	0.22	0 00:00	0.00	0.00
18	OUT2_2	Junction	268.32	274.00	0.00	0.00	0.00	19.72	269.42	0.00	4.58	0 00:00	0.00	0.00
19	OUT2_3	Junction	264.50	269.00	0.00	269.00	0.00	9.84	265.26	0.00	3.74	0 00:00	0.00	0.00
20	Outfall_2_1	Junction	294.00	300.00	294.00	300.00	0.00	18.45	295.22	0.00	4.78	0 00:00	0.00	0.00
21	Outfall_2_2	Junction	266.00	272.00	266.00	272.00	0.00	19.72	267.10	0.00	4.90	0 00:00	0.00	0.00
22	Outfall_2_3	Junction	262.00	268.00	262.00	268.00	0.00	9.83	262.71	0.00	5.29	0 00:00	0.00	0.00
23	Outfall_2_4	Junction	250.00	256.00	250.00	256.00	0.00	1.93	250.33	0.00	5.67	0 00:00	0.00	0.00
24	DP_1	Outfall	286.00					29.83	286.95					
25	DP_2	Outfall	249.00					49.76	294.00					
26	EX32-bypass(out)	Outfall	255.47					0.92	255.61					
27	EX33-bypass(out)	Outfall	255.70					0.34	255.79					
28	FSP-1	Storage Node	272.00	276.00	272.00		0.00	6.48	274.88				0.00	0.00
29	FSP-2	Storage Node	270.00	276.00	270.00		0.00	7.18	274.17				0.00	0.00

Proposal No. 609035- 126590

Pre-Development

10-yr

Boston Rd. 609035  
Westford, MA

March 13, 2023

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported (min)	Surcharged Condition
1	11-Oct	Pipe	CB10	CB11	190.10	390.40	386.00	2.3100	12.000	0.0110	5.26	6.41	0.82	9.10	0.69	0.69	0.00	Calculated
2	101-7	Pipe	DMH101	CB7	198.47	394.70	394.20	0.2500	12.000	0.0150	1.68	1.55	1.08	2.34	1.00	1.00	79.00	SURCHARGED
3	102-17	Pipe	DMH102	CB17	166.34	371.90	366.60	3.1900	12.000	0.0150	5.96	5.51	1.08	8.18	1.00	1.00	77.00	SURCHARGED
4	12-Nov	Pipe	CB11	CB12	57.91	385.90	384.60	2.2400	12.000	0.0110	6.78	6.31	1.07	9.30	1.00	1.00	25.00	SURCHARGED
5	14-Dec	Pipe	CB12	CB14	434.45	384.20	374.40	2.2600	12.000	0.0150	5.02	4.64	1.08	6.97	1.00	1.00	54.00	SURCHARGED
6	13-14	Pipe	CB13	CB14	34.67	376.40	374.70	4.9000	12.000	0.0150	4.75	6.84	0.70	9.40	0.61	0.61	0.00	Calculated
7	14-102	Pipe	CB14	DMH102	152.21	374.40	372.00	1.5800	12.000	0.0150	4.19	3.88	1.08	5.80	1.00	1.00	127.00	SURCHARGED
8	5-Jan	Pipe	DMH1	CB5	110.54	396.00	395.30	0.6300	8.000	0.0110	1.23	1.14	1.08	3.84	0.67	1.00	36.00	SURCHARGED
9	15-102	Pipe	CB15	DMH102	32.43	372.30	372.00	0.9300	12.000	0.0150	3.19	2.97	1.07	4.39	1.00	1.00	46.00	SURCHARGED
10	16-17	Pipe	CB16	CB17	60.89	368.30	365.50	4.6000	18.000	0.0150	4.79	19.52	0.25	9.13	0.51	0.34	0.00	Calculated
11	17-2	Pipe	CB17	DMH2	244.52	365.40	354.80	4.3400	12.000	0.0150	6.95	6.43	1.08	9.56	1.00	1.00	118.00	SURCHARGED
12	18-17	Pipe	CB18	CB17	38.21	366.80	366.50	0.7900	8.000	0.0150	0.99	0.93	1.07	3.09	0.67	1.00	78.00	SURCHARGED
13	19-2	Pipe	CB19	DMH2	30.83	356.70	354.80	6.1600	18.000	0.0150	3.61	22.60	0.16	9.36	0.41	0.27	0.00	Calculated
14	20-2	Pipe	CB20	DMH2	8.74	355.20	354.90	3.4300	12.000	0.0150	0.67	5.72	0.12	4.86	0.23	0.23	0.00	Calculated
15	21-22	Pipe	CB21	CB22	113.00	330.30	327.80	2.2100	12.000	0.0130	2.89	5.30	0.55	6.90	0.53	0.53	0.00	Calculated
16	22-23	Pipe	CB22	CB23	113.71	327.70	324.50	2.8100	12.000	0.0130	3.24	5.98	0.54	7.77	0.53	0.53	0.00	Calculated
17	23-24	Pipe	CB23	CB24	115.91	323.90	320.20	3.1900	12.000	0.0130	5.36	6.37	0.84	9.08	0.70	0.70	0.00	Calculated
18	24-25	Pipe	CB24	CB25	276.64	320.10	306.00	5.1000	12.000	0.0130	8.55	8.04	1.06	11.96	0.94	0.94	0.00	> CAPACITY
19	25-26	Pipe	CB25	CB26	138.90	306.00	299.10	4.9700	18.000	0.0130	9.59	23.41	0.41	12.59	0.67	0.45	0.00	Calculated
20	26-27	Pipe	CB26	CB27	68.30	298.90	295.60	4.8300	24.000	0.0130	13.76	49.73	0.28	13.53	0.72	0.36	0.00	Calculated
21	27-OUT2_1	Pipe	CB27	OUT2_1	35.92	295.50	294.50	2.7800	24.000	0.0130	17.60	20.67	0.85	7.39	1.42	0.71	0.00	Calculated
22	28-3	Pipe	CB28	DMH3	26.48	268.90	268.80	0.3800	12.000	0.0150	0.75	1.90	0.40	2.28	0.44	0.44	0.00	Calculated
23	2-OUT1	Pipe	DMH2	OUT1	530.29	354.80	331.40	4.4100	15.000	0.0110	10.24	16.04	0.64	13.85	0.73	0.58	0.00	Calculated
24	1-Mar	Pipe	CB3	DMH1	16.51	397.50	397.20	1.8200	8.000	0.0110	2.07	1.93	1.07	6.33	0.67	1.00	19.00	SURCHARGED
25	31-5	Pipe	CB31	DMH5	10.81	267.20	266.00	11.1000	12.000	0.0130	1.21	11.87	0.10	9.72	0.22	0.22	0.00	Calculated
26	32-6	Pipe	EXCB-32	DMH6	18.00	255.00	254.20	4.4400	6.000	0.0110	1.21	2.80	0.43	6.86	0.23	0.46	0.00	Calculated
27	33-out	Pipe	EXCB-33	Outfall_2_4	40.00	253.10	250.00	7.7500	12.000	0.0130	0.72	9.92	0.07	7.36	0.18	0.18	0.00	Calculated
28	4-Mar	Pipe	DMH3	DMH4	62.53	268.70	268.20	0.8000	18.000	0.0130	7.89	9.39	0.84	5.95	1.05	0.70	0.00	Calculated
29	5-Apr	Pipe	DMH4	DMH5	21.75	268.10	266.00	9.6600	18.000	0.0130	7.89	32.64	0.24	15.20	0.50	0.33	0.00	Calculated
30	5-101	Pipe	CB5	DMH101	26.79	395.20	394.80	1.4900	12.000	0.0150	1.56	3.77	0.41	4.57	0.45	0.45	0.00	Calculated
31	5-OUT2_3	Pipe	DMH5	OUT2_3	51.22	265.90	264.50	2.7300	18.000	0.0130	8.97	17.37	0.52	9.91	0.76	0.51	0.00	Calculated
32	6-101	Pipe	CB6	DMH101	28.90	394.90	394.80	0.3500	12.000	0.0150	1.94	1.82	1.07	2.69	1.00	1.00	53.00	SURCHARGED
33	6-out	Pipe	DMH6	Outfall_2_4	165.00	253.60	250.00	2.1800	12.000	0.0130	1.21	5.26	0.23	5.45	0.33	0.33	0.00	Calculated
34	8-Jul	Pipe	CB7	CB8	99.78	394.20	393.60	0.6000	12.000	0.0150	2.59	2.39	1.08	3.57	1.00	1.00	13.00	SURCHARGED
35	3-Aug	Pipe	DMH8	DMH3	59.07	268.80	268.80	0.0000	12.000	0.0110	0.19	0.17	1.08	0.28	1.00	1.00	45.00	SURCHARGED
36	9-Aug	Pipe	CB8	CB9	84.19	393.60	393.20	0.4800	12.000	0.0150	2.30	2.13	1.08	3.17	1.00	1.00	70.00	SURCHARGED
37	10-Sep	Pipe	CB9	CB10	194.56	393.20	390.40	1.4400	12.000	0.0150	3.70	3.70	1.00	5.38	0.82	0.82	0.00	Calculated
38	Blake-3	Pipe	DMH9	DMH3	20.00	268.90	268.70	1.0000	18.000	0.0150	7.06	9.10	0.78	5.69	0.99	0.66	0.00	Calculated
39	Culvert1	Pipe	Culvert1In	OUT1	45.16	332.72	329.09	8.0400	18.000	0.0150	18.78	25.81	0.73	15.93	0.95	0.63	0.00	Calculated
40	Culvert2	Pipe	Culvert2In	OUT2_2	55.47	270.70	268.32	4.2900	24.000	0.0130	19.02	46.86	0.41	14.14	0.89	0.44	0.00	Calculated
41	FH-8	Pipe	CBFD	DMH8	60.93	269.10	268.80	0.4900	12.000	0.0150	0.66	2.17	0.30	2.42	0.38	0.38	0.00	Calculated
42	FSP1-Out	Pipe	FSP1-Out	Culvert2In	20.00	273.00	272.60	2.0000	12.000	0.0110	3.01	5.95	0.51	7.60	0.50	0.50	0.00	Calculated
43	FSP2-Out	Pipe	FSP2-Out	DMH9	178.00	272.00	269.00	1.6900	18.000	0.0130	6.36	13.64	0.47	7.59	0.72	0.48	0.00	Calculated
44	HILDRETH	Pipe	HILDRETH	CB6	100.00	395.90	394.90	1.0000	12.000	0.0150	3.34	3.09	1.08	4.61	1.00	1.00	31.00	SURCHARGED
45	O2_1	Pipe	Outfall_2_1	DP_2	1093.34	294.00	294.00	0.0000	0.000	0.0150	18.45	0.00	1.08	0.00	1.00	1.00	31.00	SURCHARGED
46	O2_2	Pipe	Outfall_2_2	DP_2	539.72	266.00	266.00	0.0000	0.000	0.0150	19.72	0.00	1.08	0.00	1.00	1.00	31.00	SURCHARGED
47	O2_3	Pipe	Outfall_2_3	DP_2	246.53	262.00	262.00	0.0000	0.000	0.0150	9.83	0.00	1.08	0.00	1.00	1.00	31.00	SURCHARGED

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged Condition (min)
48	O2_4	Pipe	Outfall_2_4	DP_2	714.54	250.00	250.00	0.0000	0.000	0.0150	1.93	0.00	1.08	0.00	1.00	1.00	31.00 SURCHARGED
49	CB10-bypass	Channel	CB10	CB11	191.61	393.46	389.50	2.0700	3.600	0.0130	1.38	12.94	0.11	2.66	0.13	0.43	0.00
50	CB11-bypass	Channel	CB11	CB13	478.43	389.50	378.90	2.2200	3.600	0.0130	3.91	13.40	0.29	3.55	0.19	0.63	0.00
51	CB12-bypass	Channel	CB12	CB14	425.00	388.11	378.76	2.2000	3.600	0.0130	0.68	13.35	0.05	2.51	0.10	0.33	0.00
52	CB13-bypass	Channel	CB13	CB15	155.71	378.90	375.33	2.2900	3.600	0.0130	10.57	13.63	0.78	4.59	0.27	0.91	0.00
53	CB14-bypass	Channel	CB14	CB17	318.79	378.76	370.30	2.6500	3.600	0.0130	0.55	14.66	0.04	2.48	0.09	0.29	0.00
54	CB15-bypass	Channel	CB15	CB16	115.44	375.33	372.17	2.7400	3.600	0.0130	12.23	14.89	0.82	5.08	0.28	0.93	0.00
55	CB16-bypass	Channel	CB16	CB18	71.28	372.17	369.76	3.3800	3.600	0.0130	10.76	16.55	0.65	5.33	0.26	0.85	0.00
56	CB17-bypass	Channel	CB17	CB20	236.23	370.30	358.78	4.8800	3.600	0.0130	0.39	19.87	0.02	2.77	0.07	0.23	0.00
57	CB18-bypass	Channel	CB18	CB19	213.88	369.76	359.82	4.6500	3.600	0.0130	7.79	19.40	0.40	5.54	0.21	0.71	0.00
58	CB19-bypass	Channel	CB19	Culvert1In	528.55	359.82	332.72	5.1300	3.600	0.0130	7.11	20.38	0.35	5.63	0.20	0.67	0.00
59	CB20-bypass	Channel	CB20	OUT1	541.70	358.78	329.09	5.4800	3.600	0.0130	0.19	21.07	0.01	2.76	0.05	0.17	0.00
60	CB22-bypass	Channel	CB22	CB25	495.92	330.74	311.32	3.9200	3.600	0.0130	0.10	17.81	0.01	1.96	0.04	0.14	0.00
61	CB23-bypass	Channel	CB23	CB24	115.97	328.70	325.59	2.6800	3.600	0.0130	2.50	14.74	0.17	3.40	0.15	0.51	0.00
62	CB24-bypass	Channel	CB24	CB26	416.71	325.59	303.57	5.2800	3.600	0.0130	5.39	20.69	0.26	5.36	0.18	0.60	0.00
63	CB25-bypass	Channel	CB25	OUT2_1	230.21	311.32	300.80	4.5700	3.600	0.0130	0.59	19.24	0.03	3.01	0.08	0.27	0.00
64	CB26-bypass	Channel	CB26	CB27	68.43	303.57	300.38	4.6600	3.600	0.0130	10.45	19.43	0.54	5.97	0.24	0.79	0.00
65	CB27-bypass	Channel	CB27	Culvert2In	566.65	300.38	270.70	5.2400	3.600	0.0130	8.37	20.60	0.41	6.00	0.21	0.71	0.00
66	CB28-bypass	Channel	CB28	CB31	89.54	270.47	269.04	1.6000	3.600	0.0130	0.37	9.06	0.04	1.85	0.09	0.30	0.00
67	CB31-bypass	Channel	CB31	EXCB-32	611.00	269.04	257.18	1.9400	3.600	0.0130	0.13	9.99	0.01	2.18	0.06	0.19	0.00
68	CB5-bypass	Channel	CB5	CB12	842.80	398.31	388.11	1.2100	3.600	0.0130	0.15	7.89	0.02	1.57	0.07	0.22	0.00
69	CB7-bypass	Channel	CB7	CB8	102.09	397.14	396.62	0.5100	3.600	0.0130	1.13	7.35	0.15	1.50	0.14	0.47	0.00
70	CB8-bypass	Channel	CB8	CB9	84.93	396.62	396.20	0.4900	3.600	0.0130	1.20	6.33	0.19	1.50	0.16	0.54	0.00
71	CB9-bypass	Channel	CB9	CB10	195.58	396.20	393.46	1.4000	3.600	0.0130	0.94	10.65	0.09	2.09	0.12	0.40	0.00
72	CBFD-bypass	Channel	CBFD	CB28	102.51	271.90	270.47	1.3900	3.600	0.0130	0.37	8.47	0.04	1.76	0.09	0.31	0.00
73	EX32-bypass	Channel	EXCB-32	EX32-bypass(out)	156.00	257.18	255.47	1.1000	3.600	0.0130	0.92	7.51	0.12	2.04	0.14	0.46	0.00
74	EX33-bypass	Channel	EXCB-33	EX33-bypass(out)	70.00	256.90	255.70	1.7100	3.600	0.0130	0.34	9.39	0.04	1.84	0.09	0.29	0.00
75	Outfall-1	Channel	OUT1	DP_1	333.49	329.09	286.00	12.9200	36.000	0.0320	29.83	450.45	0.07	10.86	0.95	0.32	0.00
76	Outfall-2_1	Channel	OUT2_1	Outfall_2_1	50.00	294.50	294.00	1.0000	24.000	0.0320	18.45	62.70	0.29	5.13	1.22	0.61	0.00
77	Outfall-2_2	Channel	OUT2_2	Outfall_2_2	50.00	268.32	266.00	4.6400	18.000	0.0320	19.72	42.51	0.46	6.68	1.10	0.73	0.00
78	Outfall-2_3	Channel	OUT2_3	Outfall_2_3	50.00	264.50	262.00	5.0000	36.000	0.0320	9.83	280.21	0.04	5.74	0.71	0.24	0.00
79	FSP1-1	Orifice	FSP-1	FSP1-Out		272.00	273.00		8.000		1.24						
80	FSP1-2	Orifice	FSP-1	FSP1-Out		272.00	273.00		12.000		1.77						
81	FSP2-1	Orifice	FSP-2	FSP2-Out		270.00	272.00		8.000		1.54						
82	FSP2-2	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		2.97						
83	FSP2-3	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		1.85						

**Inlet Summary**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft²)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
1	CB10	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.40	393.46	0.00	N/A	2.94	1.56	1.38	53.03	7.00	8.66	393.63
2	CB11	FHWA HEC-22 GENERIC	N/A	On Grade	1	385.90	389.50	0.00	N/A	6.68	2.77	3.91	41.42	7.00	11.78	389.74
3	CB12	FHWA HEC-22 GENERIC	N/A	On Grade	1	384.20	388.11	0.00	N/A	1.75	1.07	0.68	61.30	7.00	7.12	388.25
4	CB13	FHWA HEC-22 GENERIC	N/A	On Grade	1	376.40	378.90	0.00	N/A	15.32	4.75	10.57	31.02	7.00	16.03	379.22
5	CB14	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.40	378.76	0.00	N/A	1.51	0.96	0.55	63.70	7.00	6.74	378.89
6	CB15	FHWA HEC-22 GENERIC	N/A	On Grade	1	372.30	375.33	0.00	N/A	17.21	4.98	12.23	28.96	7.00	16.27	375.66
7	CB16	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.30	372.17	0.00	N/A	15.55	4.80	10.75	30.86	7.00	16.18	372.49
8	CB17	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.40	370.30	0.00	N/A	1.20	0.81	0.39	67.51	7.00	6.18	370.42
9	CB18	FHWA HEC-22 GENERIC	N/A	On Grade	1	366.80	369.76	0.00	N/A	11.53	3.74	7.79	32.44	7.00	12.39	370.01
10	CB19	FHWA HEC-22 GENERIC	N/A	On Grade	1	356.70	359.82	0.00	N/A	10.72	3.60	7.13	33.54	7.00	12.00	360.06
11	CB20	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.20	358.78	0.00	N/A	0.85	0.67	0.18	78.71	7.00	4.67	358.87
12	CB21	FHWA HEC-22 GENERIC	N/A	On Sag	1	330.30	333.30	0.00	0.00	2.89	N/A	N/A	N/A	7.00	15.76	333.59
13	CB22	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.70	330.74	0.00	N/A	0.52	0.42	0.10	80.97	7.00	4.57	330.83
14	CB23	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.90	328.70	0.00	N/A	4.63	2.13	2.50	46.03	7.00	10.41	328.91
15	CB24	FHWA HEC-22 GENERIC	N/A	On Grade	1	320.10	325.59	0.00	N/A	8.85	3.45	5.40	38.94	7.00	12.35	325.84
16	CB25	FHWA HEC-22 GENERIC	N/A	On Grade	1	306.00	311.32	0.00	N/A	1.78	1.19	0.59	67.07	7.00	6.04	311.44
17	CB26	FHWA HEC-22 GENERIC	N/A	On Grade	1	298.90	303.57	0.00	N/A	14.63	4.18	10.46	28.54	7.00	13.52	303.84
18	CB27	FHWA HEC-22 GENERIC	N/A	On Grade	1	295.50	300.38	0.00	N/A	12.25	3.84	8.41	31.31	7.00	12.62	300.63
19	CB28	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.90	270.47	0.00	N/A	1.13	0.76	0.37	66.95	7.00	6.35	270.60
20	CB3	FHWA HEC-22 GENERIC	N/A	On Sag	1	397.50	399.24	0.00	0.00	3.17	N/A	N/A	N/A	7.00	16.69	399.54
21	CB31	FHWA HEC-22 GENERIC	N/A	On Grade	1	267.20	269.04	0.00	N/A	0.97	0.84	0.13	86.58	7.00	5.46	269.23
22	CB5	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.20	398.31	0.00	N/A	0.58	0.42	0.16	73.09	7.00	6.20	398.43
23	CB6	FHWA HEC-22 GENERIC	N/A	On Sag	1	394.90	398.92	0.00	0.00	0.93	N/A	N/A	N/A	7.00	7.93	399.06
24	CB7	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.20	397.14	0.00	N/A	2.34	1.20	1.14	51.40	7.00	10.44	397.35
25	CB8	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.60	396.62	0.00	N/A	2.45	1.25	1.20	51.12	7.00	10.13	396.82
26	CB9	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.20	396.20	0.00	N/A	2.52	1.58	0.94	62.62	7.00	6.65	396.33
27	CBFD	FHWA HEC-22 GENERIC	N/A	On Grade	1	0.00	271.90	269.00	N/A	1.03	0.66	0.37	63.90	7.00	7.71	272.05
28	EXCB-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	0.00	N/A	2.13	1.21	0.92	56.75	7.00	8.03	257.34
29	EXCB-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	0.00	N/A	1.06	0.72	0.34	68.08	7.00	6.19	257.02

## Subbasin Hydrology

### Subbasin : Blake1P

#### Input Data

Area (ac) ..... 2.66  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 78.7  
Rain Gage ID ..... \*

#### Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.66	-	78.7
Composite Area & Weighted CN	2.66		78.7

#### Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T<sub>c</sub> = Time of Concentration (hr)  
n = Manning's roughness  
L<sub>f</sub> = Flow Length (ft)  
P = 2 yr, 24 hr Rainfall (inches)  
S<sub>f</sub> = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 \* (S<sub>f</sub><sup>0.5</sup>) (unpaved surface)  
V = 20.3282 \* (S<sub>f</sub><sup>0.5</sup>) (paved surface)  
V = 15.0 \* (S<sub>f</sub><sup>0.5</sup>) (grassed waterway surface)  
V = 10.0 \* (S<sub>f</sub><sup>0.5</sup>) (nearly bare & untilled surface)  
V = 9.0 \* (S<sub>f</sub><sup>0.5</sup>) (cultivated straight rows surface)  
V = 7.0 \* (S<sub>f</sub><sup>0.5</sup>) (short grass pasture surface)  
V = 5.0 \* (S<sub>f</sub><sup>0.5</sup>) (woodland surface)  
V = 2.5 \* (S<sub>f</sub><sup>0.5</sup>) (forest w/heavy litter surface)  
T<sub>c</sub> = (L<sub>f</sub> / V) / (3600 sec/hr)

Where:

T<sub>c</sub> = Time of Concentration (hr)  
L<sub>f</sub> = Flow Length (ft)  
V = Velocity (ft/sec)  
S<sub>f</sub> = Slope (ft/ft)

Channel Flow Equation :

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

$$R = A_q / W_p$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where :

T<sub>c</sub> = Time of Concentration (hr)  
L<sub>f</sub> = Flow Length (ft)  
R = Hydraulic Radius (ft)  
A<sub>q</sub> = Flow Area (ft<sup>2</sup>)  
W<sub>p</sub> = Wetted Perimeter (ft)  
V = Velocity (ft/sec)  
S<sub>f</sub> = Slope (ft/ft)  
n = Manning's roughness

	Subarea A	Subarea B	Subarea C
<b>Sheet Flow Computations</b>			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0
<b>Shallow Concentrated Flow Computations</b>			
Flow Length (ft) :	346	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	7.64		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.69
Peak Runoff (cfs) .....	7.18
Weighted Curve Number .....	78.7
Time of Concentration (days hh:mm:ss) .....	0 00:07:38



**Subbasin : Blake2**

**Input Data**

Area (ac) ..... 0.31  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 82.1  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.31	-	82.1
Composite Area & Weighted CN	0.31		82.1

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 3  
Peak Runoff (cfs) ..... 0.97  
Weighted Curve Number ..... 82.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB10-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.9  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	96.9
Composite Area & Weighted CN	0.09		96.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.53  
Peak Runoff (cfs) ..... 0.37  
Weighted Curve Number ..... 96.9  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB10L-DA**

**Input Data**

Area (ac) ..... 0.93  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 80.2  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.93	-	80.2
Composite Area & Weighted CN	0.93		80.2

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.1	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.16	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	347	0	0
Slope (%) :	2.1	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.01	0	0
Computed Flow Time (min) :	5.73	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	56	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.08	0	0
Total TOC (min) .....	26.96		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.82  
 Peak Runoff (cfs) ..... 1.86  
 Weighted Curve Number ..... 80.2  
 Time of Concentration (days hh:mm:ss) ..... 0 00:26:58

**Subbasin : CB11-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.6  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	95.6
Composite Area & Weighted CN	0.09		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.38  
Peak Runoff (cfs) ..... 0.36  
Weighted Curve Number ..... 95.6  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB11L-DA**

**Input Data**

Area (ac) ..... 2.77  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 79  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.77	-	79
Composite Area & Weighted CN	2.77		79

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	409	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	6.89	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	140	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.2	0	0
Total TOC (min) .....	28.66		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.72  
 Peak Runoff (cfs) ..... 5.17  
 Weighted Curve Number ..... 79  
 Time of Concentration (days hh:mm:ss) ..... 0 00:28:40

**Subbasin : CB12-DA**

**Input Data**

Area (ac) ..... 0.4  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.5  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.4	-	95.5
Composite Area & Weighted CN	0.4		95.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.38  
Peak Runoff (cfs) ..... 1.63  
Weighted Curve Number ..... 95.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB13-DA**

**Input Data**

Area (ac) ..... 0.19  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.19	-	98
Composite Area & Weighted CN	0.19		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.79  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB13L-DA**

**Input Data**

Area (ac) ..... 7.68  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 76.9  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	7.68	-	76.9
Composite Area & Weighted CN	7.68		76.9

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.4	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.03	0	0
Computed Flow Time (min) :	24.88	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	744	0	0
Slope (%) :	1.5	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.86	0	0
Computed Flow Time (min) :	14.42	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	243	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.34	0	0
Total TOC (min) .....	39.64		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.53  
 Peak Runoff (cfs) ..... 11.49  
 Weighted Curve Number ..... 76.9  
 Time of Concentration (days hh:mm:ss) ..... 0 00:39:38



**Subbasin : CB14-DA**

**Input Data**

Area (ac) ..... 0.21  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.6  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.21	-	95.6
Composite Area & Weighted CN	0.21		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.39  
Peak Runoff (cfs) ..... 0.85  
Weighted Curve Number ..... 95.6  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB15-DA**

**Input Data**

Area (ac) ..... 0.07  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.07	-	98
Composite Area & Weighted CN	0.07		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.26  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB15L-DA**

**Input Data**

Area (ac) ..... 4.6  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 73.7  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	4.6	-	73.7
Composite Area & Weighted CN	4.6		73.7

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	706	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.89	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	35	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	33.94		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 2.26  
Peak Runoff (cfs) ..... 6.57  
Weighted Curve Number ..... 73.7  
Time of Concentration (days hh:mm:ss) ..... 0 00:33:56

**Subbasin : CB16-DA**

**Input Data**

Area (ac) ..... 0.05  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.05	-	98
Composite Area & Weighted CN	0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.65  
Peak Runoff (cfs) ..... 0.21  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB16L-DA**

**Input Data**

Area (ac) ..... 2.01  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 76.4  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	2.01	-	76.4
Composite Area & Weighted CN	2.01		76.4

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	20.77	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	659	0	0
Slope (%) :	2.2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.04	0	0
Computed Flow Time (min) :	10.56	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	104	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.1	0	0
Total TOC (min) .....	31.43		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.49  
 Peak Runoff (cfs) ..... 3.3  
 Weighted Curve Number ..... 76.4  
 Time of Concentration (days hh:mm:ss) ..... 0 00:31:26

**Subbasin : CB17-DA**

**Input Data**

Area (ac) ..... 0.17  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.7  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.17	-	95.7
Composite Area & Weighted CN	0.17		95.7

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.4  
Peak Runoff (cfs) ..... 0.67  
Weighted Curve Number ..... 95.7  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB18-DA**

**Input Data**

Area (ac) ..... 0.03  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.03	-	98
Composite Area & Weighted CN	0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.61  
Peak Runoff (cfs) ..... 0.11  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB18L-DA**

**Input Data**

Area (ac) ..... 0.5  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 73.7  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.5	-	73.7
Composite Area & Weighted CN	0.5		73.7

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.05	0	0
Computed Flow Time (min) :	18.35	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	406	0	0
Slope (%) :	3	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.21	0	0
Computed Flow Time (min) :	5.59	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	20	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	23.96		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.26  
 Peak Runoff (cfs) ..... 0.84  
 Weighted Curve Number ..... 73.7  
 Time of Concentration (days hh:mm:ss) ..... 0 00:23:58



**Subbasin : CB19-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	98
Composite Area & Weighted CN	0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.34  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB19L-DA**

**Input Data**

Area (ac) ..... 2.56  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 72.1  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.56	-	72.1
Composite Area & Weighted CN	2.56		72.1

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	498	0	0
Slope (%) :	3.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.15	0	0
Computed Flow Time (min) :	2.63	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	59	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.05	0	0
Total TOC (min) .....	12.28		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.13  
 Peak Runoff (cfs) ..... 4.97  
 Weighted Curve Number ..... 72.1  
 Time of Concentration (days hh:mm:ss) ..... 0 00:12:17

**Subbasin : CB20-DA**

**Input Data**

Area (ac) ..... 0.12  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.2  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.12	-	96.2
Composite Area & Weighted CN	0.12		96.2

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.45  
Peak Runoff (cfs) ..... 0.47  
Weighted Curve Number ..... 96.2  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB21-DA**

**Input Data**

Area (ac) ..... 1.31  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 74.6  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	1.31	-	74.6
Composite Area & Weighted CN	1.31		74.6

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	403	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.26	0	0
Total TOC (min) .....	10.84		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.34  
 Peak Runoff (cfs) ..... 2.89  
 Weighted Curve Number ..... 74.6  
 Time of Concentration (days hh:mm:ss) ..... 0 00:10:50

**Subbasin : CB22-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.5  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	95.5
Composite Area & Weighted CN	0.13		95.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.37  
Peak Runoff (cfs) ..... 0.52  
Weighted Curve Number ..... 95.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB23-DA**

**Input Data**

Area (ac) ..... 2.06  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 75.5  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.06	-	75.5
Composite Area & Weighted CN	2.06		75.5

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.69	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	575	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.79	0	0
Total TOC (min) .....	11.48		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.41  
 Peak Runoff (cfs) ..... 4.63  
 Weighted Curve Number ..... 75.5  
 Time of Concentration (days hh:mm:ss) ..... 0 00:11:29

**Subbasin : CB24-DA**

**Input Data**

Area (ac) ..... 2.61  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 76.3  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.61	-	76.3
Composite Area & Weighted CN	2.61		76.3

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.12	0	0
Computed Flow Time (min) :	6.79	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	552	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.72	0	0
Total TOC (min) .....	8.51		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.48  
 Peak Runoff (cfs) ..... 6.41  
 Weighted Curve Number ..... 76.3  
 Time of Concentration (days hh:mm:ss) ..... 0 00:08:31

**Subbasin : CB25-DA**

**Input Data**

Area (ac) ..... 0.43  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 92.4  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.43	-	92.4
Composite Area & Weighted CN		0.43		92.4

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.03  
Peak Runoff (cfs) ..... 1.69  
Weighted Curve Number ..... 92.4  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : CB26-DA**

**Input Data**

Area (ac) .....	0.07
Peak Rate Factor .....	484
Weighted Curve Number .....	96.8
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.07	-	96.8
Composite Area & Weighted CN		0.07		96.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.51
Peak Runoff (cfs) .....	0.26
Weighted Curve Number .....	96.8
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB26L-DA**

**Input Data**

Area (ac) .....	3.73
Peak Rate Factor .....	484
Weighted Curve Number .....	77.2
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		3.73	-	77.2
Composite Area & Weighted CN		3.73		77.2

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	8.59	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	628	0
Slope (%) :	9.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.05	0	0
Computed Flow Time (min) :	2.07	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	109	0	0
Channel Slope (%) :	5.9	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	19.49	0	0
Computed Flow Time (min) :	0.09	0	0
Total TOC (min) .....	10.76		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.56
Peak Runoff (cfs) .....	9.04
Weighted Curve Number .....	77.2
Time of Concentration (days hh:mm:ss) .....	0 00:10:46

**Subbasin : CB27-DA**

**Input Data**

Area (ac) .....	0.05
Peak Rate Factor .....	484
Weighted Curve Number .....	96.8
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.05	-	96.8
Composite Area & Weighted CN		0.05		96.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.51
Peak Runoff (cfs) .....	0.21
Weighted Curve Number .....	96.8
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB27L-DA**

**Input Data**

Area (ac) .....	0.78
Peak Rate Factor .....	484
Weighted Curve Number .....	72.2
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.78	-	72.2
Composite Area & Weighted CN		0.78		72.2

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	389	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.21	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	37	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	7.51		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.14
Peak Runoff (cfs) .....	1.67
Weighted Curve Number .....	72.2
Time of Concentration (days hh:mm:ss) .....	0 00:07:31

**Subbasin : CB28-DA**

**Input Data**

Area (ac) ..... 0.23  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 84.3  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.23	-	84.3
Composite Area & Weighted CN		0.23		84.3

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 3.21  
Peak Runoff (cfs) ..... 0.76  
Weighted Curve Number ..... 84.3  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB31-DA**

**Input Data**

Area (ac) .....	0.26
Peak Rate Factor .....	484
Weighted Curve Number .....	91.1
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	91.1
Composite Area & Weighted CN		0.26		91.1

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	3.9
Peak Runoff (cfs) .....	0.97
Weighted Curve Number .....	91.1
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB3-DA**

**Input Data**

Area (ac) .....	1.14
Peak Rate Factor .....	484
Weighted Curve Number .....	83.2
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		1.14	-	83.2
Composite Area & Weighted CN		1.14		83.2

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.07	0	0
Computed Flow Time (min) :	12.39	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	135	0	0
Slope (%) :	5	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.61	0	0
Computed Flow Time (min) :	0.62	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	205	0	0
Channel Slope (%) :	4	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	16.05	0	0
Computed Flow Time (min) :	0.21	0	0
Total TOC (min) .....	13.23		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	3.1
Peak Runoff (cfs) .....	3.17
Weighted Curve Number .....	83.2
Time of Concentration (days hh:mm:ss) .....	0 00:13:14

**Subbasin : CB5-DA**

**Input Data**

Area (ac) ..... 0.14  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.58  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : CB6-DA**

**Input Data**

Area (ac) .....	0.25
Peak Rate Factor .....	484
Weighted Curve Number .....	91.6
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.25	-	91.6
Composite Area & Weighted CN		0.25		91.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	3.95
Peak Runoff (cfs) .....	0.93
Weighted Curve Number .....	91.6
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB7-DA**

**Input Data**

Area (ac) .....	0.18
Peak Rate Factor .....	484
Weighted Curve Number .....	97.5
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.18	-	97.5
Composite Area & Weighted CN		0.18		97.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.6
Peak Runoff (cfs) .....	0.74
Weighted Curve Number .....	97.5
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB8-DA**

**Input Data**

Area (ac) ..... 0.04  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 98  
 Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 4.64  
 Peak Runoff (cfs) ..... 0.16  
 Weighted Curve Number ..... 98  
 Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB8L-DA**

**Input Data**

Area (ac) .....	0.64
Peak Rate Factor .....	484
Weighted Curve Number .....	83.6
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		0.64	-	83.6
Composite Area & Weighted CN		0.64		83.6

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	23.02	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	125	0	0
Slope (%) :	1.7	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.91	0	0
Computed Flow Time (min) :	2.29	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	93	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.13	0	0
Total TOC (min) .....	25.44		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	3.14
Peak Runoff (cfs) .....	1.46
Weighted Curve Number .....	83.6
Time of Concentration (days hh:mm:ss) .....	0 00:25:26

**Subbasin : CB9-DA**

**Input Data**

Area (ac) .....	0.03
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.63
Peak Runoff (cfs) .....	0.13
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB9L-DA**

**Input Data**

Area (ac) .....	0.58
Peak Rate Factor .....	484
Weighted Curve Number .....	84.9
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.58	-	84.9
Composite Area & Weighted CN		0.58		84.9

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	293	0
Slope (%) :	1.9	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.96	0	0
Computed Flow Time (min) :	5.09	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	17	0	0
Channel Slope (%) :	0.65	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	6.47	0	0
Computed Flow Time (min) :	0.04	0	0
Total TOC (min) .....	27.15		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	3.27
Peak Runoff (cfs) .....	1.31
Weighted Curve Number .....	84.9
Time of Concentration (days hh:mm:ss) .....	0 00:27:09

**Subbasin : CBFS**

**Input Data**

Area (ac) .....	0.26
Peak Rate Factor .....	484
Weighted Curve Number .....	95.6
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	95.6
Composite Area & Weighted CN		0.26		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.39
Peak Runoff (cfs) .....	1.03
Weighted Curve Number .....	95.6
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CD7L-DA**

**Input Data**

Area (ac) .....	0.63
Peak Rate Factor .....	484
Weighted Curve Number .....	83
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.63	-	83
Composite Area & Weighted CN		0.63		83

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.22	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	84	0
Slope (%) :	1.7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.1	0	0
Computed Flow Time (min) :	0.67	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	110	0	0
Channel Slope (%) :	0.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	5.67	0	0
Computed Flow Time (min) :	0.32	0	0
Total TOC (min) .....	14.21		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	3.08
Peak Runoff (cfs) .....	1.72
Weighted Curve Number .....	83
Time of Concentration (days hh:mm:ss) .....	0 00:14:13



**Subbasin : Culvert1-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.9  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.16	-	97.9
Composite Area & Weighted CN		0.16		97.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.65  
Peak Runoff (cfs) ..... 0.68  
Weighted Curve Number ..... 97.9  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Culvert1L-DA**

**Input Data**

Area (ac) .....	6.61
Peak Rate Factor .....	484
Weighted Curve Number .....	74.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		6.61	-	74.3
Composite Area & Weighted CN		6.61		74.3

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	12.93	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	623	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	3.59	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	344	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.32	0	0
Total TOC (min) .....	16.84		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.31
Peak Runoff (cfs) .....	12.74
Weighted Curve Number .....	74.3
Time of Concentration (days hh:mm:ss) .....	0 00:16:50

**Subbasin : Culvert2-DA**

**Input Data**

Area (ac) ..... 0.26  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.9  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	96.9
Composite Area & Weighted CN		0.26		96.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.54  
Peak Runoff (cfs) ..... 1.07  
Weighted Curve Number ..... 96.9  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Culvert2L-DA**

**Input Data**

Area (ac) .....	3.78
Peak Rate Factor .....	484
Weighted Curve Number .....	71.5
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		3.78	-	71.5
Composite Area & Weighted CN		3.78		71.5

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	392	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.22	0	0
Total TOC (min) .....	7.49		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.08
Peak Runoff (cfs) .....	7.9
Weighted Curve Number .....	71.5
Time of Concentration (days hh:mm:ss) .....	0 00:07:29

**Subbasin : Culvert2P-DA**

**Input Data**

Area (ac) .....	2.87
Peak Rate Factor .....	484
Weighted Curve Number .....	73.5
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area (acres)	Soil Group	Curve Number
Soil/Surface Description				
-		2.87	-	73.5
Composite Area & Weighted CN		2.87		73.5

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	317	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.04	0	0
Total TOC (min) .....	7.55		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.24
Peak Runoff (cfs) .....	6.48
Weighted Curve Number .....	73.5
Time of Concentration (days hh:mm:ss) .....	0 00:07:33

**Subbasin : EX32-DA**

**Input Data**

Area (ac) ..... 0.49  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.49	-	98
Composite Area & Weighted CN		0.49		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 2.03  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : EX33-DA**

**Input Data**

Area (ac) .....	0.27
Peak Rate Factor .....	484
Weighted Curve Number .....	93.8
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.27	-	93.8
Composite Area & Weighted CN		0.27		93.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.19
Peak Runoff (cfs) .....	1.06
Weighted Curve Number .....	93.8
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Hildreth-DA**

**Input Data**

Area (ac) .....	2.35
Peak Rate Factor .....	484
Weighted Curve Number .....	87
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area (acres)	Soil Group	Curve Number
Soil/Surface Description		2.35	-	87
Composite Area & Weighted CN		2.35		87

**Time of Concentration**

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	96	0	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	0.55	0	0

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.013	0	0
Flow Length (ft) :	553	0	0
Channel Slope (%) :	3	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.785	0	0
Wetted Perimeter (ft) :	3	0	0
Velocity (ft/sec) :	8.12	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	15.59		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	3.47
Peak Runoff (cfs) .....	6.9
Weighted Curve Number .....	87
Time of Concentration (days hh:mm:ss) .....	0 00:15:35



**Subbasin : Out1-DA**

**Input Data**

Area (ac) .....	0.36
Peak Rate Factor .....	484
Weighted Curve Number .....	95.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.36	-	95.3
Composite Area & Weighted CN		0.36		95.3

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.35
Peak Runoff (cfs) .....	1.44
Weighted Curve Number .....	95.3
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Out2\_1-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 86.8  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	86.8
Composite Area & Weighted CN		0.09		86.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 3.45  
Peak Runoff (cfs) ..... 0.31  
Weighted Curve Number ..... 86.8  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Out2\_2-DA**

**Input Data**

Area (ac) ..... 0.25  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 85.5  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.25	-	85.5
Composite Area & Weighted CN		0.25		85.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 3.32  
Peak Runoff (cfs) ..... 0.82  
Weighted Curve Number ..... 85.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Out2\_3-DA**

**Input Data**

Area (ac) .....	0.26
Peak Rate Factor .....	484
Weighted Curve Number .....	89
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	89
Composite Area & Weighted CN		0.26		89

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	3.68
Peak Runoff (cfs) .....	0.96
Weighted Curve Number .....	89
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Junction Input**

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Culvert1In	332.72	336.00	3.28	0.00	-332.72	336.00	0.00	0.00	0.00
2	Culvert2In	270.70	274.00	3.30	0.00	-270.70	0.00	-274.00	0.00	0.00
3	DMH1	396.00	399.76	3.76	0.00	-396.00	399.76	0.00	0.00	0.00
4	DMH101	394.70	399.00	4.30	0.00	-394.70	399.00	0.00	0.00	0.00
5	DMH102	371.90	375.50	3.60	0.00	-371.90	375.50	0.00	0.00	0.00
6	DMH2	354.80	358.51	3.71	0.00	-354.80	358.51	0.00	0.00	0.00
7	DMH3	268.70	271.83	3.13	0.00	-268.70	271.83	0.00	0.00	0.00
8	DMH4	268.10	271.22	3.12	0.00	-268.10	271.22	0.00	0.00	0.00
9	DMH5	265.90	269.46	3.56	0.00	-265.90	269.46	0.00	0.00	0.00
10	DMH6	253.60	258.48	4.88	0.00	-253.60	258.48	0.00	0.00	0.00
11	DMH8	268.80	272.80	4.00	0.00	-268.80	272.80	0.00	0.00	0.00
12	DMH9	268.90	271.70	2.80	0.00	-268.90	271.70	0.00	0.00	0.00
13	FSP1-Out	273.00	276.00	3.00	0.00	-273.00	276.00	0.00	7794.00	0.00
14	FSP2-Out	272.00	276.00	4.00	0.00	-272.00	276.00	0.00	3746.00	0.00
15	HILDRETH	395.90	399.00	3.10	395.90	0.00	395.90	-3.10	0.00	0.00
16	OUT1	329.09	336.00	6.91	0.00	-329.09	336.00	0.00	0.00	0.00
17	OUT2_1	295.20	301.00	5.80	0.00	-295.20	301.00	0.00	0.00	0.00
18	OUT2_2	268.32	274.00	5.68	0.00	-268.32	0.00	-274.00	0.00	0.00
19	OUT2_3	264.50	269.00	4.50	0.00	-264.50	269.00	0.00	0.00	0.00
20	Outfall_2_1	294.00	300.00	6.00	294.00	0.00	300.00	0.00	0.00	0.00
21	Outfall_2_2	266.00	272.00	6.00	266.00	0.00	272.00	0.00	0.00	0.00
22	Outfall_2_3	262.00	268.00	6.00	262.00	0.00	268.00	0.00	0.00	0.00
23	Outfall_2_4	250.00	256.00	6.00	250.00	0.00	256.00	0.00	0.00	0.00

**Junction Results**

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert1In	18.78	13.12	333.67	0.95	0.00	2.33	332.76	0.04	0 12:13	0 00:00	0.00	0.00
2	Culvert2In	19.02	8.93	273.10	2.40	0.00	0.90	272.62	1.92	0 12:21	0 00:00	0.00	0.00
3	DMH1	2.07	0.00	399.76	3.76	0.00	0.00	397.25	1.25	0 11:54	0 12:02	0.38	39.00
4	DMH101	3.37	0.00	399.00	4.30	0.00	0.00	394.94	0.24	0 11:37	0 12:06	1.60	83.00
5	DMH102	7.07	0.00	375.50	3.60	0.00	0.00	372.17	0.27	0 11:55	0 12:53	1.47	89.00
6	DMH2	10.24	0.00	355.80	1.00	0.00	2.71	354.98	0.18	0 11:52	0 00:00	0.00	0.00
7	DMH3	7.89	0.00	269.80	1.10	0.00	2.03	268.88	0.18	0 11:45	0 00:00	0.00	0.00
8	DMH4	7.89	0.00	269.25	1.15	0.00	1.97	268.25	0.15	0 12:08	0 00:00	0.00	0.00
9	DMH5	8.97	0.00	266.66	0.76	0.00	2.80	266.03	0.13	0 12:08	0 00:00	0.00	0.00
10	DMH6	1.21	0.00	254.43	0.83	0.00	4.05	254.22	0.62	0 12:06	0 00:00	0.00	0.00
11	DMH8	0.66	0.00	272.80	4.00	0.00	0.00	268.91	0.11	0 11:39	0 12:06	0.18	50.00
12	DMH9	7.06	0.97	269.89	0.99	0.00	1.81	269.03	0.13	0 12:10	0 00:00	0.00	0.00
13	FSP1-Out	3.01	0.00	273.50	0.50	0.00	2.62	273.02	0.02	0 12:21	0 00:00	0.00	0.00
14	FSP2-Out	6.36	0.00	272.72	0.72	0.00	4.03	272.03	0.03	0 12:10	0 00:00	0.00	0.00
15	HILDRETH	6.90	6.90	399.00	3.10	0.00	0.00	395.97	0.07	0 11:57	0 12:11	1.10	33.00
16	OUT1	29.83	1.44	332.13	3.04	0.00	3.87	331.49	2.40	0 12:21	0 00:00	0.00	0.00
17	OUT2_1	18.45	0.31	300.88	5.68	0.00	0.22	300.80	5.60	0 12:07	0 00:00	0.00	0.00
18	OUT2_2	19.72	0.82	269.42	1.10	0.00	4.58	268.37	0.05	0 12:09	0 00:00	0.00	0.00
19	OUT2_3	9.84	0.96	265.26	0.76	0.00	3.74	264.54	0.04	0 12:08	0 00:00	0.00	0.00
20	Outfall_2_1	18.45	0.00	295.22	1.22	0.00	4.78	294.08	0.08	0 12:08	0 00:00	0.00	0.00
21	Outfall_2_2	19.72	0.00	267.10	1.10	0.00	4.90	266.05	0.05	0 12:09	0 00:00	0.00	0.00
22	Outfall_2_3	9.83	0.00	262.71	0.71	0.00	5.29	262.03	0.03	0 12:08	0 00:00	0.00	0.00
23	Outfall_2_4	1.93	0.00	250.33	0.33	0.00	5.67	250.02	0.02	0 12:06	0 00:00	0.00	0.00

**Channel Input**

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 CB10-bypass	191.61	393.46	3.06	389.50	3.60	3.96	2.0700	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
2 CB11-bypass	478.43	389.50	3.60	378.90	2.50	10.60	2.2200	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
3 CB12-bypass	425.00	388.11	3.91	378.76	4.36	9.35	2.2000	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
4 CB13-bypass	155.71	378.90	2.50	375.33	3.03	3.57	2.2900	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
5 CB14-bypass	318.79	378.76	4.36	370.30	4.90	8.46	2.6500	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
6 CB15-bypass	115.44	375.33	3.03	372.17	3.87	3.16	2.7400	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
7 CB16-bypass	71.28	372.17	3.87	369.76	2.96	2.41	3.3800	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
8 CB17-bypass	236.23	370.30	4.90	358.78	3.58	11.52	4.8800	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
9 CB18-bypass	213.88	369.76	2.96	359.82	3.12	9.94	4.6500	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
10 CB19-bypass	528.55	359.82	3.12	332.72	0.00	27.10	5.1300	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
11 CB20-bypass	541.70	358.78	3.58	329.09	0.00	29.69	5.4800	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
12 CB22-bypass	495.92	330.74	3.04	311.32	5.32	19.42	3.9200	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
13 CB23-bypass	115.97	328.70	4.80	325.59	5.49	3.11	2.6800	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
14 CB24-bypass	416.71	325.59	5.49	303.57	4.67	22.02	5.2800	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
15 CB25-bypass	230.21	311.32	5.32	300.80	5.60	10.52	4.5700	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
16 CB26-bypass	68.43	303.57	4.67	300.38	4.88	3.19	4.6600	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
17 CB27-bypass	566.65	300.38	4.88	270.70	0.00	29.68	5.2400	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
18 CB28-bypass	89.54	270.47	1.57	269.04	1.84	1.43	1.6000	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
19 CB31-bypass	611.00	269.04	1.84	257.18	2.18	11.86	1.9400	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
20 CB5-bypass	842.80	398.31	3.11	388.11	3.91	10.20	1.2100	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
21 CB7-bypass	102.09	397.14	2.94	396.62	3.02	0.52	0.5100	Trapezoidal	0.300	19.600	0.0130	0.5000	0.5000	0.0000	0.00	No
22 CB8-bypass	84.93	396.62	3.02	396.20	3.00	0.42	0.4900	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
23 CB9-bypass	195.58	396.20	3.00	393.46	3.06	2.74	1.4000	Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
24 Cbfd-bypass	102.51	271.90	271.90	270.47	1.57	1.43	1.3900	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
25 EX32-bypass	156.00	257.18	2.18	255.47	0.00	1.71	1.1000	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
26 EX33-bypass	70.00	256.90	3.80	255.70	0.00	1.20	1.7100	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
27 Outfall-1	333.49	329.09	0.00	286.00	0.00	43.09	12.9200	Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No
28 Outfall-2_1	50.00	294.50	-0.70	294.00	0.00	0.50	1.0000	Trapezoidal	2.000	8.500	0.0320	0.5000	0.5000	0.0000	0.00	No
29 Outfall-2_2	50.00	268.32	0.00	266.00	0.00	2.32	4.6400	Trapezoidal	1.500	6.500	0.0320	0.5000	0.5000	0.0000	0.00	No
30 Outfall-2_3	50.00	264.50	0.00	262.00	0.00	2.50	5.0000	Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No

**Channel Results**

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	CB10-bypass	1.38	0 12:19	12.94	0.11	2.66	1.20	0.13	0.43	0.00		
2	CB11-bypass	3.91	0 12:21	13.40	0.29	3.55	2.25	0.19	0.63	0.00		
3	CB12-bypass	0.68	0 12:08	13.35	0.05	2.51	2.82	0.10	0.33	0.00		
4	CB13-bypass	10.57	0 12:25	13.63	0.78	4.59	0.57	0.27	0.91	0.00		
5	CB14-bypass	0.55	0 12:08	14.66	0.04	2.48	2.14	0.09	0.29	0.00		
6	CB15-bypass	12.23	0 12:26	14.89	0.82	5.08	0.38	0.28	0.93	0.00		
7	CB16-bypass	10.76	0 12:25	16.55	0.65	5.33	0.22	0.26	0.85	0.00		
8	CB17-bypass	0.39	0 12:08	19.87	0.02	2.77	1.42	0.07	0.23	0.00		
9	CB18-bypass	7.79	0 12:25	19.40	0.40	5.54	0.64	0.21	0.71	0.00		
10	CB19-bypass	7.11	0 12:23	20.38	0.35	5.63	1.56	0.20	0.67	0.00		
11	CB20-bypass	0.19	0 12:09	21.07	0.01	2.76	3.27	0.05	0.17	0.00		
12	CB22-bypass	0.10	0 12:08	17.81	0.01	1.96	4.22	0.04	0.14	0.00		
13	CB23-bypass	2.50	0 12:09	14.74	0.17	3.40	0.57	0.15	0.51	0.00		
14	CB24-bypass	5.39	0 12:09	20.69	0.26	5.36	1.30	0.18	0.60	0.00		
15	CB25-bypass	0.59	0 12:07	19.24	0.03	3.01	1.27	0.08	0.27	0.00		
16	CB26-bypass	10.45	0 12:09	19.43	0.54	5.97	0.19	0.24	0.79	0.00		
17	CB27-bypass	8.37	0 12:10	20.60	0.41	6.00	1.57	0.21	0.71	0.00		
18	CB28-bypass	0.37	0 12:07	9.06	0.04	1.85	0.81	0.09	0.30	0.00		
19	CB31-bypass	0.13	0 12:09	9.99	0.01	2.18	4.67	0.06	0.19	0.00		
20	CB5-bypass	0.15	0 12:10	7.89	0.02	1.57	8.95	0.07	0.22	0.00		
21	CB7-bypass	1.13	0 12:08	7.35	0.15	1.50	1.13	0.14	0.47	0.00		
22	CB8-bypass	1.20	0 12:13	6.33	0.19	1.50	0.94	0.16	0.54	0.00		
23	CB9-bypass	0.94	0 12:16	10.65	0.09	2.09	1.56	0.12	0.40	0.00		
24	CBFD-bypass	0.37	0 12:06	8.47	0.04	1.76	0.97	0.09	0.31	0.00		
25	EX32-bypass	0.92	0 12:07	7.51	0.12	2.04	1.27	0.14	0.46	0.00		
26	EX33-bypass	0.34	0 12:06	9.39	0.04	1.84	0.63	0.09	0.29	0.00		
27	Outfall-1	29.83	0 12:14	450.45	0.07	10.86	0.51	0.95	0.32	0.00		
28	Outfall-2_1	18.45	0 12:08	62.70	0.29	5.13	0.16	1.22	0.61	0.00		
29	Outfall-2_2	19.72	0 12:09	42.51	0.46	6.68	0.12	1.10	0.73	0.00		
30	Outfall-2_3	9.83	0 12:08	280.21	0.04	5.74	0.15	0.71	0.24	0.00		



Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Shape	Pipe Diameter (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 11-Oct	190.10	390.40	0.00	386.00	0.10	4.40	2.3100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
2 101-7	198.47	394.70	0.00	394.20	0.00	0.50	0.2500	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
3 102-17	166.34	371.90	0.00	366.60	1.20	5.30	3.1900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
4 12-Nov	57.91	385.90	0.00	384.60	0.40	1.30	2.2400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
5 14-Dec	434.45	384.20	0.00	374.40	0.00	9.80	2.2600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
6 13-14	34.67	376.40	0.00	374.70	0.30	1.70	4.9000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
7 14-102	152.21	374.40	0.00	372.00	0.10	2.40	1.5800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
8 5-Jan	110.54	396.00	0.00	395.30	0.10	0.70	0.6300	CIRCULAR	8.040	8.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
9 15-102	32.43	372.30	0.00	372.00	0.10	0.30	0.9300	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
10 16-17	60.89	368.30	0.00	365.50	0.10	2.80	4.6000	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
11 17-2	244.52	365.40	0.00	354.80	0.00	10.60	4.3400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
12 18-17	38.21	366.80	0.00	366.50	1.10	0.30	0.7900	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No	1
13 19-2	30.83	356.70	0.00	354.80	0.00	1.90	6.1600	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
14 20-2	8.74	355.20	0.00	354.90	0.10	0.30	3.4300	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
15 21-22	113.00	330.30	0.00	327.80	0.10	2.50	2.2100	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
16 22-23	113.71	327.70	0.00	324.50	0.60	3.20	2.8100	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
17 23-24	115.91	323.90	0.00	320.20	0.10	3.70	3.1900	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
18 24-25	276.64	320.10	0.00	306.00	0.00	14.10	5.1000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
19 25-26	138.90	306.00	0.00	299.10	0.20	6.90	4.9700	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
20 26-27	68.30	298.90	0.00	295.60	0.10	3.30	4.8300	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
21 27-OUT2_1	35.92	295.50	0.00	294.50	-0.70	1.00	2.7800	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
22 28-3	26.48	268.90	0.00	268.80	0.10	0.10	0.3800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
23 2-OUT1	530.29	354.80	0.00	331.40	2.31	23.40	4.4100	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
24 1-Mar	16.51	397.50	0.00	397.20	1.20	0.30	1.8200	CIRCULAR	8.040	8.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
25 31-5	10.81	267.20	0.00	266.00	0.10	1.20	11.1000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
26 32-6	18.00	255.00	0.00	254.20	0.60	0.80	4.4400	CIRCULAR	6.000	6.000	0.0110	0.5000	0.5000	0.0000	0.00	No	2
27 33-out	40.00	253.10	0.00	250.00	0.00	3.10	7.7500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
28 4-Mar	62.53	268.70	0.00	268.20	0.10	0.50	0.8000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
29 5-Apr	21.75	268.10	0.00	266.00	0.10	2.10	9.6600	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
30 5-101	26.79	395.20	0.00	394.80	0.10	0.40	1.4900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
31 5-OUT2_3	51.22	265.90	0.00	264.50	0.00	1.40	2.7300	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
32 6-101	28.90	394.90	0.00	394.80	0.10	0.10	0.3500	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
33 6-out	165.00	253.60	0.00	250.00	0.00	3.60	2.1800	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
34 8-Jul	99.78	394.20	0.00	393.60	0.00	0.60	0.6000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
35 3-Aug	59.07	268.80	0.00	268.80	0.10	0.00	0.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
36 9-Aug	84.19	393.60	0.00	393.20	0.00	0.40	0.4800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
37 10-Sep	194.56	393.20	0.00	390.40	0.00	2.80	1.4400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
38 Blake-3	20.00	268.90	0.00	268.70	0.00	0.20	1.0000	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
39 Culvert1	45.16	332.72	0.00	329.09	0.00	3.63	8.0400	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
40 Culvert2	55.47	270.70	0.00	268.32	0.00	2.38	4.2900	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
41 FH-8	60.93	269.10	269.10	268.80	0.00	0.30	0.4900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
42 FSP1-Out	20.00	273.00	0.00	272.60	1.90	0.40	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
43 FSP2-Out	178.00	272.00	0.00	269.00	0.10	3.00	1.6900	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
44 HILDRETH	100.00	395.90	0.00	394.90	0.00	1.00	1.0000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
45 O2_1	1093.34	294.00	0.00	294.00	45.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
46 O2_2	539.72	266.00	0.00	266.00	17.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
47 O2_3	246.53	262.00	0.00	262.00	13.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
48 O2_4	714.54	250.00	0.00	250.00	1.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

**Pipe Results**

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 11-Oct	5.26	0 12:17	6.41	0.82	9.10	0.35	0.69	0.69	0.00		Calculated
2 101-7	1.68	0 11:40	1.55	1.08	2.34	1.41	1.00	1.00	79.00		SURCHARGED
3 102-17	5.96	0 12:01	5.51	1.08	8.18	0.34	1.00	1.00	77.00		SURCHARGED
4 12-Nov	6.78	0 12:32	6.31	1.07	9.30	0.10	1.00	1.00	25.00		SURCHARGED
5 14-Dec	5.02	0 12:53	4.64	1.08	6.97	1.04	1.00	1.00	54.00		SURCHARGED
6 13-14	4.75	0 12:25	6.84	0.70	9.40	0.06	0.61	0.61	0.00		Calculated
7 14-102	4.19	0 11:39	3.88	1.08	5.80	0.44	1.00	1.00	127.00		SURCHARGED
8 5-Jan	1.23	0 11:56	1.14	1.08	3.84	0.48	0.67	1.00	36.00		SURCHARGED
9 15-102	3.19	0 12:53	2.97	1.07	4.39	0.12	1.00	1.00	46.00		SURCHARGED
10 16-17	4.79	0 12:25	19.52	0.25	9.13	0.11	0.51	0.34	0.00		Calculated
11 17-2	6.95	0 13:50	6.43	1.08	9.56	0.43	1.00	1.00	118.00		SURCHARGED
12 18-17	0.99	0 11:57	0.93	1.07	3.09	0.21	0.67	1.00	78.00		SURCHARGED
13 19-2	3.61	0 12:22	22.60	0.16	9.36	0.05	0.41	0.27	0.00		Calculated
14 20-2	0.67	0 12:06	5.72	0.12	4.86	0.03	0.23	0.23	0.00		Calculated
15 21-22	2.89	0 12:09	5.30	0.55	6.90	0.27	0.53	0.53	0.00		Calculated
16 22-23	3.24	0 12:08	5.98	0.54	7.77	0.24	0.53	0.53	0.00		Calculated
17 23-24	5.36	0 12:09	6.37	0.84	9.08	0.21	0.70	0.70	0.00		Calculated
18 24-25	8.55	0 12:12	8.04	1.06	11.96	0.39	0.94	0.94	0.00		> CAPACITY
19 25-26	9.59	0 12:08	23.41	0.41	12.59	0.18	0.67	0.45	0.00		Calculated
20 26-27	13.76	0 12:08	49.73	0.28	13.53	0.08	0.72	0.36	0.00		Calculated
21 27-OUT2_1	17.60	0 12:08	20.67	0.85	7.39	0.08	1.42	0.71	0.00		Calculated
22 28-3	0.75	0 12:06	1.90	0.40	2.28	0.19	0.44	0.44	0.00		Calculated
23 2-OUT1	10.24	0 12:21	16.04	0.64	13.85	0.64	0.73	0.58	0.00		Calculated
24 1-Mar	2.07	0 12:01	1.93	1.07	6.33	0.04	0.67	1.00	19.00		SURCHARGED
25 31-5	1.21	0 12:06	11.87	0.10	9.72	0.02	0.22	0.22	0.00		Calculated
26 32-6	1.21	0 12:06	2.80	0.43	6.86	0.04	0.23	0.46	0.00		Calculated
27 33-out	0.72	0 12:06	9.92	0.07	7.36	0.09	0.18	0.18	0.00		Calculated
28 4-Mar	7.89	0 12:08	9.39	0.84	5.95	0.18	1.05	0.70	0.00		Calculated
29 5-Apr	7.89	0 12:09	32.64	0.24	15.20	0.02	0.50	0.33	0.00		Calculated
30 5-101	1.56	0 12:06	3.77	0.41	4.57	0.10	0.45	0.45	0.00		Calculated
31 5-OUT2_3	8.97	0 12:08	17.37	0.52	9.91	0.09	0.76	0.51	0.00		Calculated
32 6-101	1.94	0 12:40	1.82	1.07	2.69	0.18	1.00	1.00	53.00		SURCHARGED
33 6-out	1.21	0 12:06	5.26	0.23	5.45	0.50	0.33	0.33	0.00		Calculated
34 8-Jul	2.59	0 12:06	2.39	1.08	3.57	0.47	1.00	1.00	13.00		SURCHARGED
35 3-Aug	0.19	0 12:32	0.17	1.08	0.28	3.52	1.00	1.00	45.00		SURCHARGED
36 9-Aug	2.30	0 11:48	2.13	1.08	3.17	0.44	1.00	1.00	70.00		SURCHARGED
37 10-Sep	3.70	0 12:16	3.70	1.00	5.38	0.60	0.82	0.82	0.00		Calculated
38 Blake-3	7.06	0 12:10	9.10	0.78	5.69	0.06	0.99	0.66	0.00		Calculated
39 Culvert1	18.78	0 12:14	25.81	0.73	15.93	0.05	0.95	0.63	0.00		Calculated
40 Culvert2	19.02	0 12:09	46.86	0.41	14.14	0.07	0.89	0.44	0.00		Calculated
41 FH-8	0.66	0 12:06	2.17	0.30	2.42	0.42	0.38	0.38	0.00		Calculated
42 FSP1-Out	3.01	0 12:21	5.95	0.51	7.60	0.04	0.50	0.50	0.00		Calculated
43 FSP2-Out	6.36	0 12:10	13.64	0.47	7.59	0.39	0.72	0.48	0.00		Calculated
44 HILDRETH	3.34	0 12:30	3.09	1.08	4.61	0.36	1.00	1.00	31.00		SURCHARGED
45 O2_1	18.45	0 12:08	0.00	1.08	0.00		1.00	1.00	31.00		SURCHARGED
46 O2_2	19.72	0 12:09	0.00	1.08	0.00		1.00	1.00	31.00		SURCHARGED
47 O2_3	9.83	0 12:08	0.00	1.08	0.00		1.00	1.00	31.00		SURCHARGED
48 O2_4	1.93	0 12:06	0.00	1.08	0.00		1.00	1.00	31.00		SURCHARGED

**Inlet Input**

SN ID	Element Manufacturer	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft <sup>2</sup> )	Grate Clogging Factor (%)
1	CB10	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.40	393.46	3.06	0.00	0.00	N/A	0.00
2	CB11	FHWA HEC-22 GENERIC	N/A	On Grade	1	385.90	389.50	3.60	0.00	0.00	N/A	0.00
3	CB12	FHWA HEC-22 GENERIC	N/A	On Grade	1	384.20	388.11	3.91	0.00	0.00	N/A	0.00
4	CB13	FHWA HEC-22 GENERIC	N/A	On Grade	1	376.40	378.90	2.50	0.00	0.00	N/A	0.00
5	CB14	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.40	378.76	4.36	0.00	0.00	N/A	0.00
6	CB15	FHWA HEC-22 GENERIC	N/A	On Grade	1	372.30	375.33	3.03	0.00	0.00	N/A	0.00
7	CB16	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.30	372.17	3.87	0.00	0.00	N/A	0.00
8	CB17	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.40	370.30	4.90	0.00	0.00	N/A	0.00
9	CB18	FHWA HEC-22 GENERIC	N/A	On Grade	1	366.80	369.76	2.96	0.00	0.00	N/A	0.00
10	CB19	FHWA HEC-22 GENERIC	N/A	On Grade	1	356.70	359.82	3.12	0.00	0.00	N/A	0.00
11	CB20	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.20	358.78	3.58	0.00	0.00	N/A	0.00
12	CB21	FHWA HEC-22 GENERIC	N/A	On Sag	1	330.30	333.30	3.00	0.00	0.00	0.00	0.00
13	CB22	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.70	330.74	3.04	0.00	0.00	N/A	0.00
14	CB23	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.90	328.70	4.80	0.00	0.00	N/A	0.00
15	CB24	FHWA HEC-22 GENERIC	N/A	On Grade	1	320.10	325.59	5.49	0.00	0.00	N/A	0.00
16	CB25	FHWA HEC-22 GENERIC	N/A	On Grade	1	306.00	311.32	5.32	0.00	0.00	N/A	0.00
17	CB26	FHWA HEC-22 GENERIC	N/A	On Grade	1	298.90	303.57	4.67	0.00	0.00	N/A	0.00
18	CB27	FHWA HEC-22 GENERIC	N/A	On Grade	1	295.50	300.38	4.88	0.00	0.00	N/A	0.00
19	CB28	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.90	270.47	1.57	0.00	0.00	N/A	0.00
20	CB3	FHWA HEC-22 GENERIC	N/A	On Sag	1	397.50	399.24	1.74	0.00	0.00	0.00	0.00
21	CB31	FHWA HEC-22 GENERIC	N/A	On Grade	1	267.20	269.04	1.84	0.00	0.00	N/A	0.00
22	CB5	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.20	398.31	3.11	0.00	0.00	N/A	0.00
23	CB6	FHWA HEC-22 GENERIC	N/A	On Sag	1	394.90	398.92	4.02	0.00	0.00	0.00	0.00
24	CB7	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.20	397.14	2.94	0.00	0.00	N/A	0.00
25	CB8	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.60	396.62	3.02	0.00	0.00	N/A	0.00
26	CB9	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.20	396.20	3.00	0.00	0.00	N/A	0.00
27	CBFD	FHWA HEC-22 GENERIC	N/A	On Grade	1	0.00	271.90	271.90	269.00	269.00	N/A	0.00
28	EXCB-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	2.18	0.00	0.00	N/A	0.00
29	EXCB-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	3.80	0.00	0.00	N/A	0.00

**Roadway & Gutter Input**

SN Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1 CB10	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
2 CB11	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
3 CB12	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
4 CB13	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
5 CB14	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
6 CB15	0.0260	0.0200	0.0130	0.0200	3.00	0.0000	7.00
7 CB16	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
8 CB17	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
9 CB18	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
10 CB19	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
11 CB20	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
12 CB21	N/A	0.0200	0.0130	0.0200	3.00	0.0000	7.00
13 CB22	0.0200	0.0200	0.0130	0.0200	3.00	0.0000	7.00
14 CB23	0.0200	0.0200	0.0130	0.0200	3.00	0.0000	7.00
15 CB24	0.0300	0.0200	0.0130	0.0200	3.00	0.0000	7.00
16 CB25	0.0550	0.0200	0.0130	0.0200	3.00	0.0000	7.00
17 CB26	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
18 CB27	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
19 CB28	0.0170	0.0200	0.0130	0.0200	3.00	0.0000	7.00
20 CB3	N/A	0.0200	0.0130	0.0200	3.00	0.0000	7.00
21 CB31	0.0100	0.0200	0.0130	0.0620	2.00	0.0656	7.00
22 CB5	0.0050	0.0200	0.0130	0.0200	2.00	0.0000	7.00
23 CB6	N/A	0.0200	0.0160	0.0200	2.00	0.0000	7.00
24 CB7	0.0050	0.0200	0.0130	0.0200	3.00	0.0000	7.00
25 CB8	0.0065	0.0200	0.0130	0.0200	3.00	0.0000	7.00
26 CB9	0.0650	0.0200	0.0130	0.0200	3.00	0.0000	7.00
27 CBFD	0.0050	0.0200	0.0130	0.0200	3.00	0.0000	7.00
28 EXCB-32	0.0170	0.0200	0.0130	0.0200	3.00	0.0328	7.00
29 EXCB-33	0.0170	0.0200	0.0130	0.0200	2.00	0.0000	7.00

**Inlet Results**

SN Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Time of Max Depth Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1 CB10	2.94	2.01	1.56	1.38	53.03	8.66	393.63	0.17	0 12:16	0.00	0.00
2 CB11	6.68	5.31	2.77	3.91	41.42	11.78	389.74	0.24	0 12:05	0.53	30.00
3 CB12	1.75	1.63	1.07	0.68	61.30	7.12	388.25	0.14	0 11:52	1.64	60.00
4 CB13	15.32	11.68	4.75	10.57	31.02	16.03	379.22	0.32	0 12:25	0.00	0.00
5 CB14	1.51	0.85	0.96	0.55	63.70	6.74	378.89	0.13	0 11:35	6.48	132.00
6 CB15	17.21	6.65	4.98	12.23	28.96	16.27	375.66	0.33	0 12:05	1.03	51.00
7 CB16	15.55	3.38	4.80	10.75	30.86	16.18	372.49	0.32	0 12:25	0.00	0.00
8 CB17	1.20	0.67	0.81	0.39	67.51	6.18	370.42	0.12	0 11:46	5.04	125.00
9 CB18	11.53	0.88	3.74	7.79	32.44	12.39	370.01	0.25	0 11:55	1.97	81.00
10 CB19	10.72	5.22	3.60	7.13	33.54	12.00	360.06	0.24	0 12:22	0.00	0.00
11 CB20	0.85	0.47	0.67	0.18	78.71	4.67	358.87	0.09	0 12:06	0.00	0.00
12 CB21	2.89	2.89	N/A	N/A	N/A	15.76	333.59	0.29	0 12:09	0.00	0.00
13 CB22	0.52	0.52	0.42	0.10	80.97	4.57	330.83	0.09	0 12:09	0.00	0.00
14 CB23	4.63	4.63	2.13	2.50	46.03	10.41	328.91	0.21	0 12:08	0.00	0.00
15 CB24	8.85	6.41	3.45	5.40	38.94	12.35	325.84	0.25	0 12:05	0.06	8.00
16 CB25	1.78	1.69	1.19	0.59	67.07	6.04	311.44	0.12	0 12:12	0.00	0.00
17 CB26	14.63	9.27	4.18	10.46	28.54	13.52	303.84	0.27	0 12:08	0.00	0.00
18 CB27	12.25	1.87	3.84	8.41	31.31	12.62	300.63	0.25	0 12:08	0.00	0.00
19 CB28	1.13	0.76	0.76	0.37	66.95	6.35	270.60	0.13	0 12:06	0.00	0.00
20 CB3	3.17	3.17	N/A	N/A	N/A	16.69	399.54	0.30	0 12:00	0.00	0.00
21 CB31	0.97	0.97	0.84	0.13	86.58	5.46	269.23	0.19	0 12:07	0.00	0.00
22 CB5	0.58	0.58	0.42	0.16	73.09	6.20	398.43	0.12	0 11:56	0.00	0.00
23 CB6	0.93	0.93	N/A	N/A	N/A	7.93	399.06	0.14	0 11:45	0.00	0.00
24 CB7	2.34	2.34	1.20	1.14	51.40	10.44	397.35	0.21	0 11:58	0.07	22.00
25 CB8	2.45	1.53	1.25	1.20	51.12	10.13	396.82	0.20	0 11:39	0.98	81.00
26 CB9	2.52	1.37	1.58	0.94	62.62	6.65	396.33	0.13	0 11:48	0.00	0.00
27 CBFD	1.03	1.03	0.66	0.37	63.90	7.71	272.05	0.15	0 12:06	0.00	0.00
28 EXCB-32	2.13	2.03	1.21	0.92	56.75	8.03	257.34	0.16	0 12:06	0.00	0.00
29 EXCB-33	1.06	1.06	0.72	0.34	68.08	6.19	257.02	0.12	0 12:06	0.00	0.00

## Storage Nodes

### Storage Node : FSP-1

#### Input Data

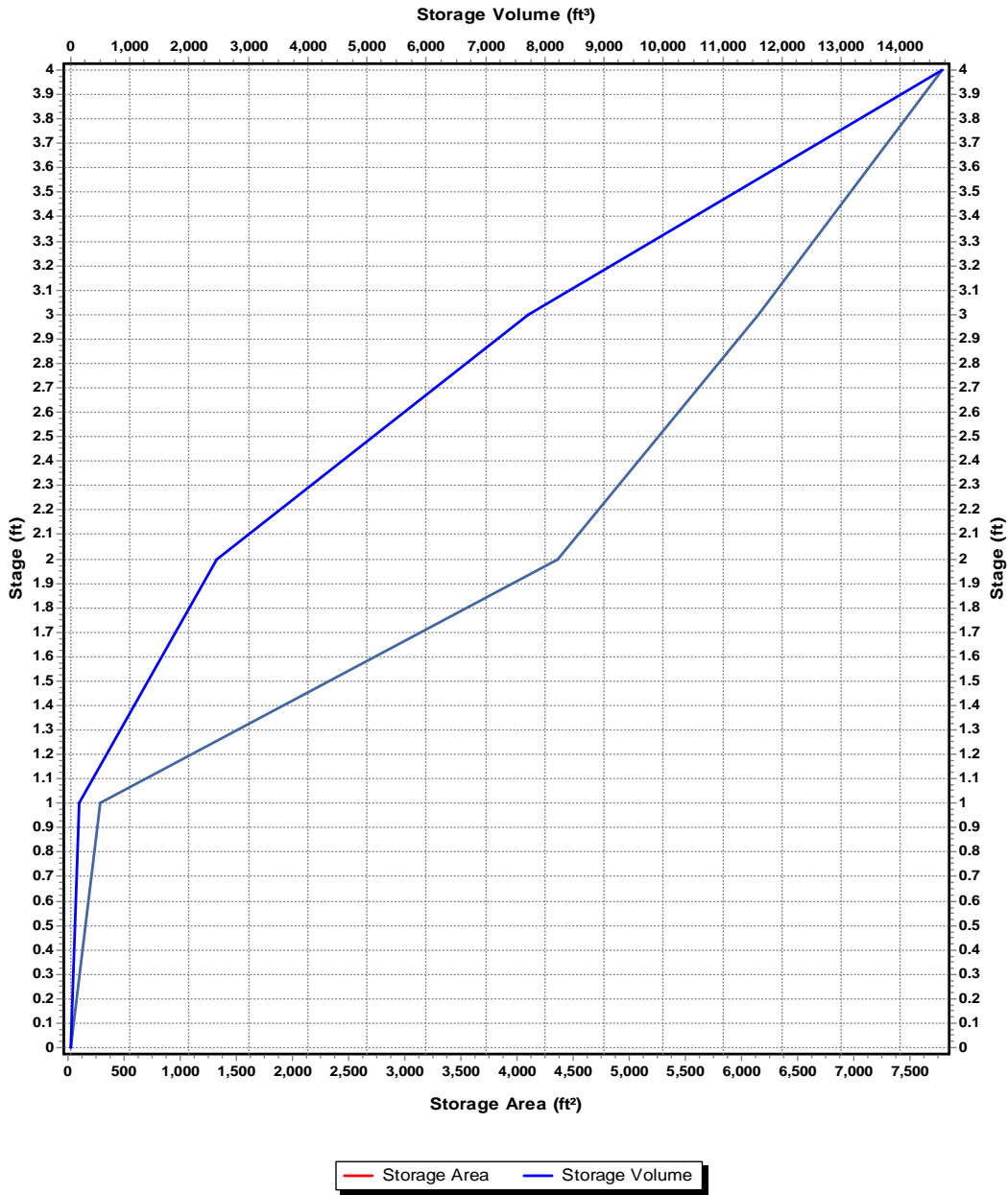
Invert Elevation (ft) ..... 272  
Max (Rim) Elevation (ft) ..... 276  
Max (Rim) Offset (ft) ..... 4  
Initial Water Elevation (ft) ..... 272  
Initial Water Depth (ft) ..... 0  
Ponded Area (ft<sup>2</sup>) ..... 0  
Evaporation Loss ..... 0

#### Storage Area Volume Curves

Storage Curve : FH-Pond1

Stage	Storage Area	Storage Volume
(ft)	(ft <sup>2</sup> )	(ft <sup>3</sup> )
0	20	0
1	277	148.5
2	4361	2467.5
3	6157	7726.5
4	7794	14702

### Storage Area Volume Curves



**Storage Node : FSP-1 (continued)**

**Outflow Orifices**

SN ID	Element	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	FSP1-1	Side	CIRCULAR	No	8.00			274.00	0.60
2	FSP1-2	Side	CIRCULAR	No	12.00			274.12	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	6.48
Peak Lateral Inflow (cfs) .....	6.48
Peak Outflow (cfs) .....	3.01
Peak Exfiltration Flow Rate (cfm) .....	8.42
Max HGL Elevation Attained (ft) .....	274.88
Max HGL Depth Attained (ft) .....	2.88
Average HGL Elevation Attained (ft) .....	272.51
Average HGL Depth Attained (ft) .....	0.51
Time of Max HGL Occurrence (days hh:mm) .....	0 12:21
Total Exfiltration Volume (1000-ft <sup>3</sup> ) .....	8.739
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0



**Storage Node : FSP-2**

**Input Data**

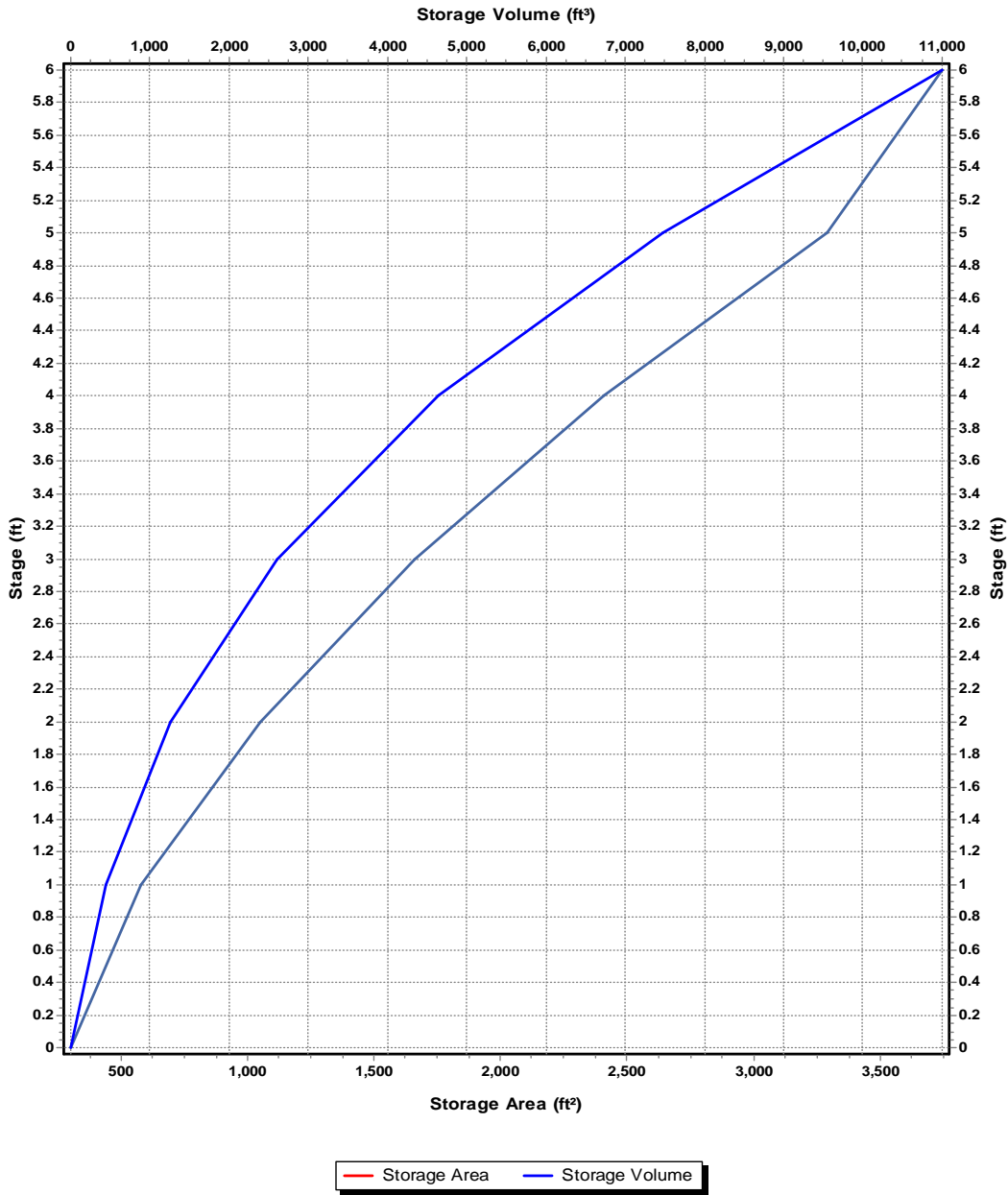
Invert Elevation (ft) .....	270
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	6
Initial Water Elevation (ft) .....	270
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	0
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : FH-Pond2

Stage (ft)	Storage Area (ft <sup>2</sup> )	Storage Volume (ft <sup>3</sup> )
0	300	0
1	578	439
2	1048	1252
3	1659	2605.5
4	2406	4638
5	3289	7485.5
6	3746	11003

### Storage Area Volume Curves



**Storage Node : FSP-2 (continued)**

**Outflow Orifices**

SN ID	Element Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	FSP2-1	Side	CIRCULAR No	8.00			273.00	0.60
2	FSP2-2	Side	CIRCULAR No	15.00			273.25	0.60
3	FSP2-3	Side	CIRCULAR No	15.00			273.50	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	7.18
Peak Lateral Inflow (cfs) .....	7.18
Peak Outflow (cfs) .....	6.36
Peak Exfiltration Flow Rate (cfm) .....	3.63
Max HGL Elevation Attained (ft) .....	274.17
Max HGL Depth Attained (ft) .....	4.17
Average HGL Elevation Attained (ft) .....	270.94
Average HGL Depth Attained (ft) .....	0.94
Time of Max HGL Occurrence (days hh:mm) .....	0 12:10
Total Exfiltration Volume (1000-ft³) .....	5.591
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

### Project Description

File Name ..... Boston Rd - Pre Dev - 20221215.SPF

### Project Options

Flow Units ..... CFS  
 Elevation Type ..... Elevation  
 Hydrology Method ..... SCS TR-55  
 Time of Concentration (TOC) Method ..... SCS TR-55  
 Link Routing Method ..... Kinematic Wave  
 Enable Overflow Ponding at Nodes ..... YES  
 Skip Steady State Analysis Time Periods ... YES

### Analysis Options

Start Analysis On ..... 00:00:00      0:00:00  
 End Analysis On ..... 00:00:00      0:00:00  
 Start Reporting On ..... 00:00:00      0:00:00  
 Antecedent Dry Days ..... 0      days  
 Runoff (Dry Weather) Time Step ..... 0 01:00:00      days hh:mm:ss  
 Runoff (Wet Weather) Time Step ..... 0 00:05:00      days hh:mm:ss  
 Reporting Time Step ..... 0 00:00:10      days hh:mm:ss  
 Routing Time Step ..... 10      seconds

### Number of Elements

	Qty
Rain Gages .....	1
Subbasins .....	53
Nodes.....	58
<i>Junctions</i> .....	23
<i>Outfalls</i> .....	4
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	29
<i>Storage Nodes</i> .....	2
Links.....	83
<i>Channels</i> .....	30
<i>Pipes</i> .....	48
<i>Pumps</i> .....	0
<i>Orifices</i> .....	5
<i>Weirs</i> .....	0
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

### Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	100-yr	Cumulative	inches	Massachusetts	Middlesex	100.00	7.65	SCS Type III 24-hr

**Subbasin Summary**

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Blake1P	2.66	484.00	78.70	7.65	5.15	13.68	13.48	0 00:07:38
2	Blake2	0.31	484.00	82.10	7.65	5.54	1.72	1.74	0 00:05:00
3	CB10-DA	0.09	484.00	96.90	7.65	7.28	0.67	0.58	0 00:05:00
4	CB10L-DA	0.93	484.00	80.20	7.65	5.32	4.96	3.46	0 00:26:57
5	CB11-DA	0.09	484.00	95.60	7.65	7.12	0.66	0.57	0 00:05:00
6	CB11L-DA	2.77	484.00	79.00	7.65	5.18	14.37	9.78	0 00:28:39
7	CB12-DA	0.40	484.00	95.50	7.65	7.11	2.87	2.58	0 00:05:00
8	CB13-DA	0.19	484.00	98.00	7.65	7.41	1.42	1.24	0 00:05:00
9	CB13L-DA	7.68	484.00	76.90	7.65	4.94	37.94	22.40	0 00:39:38
10	CB14-DA	0.21	484.00	95.60	7.65	7.12	1.49	1.35	0 00:05:00
11	CB15-DA	0.07	484.00	98.00	7.65	7.41	0.50	0.41	0 00:05:00
12	CB15L-DA	4.60	484.00	73.70	7.65	4.58	21.07	13.43	0 00:33:56
13	CB16-DA	0.05	484.00	98.00	7.65	7.41	0.38	0.33	0 00:05:00
14	CB16L-DA	2.01	484.00	76.40	7.65	4.89	9.84	6.49	0 00:31:25
15	CB17-DA	0.17	484.00	95.70	7.65	7.14	1.18	1.06	0 00:05:00
16	CB18-DA	0.03	484.00	98.00	7.65	7.38	0.19	0.17	0 00:05:00
17	CB18L-DA	0.50	484.00	73.70	7.65	4.58	2.30	1.71	0 00:23:57
18	CB19-DA	0.09	484.00	98.00	7.65	7.41	0.64	0.54	0 00:05:00
19	CB19L-DA	2.56	484.00	72.10	7.65	4.40	11.28	10.36	0 00:12:16
20	CB20-DA	0.12	484.00	96.20	7.65	7.19	0.84	0.74	0 00:05:00
21	CB21-DA	1.31	484.00	74.60	7.65	4.68	6.14	5.78	0 00:10:50
22	CB22-DA	0.13	484.00	95.50	7.65	7.11	0.90	0.82	0 00:05:00
23	CB23-DA	2.06	484.00	75.50	7.65	4.78	9.85	9.15	0 00:11:28
24	CB24-DA	2.61	484.00	76.30	7.65	4.88	12.73	12.46	0 00:08:30
25	CB25-DA	0.43	484.00	92.40	7.65	6.74	2.92	2.73	0 00:05:00
26	CB26-DA	0.07	484.00	96.80	7.65	7.26	0.47	0.41	0 00:05:00
27	CB26L-DA	3.73	484.00	77.20	7.65	4.98	18.58	17.42	0 00:10:45
28	CB27-DA	0.05	484.00	96.80	7.65	7.26	0.36	0.33	0 00:05:00
29	CB27L-DA	0.78	484.00	72.20	7.65	4.41	3.43	3.43	0 00:07:30
30	CB28-DA	0.23	484.00	84.30	7.65	5.79	1.32	1.32	0 00:05:00
31	CB31-DA	0.26	484.00	91.10	7.65	6.59	1.70	1.59	0 00:05:00
32	CB3-DA	1.14	484.00	83.20	7.65	5.67	6.46	5.66	0 00:13:13
33	CB5-DA	0.14	484.00	98.00	7.65	7.41	1.04	0.91	0 00:05:00
34	CB6-DA	0.25	484.00	91.60	7.65	6.65	1.64	1.51	0 00:05:00
35	CB7-DA	0.18	484.00	97.50	7.65	7.35	1.32	1.15	0 00:05:00
36	CB8-DA	0.04	484.00	98.00	7.65	7.40	0.29	0.25	0 00:05:00
37	CB8L-DA	0.64	484.00	83.60	7.65	5.71	3.68	2.60	0 00:25:26
38	CB9-DA	0.03	484.00	98.00	7.65	7.40	0.24	0.21	0 00:05:00
39	CB9L-DA	0.58	484.00	84.90	7.65	5.86	3.38	2.31	0 00:27:09
40	CBFS	0.26	484.00	95.60	7.65	7.12	1.84	1.64	0 00:05:00
41	CD7L-DA	0.63	484.00	83.00	7.65	5.64	3.56	3.08	0 00:14:12
42	Culvert1-DA	0.16	484.00	97.90	7.65	7.40	1.21	1.07	0 00:05:00
43	Culvert1L-DA	6.61	484.00	74.30	7.65	4.65	30.74	25.71	0 00:16:50
44	Culvert2-DA	0.26	484.00	96.90	7.65	7.28	1.92	1.69	0 00:05:00
45	Culvert2L-DA	3.78	484.00	71.50	7.65	4.33	16.36	16.45	0 00:07:29
46	Culvert2P-DA	2.87	484.00	73.50	7.65	4.56	13.07	13.08	0 00:07:33
47	EX32-DA	0.49	484.00	98.00	7.65	7.41	3.65	3.18	0 00:05:00
48	EX33-DA	0.27	484.00	93.80	7.65	6.91	1.86	1.70	0 00:05:00
49	Hildreth-DA	2.35	484.00	87.00	7.65	6.11	14.35	11.82	0 00:15:35
50	Out1-DA	0.36	484.00	95.30	7.65	7.09	2.52	2.29	0 00:05:00
51	Out2_1-DA	0.09	484.00	86.80	7.65	6.08	0.56	0.53	0 00:05:00
52	Out2_2-DA	0.25	484.00	85.50	7.65	5.93	1.45	1.42	0 00:05:00
53	Out2_3-DA	0.26	484.00	89.00	7.65	6.34	1.66	1.59	0 00:05:00

**Node Summary**

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft <sup>2</sup> )	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert1In	Junction	332.72	336.00	0.00	336.00	0.00	43.58	336.00	0.00	0.00	0 12:11	4.56	28.00
2	Culvert2In	Junction	270.70	274.00	0.00	0.00	0.00	41.41	273.60	0.00	0.40	0 00:00	0.00	0.00
3	DMH1	Junction	396.00	399.76	0.00	399.76	0.00	2.07	399.76	0.00	0.00	0 11:53	0.64	59.00
4	DMH101	Junction	394.70	399.00	0.00	399.00	0.00	3.55	399.00	0.00	0.00	0 12:06	2.78	173.00
5	DMH102	Junction	371.90	375.50	0.00	375.50	0.00	7.07	375.50	0.00	0.00	0 13:14	2.54	170.00
6	DMH2	Junction	354.80	358.51	0.00	358.51	0.00	12.48	355.80	0.00	2.71	0 00:00	0.00	0.00
7	DMH3	Junction	268.70	271.83	0.00	271.83	0.00	10.71	271.83	0.00	0.00	0 12:01	0.26	21.00
8	DMH4	Junction	268.10	271.22	0.00	271.22	0.00	10.08	269.70	0.00	1.52	0 00:00	0.00	0.00
9	DMH5	Junction	265.90	269.46	0.00	269.46	0.00	11.84	266.81	0.00	2.65	0 00:00	0.00	0.00
10	DMH6	Junction	253.60	258.48	0.00	258.48	0.00	1.72	254.48	0.00	4.00	0 00:00	0.00	0.00
11	DMH8	Junction	268.80	272.80	0.00	272.80	0.00	0.93	272.80	0.00	0.00	0 12:06	0.33	66.00
12	DMH9	Junction	268.90	271.70	0.00	271.70	0.00	13.32	271.70	0.00	0.00	0 12:09	0.79	19.00
13	FSP1-Out	Junction	273.00	276.00	0.00	276.00	7794.00	6.11	276.13	0.01	0.00	0 12:20	0.03	22.00
14	FSP2-Out	Junction	272.00	276.00	0.00	276.00	3746.00	12.03	273.09	0.00	3.66	0 00:00	0.00	0.00
15	HILDRETH	Junction	395.90	399.00	395.90	395.90	0.00	11.82	399.00	0.00	0.00	0 12:10	3.42	53.00
16	OUT1	Junction	329.09	336.00	0.00	336.00	0.00	42.11	332.23	0.00	3.77	0 00:00	0.00	0.00
17	OUT2_1	Junction	295.20	301.00	0.00	301.00	0.00	22.17	300.91	0.00	0.19	0 00:00	0.00	0.00
18	OUT2_2	Junction	268.32	274.00	0.00	0.00	0.00	42.78	274.00	0.00	0.00	0 12:07	0.01	2.00
19	OUT2_3	Junction	264.50	269.00	0.00	269.00	0.00	13.34	265.41	0.00	3.59	0 00:00	0.00	0.00
20	Outfall_2_1	Junction	294.00	300.00	294.00	300.00	0.00	22.17	295.32	0.00	4.68	0 00:00	0.00	0.00
21	Outfall_2_2	Junction	266.00	272.00	266.00	272.00	0.00	42.51	267.50	0.00	4.50	0 00:00	0.00	0.00
22	Outfall_2_3	Junction	262.00	268.00	262.00	268.00	0.00	13.29	262.82	0.00	5.18	0 00:00	0.00	0.00
23	Outfall_2_4	Junction	250.00	256.00	250.00	256.00	0.00	2.74	250.39	0.00	5.61	0 00:00	0.00	0.00
24	DP_1	Outfall	286.00					41.86	287.10					
25	DP_2	Outfall	249.00					80.47	294.00					
26	EX32-bypass(out)	Outfall	255.47					1.78	255.64					
27	EX33-bypass(out)	Outfall	255.70					0.68	255.81					
28	FSP-1	Storage Node	272.00	276.00	272.00		0.00	13.08	275.79				0.00	0.00
29	FSP-2	Storage Node	270.00	276.00	270.00		0.00	13.48	274.73				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged (min)	Reported Condition
1	11-Oct	Pipe	CB10	CB11	190.10	390.40	386.00	2.3100	12.000	0.0110	6.36	6.41	0.99	9.49	0.81	0.81	0.00	Calculated
2	101-7	Pipe	DMH101	CB7	198.47	394.70	394.20	0.2500	12.000	0.0150	1.68	1.55	1.08	2.33	1.00	1.00	161.00	SURCHARGED
3	102-17	Pipe	DMH102	CB17	166.34	371.90	366.60	3.1900	12.000	0.0150	5.96	5.51	1.08	8.20	1.00	1.00	143.00	SURCHARGED
4	12-Nov	Pipe	CB11	CB12	57.91	385.90	384.60	2.2400	12.000	0.0110	6.76	6.31	1.07	9.31	1.00	1.00	48.00	SURCHARGED
5	14-Dec	Pipe	CB12	CB14	434.45	384.20	374.40	2.2600	12.000	0.0150	5.02	4.64	1.08	6.94	1.00	1.00	85.00	SURCHARGED
6	13-14	Pipe	CB13	CB14	34.67	376.40	374.70	4.9000	12.000	0.0150	7.00	6.84	1.02	10.03	0.91	0.91	0.00	> CAPACITY
7	14-102	Pipe	CB14	DMH102	152.21	374.40	372.00	1.5800	12.000	0.0150	4.20	3.88	1.08	5.77	1.00	1.00	263.00	SURCHARGED
8	5-Jan	Pipe	DMH1	CB5	110.54	396.00	395.30	0.6300	8.000	0.0110	1.23	1.14	1.08	3.83	0.67	1.00	56.00	SURCHARGED
9	15-102	Pipe	CB15	DMH102	32.43	372.30	372.00	0.9300	12.000	0.0150	3.19	2.97	1.08	4.39	1.00	1.00	79.00	SURCHARGED
10	16-17	Pipe	CB16	CB17	60.89	368.30	365.50	4.6000	18.000	0.0150	5.68	19.52	0.29	9.57	0.55	0.37	0.00	Calculated
11	17-2	Pipe	CB17	DMH2	244.52	365.40	354.80	4.3400	12.000	0.0150	6.96	6.43	1.08	9.58	1.00	1.00	240.00	SURCHARGED
12	18-17	Pipe	CB18	CB17	38.21	366.80	366.50	0.7900	8.000	0.0150	0.99	0.93	1.07	3.09	0.67	1.00	143.00	SURCHARGED
13	19-2	Pipe	CB19	DMH2	30.83	356.70	354.80	6.1600	18.000	0.0150	5.00	22.60	0.22	10.27	0.48	0.32	0.00	Calculated
14	20-2	Pipe	CB20	DMH2	8.74	355.20	354.90	3.4300	12.000	0.0150	1.13	5.72	0.20	5.66	0.30	0.30	0.00	Calculated
15	21-22	Pipe	CB21	CB22	113.00	330.30	327.80	2.2100	12.000	0.0130	5.60	5.30	1.06	7.91	0.94	0.94	0.00	> CAPACITY
16	22-23	Pipe	CB22	CB23	113.71	327.70	324.50	2.8100	12.000	0.0130	6.27	5.98	1.05	8.87	0.92	0.92	0.00	> CAPACITY
17	23-24	Pipe	CB23	CB24	115.91	323.90	320.20	3.1900	12.000	0.0130	6.81	6.37	1.07	9.45	1.00	1.00	16.00	SURCHARGED
18	24-25	Pipe	CB24	CB25	276.64	320.10	306.00	5.1000	12.000	0.0130	8.69	8.04	1.08	12.04	1.00	1.00	26.00	SURCHARGED
19	25-26	Pipe	CB25	CB26	138.90	306.00	299.10	4.9700	18.000	0.0130	10.07	23.41	0.43	12.91	0.69	0.46	0.00	Calculated
20	26-27	Pipe	CB26	CB27	68.30	298.90	295.60	4.8300	24.000	0.0130	15.36	49.73	0.31	13.94	0.76	0.38	0.00	Calculated
21	27-OUT2_1	Pipe	CB27	OUT2_1	35.92	295.50	294.50	2.7800	24.000	0.0130	20.44	20.67	0.99	7.50	1.62	0.81	0.00	Calculated
22	28-3	Pipe	CB28	DMH3	26.48	268.90	268.80	0.3800	12.000	0.0150	1.17	1.90	0.61	2.54	0.57	0.57	0.00	Calculated
23	2-OUT1	Pipe	DMH2	OUT1	530.29	354.80	331.40	4.4100	15.000	0.0110	12.48	16.04	0.78	14.46	0.83	0.66	0.00	Calculated
24	1-Mar	Pipe	CB3	DMH1	16.51	397.50	397.20	1.8200	8.000	0.0110	2.07	1.93	1.08	6.35	0.67	1.00	38.00	SURCHARGED
25	31-5	Pipe	CB31	DMH5	10.81	267.20	266.00	11.1000	12.000	0.0130	2.08	11.87	0.18	11.35	0.28	0.28	0.00	Calculated
26	32-6	Pipe	EXCB-32	DMH6	18.00	255.00	254.20	4.4400	6.000	0.0110	1.72	2.80	0.62	7.48	0.28	0.57	0.00	Calculated
27	33-out	Pipe	EXCB-33	Outfall_2_4	40.00	253.10	250.00	7.7500	12.000	0.0130	1.02	9.92	0.10	8.15	0.22	0.22	0.00	Calculated
28	4-Mar	Pipe	DMH3	DMH4	62.53	268.70	268.20	0.8000	18.000	0.0130	10.08	9.39	1.07	6.20	1.50	1.00	16.00	SURCHARGED
29	5-Apr	Pipe	DMH4	DMH5	21.75	268.10	266.00	9.6600	18.000	0.0130	10.00	32.64	0.31	16.28	0.57	0.38	0.00	Calculated
30	5-101	Pipe	CB5	DMH101	26.79	395.20	394.80	1.4900	12.000	0.0150	1.73	3.77	0.46	4.70	0.48	0.48	0.00	Calculated
31	5-OUT2_3	Pipe	DMH5	OUT2_3	51.22	265.90	264.50	2.7300	18.000	0.0130	11.83	17.37	0.68	10.58	0.91	0.61	0.00	Calculated
32	6-101	Pipe	CB6	DMH101	28.90	394.90	394.80	0.3500	12.000	0.0150	1.94	1.82	1.07	2.69	1.00	1.00	79.00	SURCHARGED
33	6-out	Pipe	DMH6	Outfall_2_4	165.00	253.60	250.00	2.1800	12.000	0.0130	1.72	5.26	0.33	6.00	0.39	0.39	0.00	Calculated
34	8-Jul	Pipe	CB7	CB8	99.78	394.20	393.60	0.6000	12.000	0.0150	2.59	2.39	1.08	3.57	1.00	1.00	33.00	SURCHARGED
35	3-Aug	Pipe	DMH8	DMH3	59.07	268.80	268.80	0.0000	12.000	0.0110	0.19	0.17	1.08	0.27	1.00	1.00	61.00	SURCHARGED
36	9-Aug	Pipe	CB8	CB9	84.19	393.60	393.20	0.4800	12.000	0.0150	2.30	2.13	1.08	3.16	1.00	1.00	122.00	SURCHARGED
37	10-Sep	Pipe	CB9	CB10	194.56	393.20	390.40	1.4400	12.000	0.0150	4.01	3.70	1.08	5.53	1.00	1.00	28.00	SURCHARGED
38	Blake-3	Pipe	DMH9	DMH3	20.00	268.90	268.70	1.0000	18.000	0.0150	9.75	9.10	1.07	5.94	1.50	1.00	16.00	SURCHARGED
39	Culvert1	Pipe	Culvert1In	OUT1	45.16	332.72	329.09	8.0400	18.000	0.0150	27.82	25.81	1.08	16.83	1.50	1.00	24.00	SURCHARGED
40	Culvert2	Pipe	Culvert2In	OUT2_2	55.47	270.70	268.32	4.2900	24.000	0.0130	41.40	46.86	0.88	16.83	1.46	0.73	0.00	Calculated
41	FH-8	Pipe	CBFD	DMH8	60.93	269.10	268.80	0.4900	12.000	0.0150	0.93	2.17	0.43	2.65	0.46	0.46	0.00	Calculated
42	FSP1-Out	Pipe	FSP1-Out	Culvert2In	20.00	273.00	272.60	2.0000	12.000	0.0110	6.35	5.95	1.07	8.71	1.00	1.00	20.00	SURCHARGED
43	FSP2-Out	Pipe	FSP2-Out	DMH9	178.00	272.00	269.00	1.6900	18.000	0.0130	12.02	13.64	0.88	8.71	1.09	0.73	0.00	Calculated
44	HILDRETH	Pipe	HILDRETH	CB6	100.00	395.90	394.90	1.0000	12.000	0.0150	3.34	3.09	1.08	4.62	1.00	1.00	50.00	SURCHARGED
45	O2_1	Pipe	Outfall_2_1	DP_2	1093.34	294.00	294.00	0.0000	0.000	0.0150	22.17	0.00	1.08	0.00	1.00	1.00	50.00	SURCHARGED
46	O2_2	Pipe	Outfall_2_2	DP_2	539.72	266.00	266.00	0.0000	0.000	0.0150	42.51	0.00	1.08	0.00	1.00	1.00	50.00	SURCHARGED
47	O2_3	Pipe	Outfall_2_3	DP_2	246.53	262.00	262.00	0.0000	0.000	0.0150	13.29	0.00	1.08	0.00	1.00	1.00	50.00	SURCHARGED

Proposal No. 609035- 126590

Pre-Development  
100-yr

Boston Rd. 609035  
Westford, MA

March 13, 2023

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported (min)	Surcharged Condition
48	O2_4	Pipe	Outfall_2_4	DP_2	714.54	250.00	250.00	0.0000	0.000	0.0150	2.74	0.00	1.08	0.00	1.00	1.00	50.00	SURCHARGED
49	CB10-bypass	Channel	CB10	CB11	191.61	393.46	389.50	2.0700	3.600	0.0130	3.64	12.94	0.28	3.38	0.19	0.62	0.00	
50	CB11-bypass	Channel	CB11	CB13	478.43	389.50	378.90	2.2200	3.600	0.0130	9.14	13.40	0.68	4.39	0.26	0.87	0.00	
51	CB12-bypass	Channel	CB12	CB14	425.00	388.11	378.76	2.2000	3.600	0.0130	1.32	13.35	0.10	2.88	0.13	0.42	0.00	
52	CB13-bypass	Channel	CB13	CB15	155.71	378.90	375.33	2.2900	3.600	0.0130	13.63	13.63	1.00	4.90	0.30	1.00	38.00	
53	CB14-bypass	Channel	CB14	CB17	318.79	378.76	370.30	2.6500	3.600	0.0130	1.19	14.66	0.08	2.94	0.12	0.39	0.00	
54	CB15-bypass	Channel	CB15	CB16	115.44	375.33	372.17	2.7400	3.600	0.0130	14.89	14.89	1.00	5.35	0.30	1.00	40.00	
55	CB16-bypass	Channel	CB16	CB18	71.28	372.17	369.76	3.3800	3.600	0.0130	15.81	16.55	0.96	5.86	0.29	0.98	0.00	
56	CB17-bypass	Channel	CB17	CB20	236.23	370.30	358.78	4.8800	3.600	0.0130	0.95	19.87	0.05	3.40	0.10	0.32	0.00	
57	CB18-bypass	Channel	CB18	CB19	213.88	369.76	359.82	4.6500	3.600	0.0130	12.99	19.40	0.67	6.29	0.26	0.86	0.00	
58	CB19-bypass	Channel	CB19	Culvert1In	528.55	359.82	332.72	5.1300	3.600	0.0130	17.23	20.38	0.85	7.02	0.28	0.94	0.00	
59	CB20-bypass	Channel	CB20	OUT1	541.70	358.78	329.09	5.4800	3.600	0.0130	0.55	21.07	0.03	3.36	0.08	0.25	0.00	
60	CB22-bypass	Channel	CB22	CB25	495.92	330.74	311.32	3.9200	3.600	0.0130	0.23	17.81	0.01	2.54	0.06	0.19	0.00	
61	CB23-bypass	Channel	CB23	CB24	115.97	328.70	325.59	2.6800	3.600	0.0130	5.74	14.74	0.39	4.18	0.21	0.70	0.00	
62	CB24-bypass	Channel	CB24	CB26	416.71	325.59	303.57	5.2800	3.600	0.0130	13.05	20.69	0.63	6.66	0.25	0.84	0.00	
63	CB25-bypass	Channel	CB25	OUT2_1	230.21	311.32	300.80	4.5700	3.600	0.0130	1.21	19.24	0.06	3.54	0.11	0.35	0.00	
64	CB26-bypass	Channel	CB26	CB27	68.43	303.57	300.38	4.6600	3.600	0.0130	19.43	19.43	1.00	6.98	0.30	1.00	11.00	
65	CB27-bypass	Channel	CB27	Culvert2In	566.65	300.38	270.70	5.2400	3.600	0.0130	18.10	20.60	0.88	7.21	0.29	0.95	0.00	
66	CB28-bypass	Channel	CB28	CB31	89.54	270.47	269.04	1.6000	3.600	0.0130	0.86	9.06	0.10	2.26	0.12	0.41	0.00	
67	CB31-bypass	Channel	CB31	EXCB-32	611.00	269.04	257.18	1.9400	3.600	0.0130	0.37	9.99	0.04	2.52	0.09	0.28	0.00	
68	CB5-bypass	Channel	CB5	CB12	842.80	398.31	388.11	1.2100	3.600	0.0130	0.32	7.89	0.04	1.98	0.09	0.29	0.00	
69	CB7-bypass	Channel	CB7	CB8	102.09	397.14	396.62	0.5100	3.600	0.0130	2.28	7.35	0.31	1.78	0.19	0.63	0.00	
70	CB8-bypass	Channel	CB8	CB9	84.93	396.62	396.20	0.4900	3.600	0.0130	2.67	6.33	0.42	1.83	0.22	0.72	0.00	
71	CB9-bypass	Channel	CB9	CB10	195.58	396.20	393.46	1.4000	3.600	0.0130	2.62	10.65	0.25	2.70	0.18	0.59	0.00	
72	CBFD-bypass	Channel	CBFD	CB28	102.51	271.90	270.47	1.3900	3.600	0.0130	0.71	8.47	0.08	2.06	0.12	0.39	0.00	
73	EX32-bypass	Channel	EXCB-32	EX32-bypass(out)	156.00	257.18	255.47	1.1000	3.600	0.0130	1.78	7.51	0.24	2.38	0.17	0.58	0.00	
74	EX33-bypass	Channel	EXCB-33	EX33-bypass(out)	70.00	256.90	255.70	1.7100	3.600	0.0130	0.68	9.39	0.07	2.17	0.11	0.37	0.00	
75	Outfall-1	Channel	OUT1	DP_1	333.49	329.09	286.00	12.9200	36.000	0.0320	41.86	450.45	0.09	12.00	1.10	0.37	0.00	
76	Outfall-2_1	Channel	OUT2_1	Outfall_2_1	50.00	294.50	294.00	1.0000	24.000	0.0320	22.17	62.70	0.35	5.37	1.32	0.66	0.00	
77	Outfall-2_2	Channel	OUT2_2	Outfall_2_2	50.00	268.32	266.00	4.6400	18.000	0.0320	42.51	42.51	1.00	8.10	1.50	1.00	2.00	
78	Outfall-2_3	Channel	OUT2_3	Outfall_2_3	50.00	264.50	262.00	5.0000	36.000	0.0320	13.29	280.21	0.05	6.22	0.82	0.27	0.00	
79	FSP1-1	Orifice	FSP-1	FSP1-Out		272.00	273.00		8.000									
80	FSP1-2	Orifice	FSP-1	FSP1-Out		272.00	273.00		12.000									
81	FSP2-1	Orifice	FSP-2	FSP2-Out		270.00	272.00		8.000									
82	FSP2-2	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000									
83	FSP2-3	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000									



**Inlet Summary**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft²)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
1	CB10	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.40	393.46	0.00	N/A	6.30	2.67	3.63	42.32	7.00	11.46	393.69
2	CB11	FHWA HEC-22 GENERIC	N/A	On Grade	1	385.90	389.50	0.00	N/A	13.60	4.46	9.14	32.79	7.00	15.37	389.81
3	CB12	FHWA HEC-22 GENERIC	N/A	On Grade	1	384.20	388.11	0.00	N/A	2.82	1.52	1.31	53.72	7.00	8.51	388.28
4	CB13	FHWA HEC-22 GENERIC	N/A	On Grade	1	376.40	378.90	0.00	N/A	31.23	6.84	24.39	21.91	7.00	20.91	379.32
5	CB14	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.40	378.76	0.00	N/A	2.63	1.44	1.19	54.76	7.00	8.30	378.93
6	CB15	FHWA HEC-22 GENERIC	N/A	On Grade	1	372.30	375.33	0.00	N/A	27.19	6.23	20.96	22.91	7.00	19.19	375.71
7	CB16	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.30	372.17	0.00	N/A	21.49	5.68	15.81	26.43	7.00	18.19	372.53
8	CB17	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.40	370.30	0.00	N/A	2.23	1.28	0.95	57.51	7.00	7.76	370.46
9	CB18	FHWA HEC-22 GENERIC	N/A	On Grade	1	366.80	369.76	0.00	N/A	17.51	4.54	12.97	25.91	7.00	14.49	370.05
10	CB19	FHWA HEC-22 GENERIC	N/A	On Grade	1	356.70	359.82	0.00	N/A	22.25	4.97	17.27	22.36	7.00	15.77	360.14
11	CB20	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.20	358.78	0.00	N/A	1.67	1.13	0.54	67.58	7.00	5.98	358.90
12	CB21	FHWA HEC-22 GENERIC	N/A	On Sag	1	330.30	333.30	0.00	0.00	5.78	N/A	N/A	N/A	7.00	24.44	333.76
13	CB22	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.70	330.74	0.00	N/A	0.82	0.60	0.22	73.33	7.00	5.45	330.85
14	CB23	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.90	328.70	0.00	N/A	9.15	3.41	5.74	37.25	7.00	13.40	328.97
15	CB24	FHWA HEC-22 GENERIC	N/A	On Grade	1	320.10	325.59	0.00	N/A	18.10	5.02	13.08	27.72	7.00	16.09	325.91
16	CB25	FHWA HEC-22 GENERIC	N/A	On Grade	1	306.00	311.32	0.00	N/A	2.94	1.73	1.21	58.82	7.00	7.28	311.47
17	CB26	FHWA HEC-22 GENERIC	N/A	On Grade	1	298.90	303.57	0.00	N/A	30.81	5.61	25.21	18.19	7.00	17.82	303.93
18	CB27	FHWA HEC-22 GENERIC	N/A	On Grade	1	295.50	300.38	0.00	N/A	23.18	5.07	18.11	21.88	7.00	16.05	300.70
19	CB28	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.90	270.47	0.00	N/A	2.03	1.17	0.86	57.52	7.00	7.89	270.63
20	CB3	FHWA HEC-22 GENERIC	N/A	On Sag	1	397.50	399.24	0.00	0.00	5.66	N/A	N/A	N/A	7.00	24.12	399.69
21	CB31	FHWA HEC-22 GENERIC	N/A	On Grade	1	267.20	269.04	0.00	N/A	1.59	1.22	0.36	77.15	7.00	7.01	269.26
22	CB5	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.20	398.31	0.00	N/A	0.91	0.60	0.31	65.95	7.00	7.35	398.46
23	CB6	FHWA HEC-22 GENERIC	N/A	On Sag	1	394.90	398.92	0.00	0.00	1.51	N/A	N/A	N/A	7.00	10.59	399.11
24	CB7	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.20	397.14	0.00	N/A	4.06	1.77	2.29	43.67	7.00	12.86	397.40
25	CB8	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.60	396.62	0.00	N/A	4.62	1.95	2.67	42.28	7.00	12.86	396.88
26	CB9	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.20	396.20	0.00	N/A	4.96	2.33	2.63	46.99	7.00	8.56	396.37
27	CBFD	FHWA HEC-22 GENERIC	N/A	On Grade	1	0.00	271.90	269.00	N/A	1.64	0.93	0.71	56.76	7.00	9.13	272.08
28	EXCB-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	0.00	N/A	3.50	1.72	1.78	49.20	7.00	9.68	257.37
29	EXCB-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	0.00	N/A	1.70	1.03	0.67	60.34	7.00	7.38	257.05

## Subbasin Hydrology

### Subbasin : Blake1P

#### Input Data

Area (ac) ..... 2.66  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 78.7  
Rain Gage ID ..... \*

#### Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.66	-	78.7
Composite Area & Weighted CN	2.66		78.7

#### Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T<sub>c</sub> = Time of Concentration (hr)  
n = Manning's roughness  
L<sub>f</sub> = Flow Length (ft)  
P = 2 yr, 24 hr Rainfall (inches)  
S<sub>f</sub> = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 \* (S<sub>f</sub><sup>0.5</sup>) (unpaved surface)  
V = 20.3282 \* (S<sub>f</sub><sup>0.5</sup>) (paved surface)  
V = 15.0 \* (S<sub>f</sub><sup>0.5</sup>) (grassed waterway surface)  
V = 10.0 \* (S<sub>f</sub><sup>0.5</sup>) (nearly bare & untilled surface)  
V = 9.0 \* (S<sub>f</sub><sup>0.5</sup>) (cultivated straight rows surface)  
V = 7.0 \* (S<sub>f</sub><sup>0.5</sup>) (short grass pasture surface)  
V = 5.0 \* (S<sub>f</sub><sup>0.5</sup>) (woodland surface)  
V = 2.5 \* (S<sub>f</sub><sup>0.5</sup>) (forest w/heavy litter surface)  
T<sub>c</sub> = (L<sub>f</sub> / V) / (3600 sec/hr)

Where:

T<sub>c</sub> = Time of Concentration (hr)  
L<sub>f</sub> = Flow Length (ft)  
V = Velocity (ft/sec)  
S<sub>f</sub> = Slope (ft/ft)

Channel Flow Equation :

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

$$R = A_q / W_p$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where :

T<sub>c</sub> = Time of Concentration (hr)  
L<sub>f</sub> = Flow Length (ft)  
R = Hydraulic Radius (ft)  
A<sub>q</sub> = Flow Area (ft<sup>2</sup>)  
W<sub>p</sub> = Wetted Perimeter (ft)  
V = Velocity (ft/sec)  
S<sub>f</sub> = Slope (ft/ft)  
n = Manning's roughness

	Subarea A	Subarea B	Subarea C
<b>Sheet Flow Computations</b>			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0
<b>Shallow Concentrated Flow Computations</b>			
Flow Length (ft) :	346	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	7.64		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	5.15
Peak Runoff (cfs) .....	13.48
Weighted Curve Number .....	78.7
Time of Concentration (days hh:mm:ss) .....	0 00:07:38

**Subbasin : Blake2**

**Input Data**

Area (ac) ..... 0.31  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 82.1  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.31	-	82.1
Composite Area & Weighted CN	0.31		82.1

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 5.54  
Peak Runoff (cfs) ..... 1.74  
Weighted Curve Number ..... 82.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB10-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.9  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	96.9
Composite Area & Weighted CN	0.09		96.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.28  
Peak Runoff (cfs) ..... 0.58  
Weighted Curve Number ..... 96.9  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB10L-DA**

**Input Data**

Area (ac) ..... 0.93  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 80.2  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.93	-	80.2
Composite Area & Weighted CN	0.93		80.2

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.1	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.16	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	347	0	0
Slope (%) :	2.1	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.01	0	0
Computed Flow Time (min) :	5.73	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	56	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.08	0	0
Total TOC (min) .....	26.96		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 5.32  
 Peak Runoff (cfs) ..... 3.46  
 Weighted Curve Number ..... 80.2  
 Time of Concentration (days hh:mm:ss) ..... 0 00:26:58

**Subbasin : CB11-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.6  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	95.6
Composite Area & Weighted CN	0.09		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.12  
Peak Runoff (cfs) ..... 0.57  
Weighted Curve Number ..... 95.6  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB11L-DA**

**Input Data**

Area (ac) ..... 2.77  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 79  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.77	-	79
Composite Area & Weighted CN	2.77		79

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	409	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	6.89	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	140	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.2	0	0
Total TOC (min) .....	28.66		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 5.18  
 Peak Runoff (cfs) ..... 9.78  
 Weighted Curve Number ..... 79  
 Time of Concentration (days hh:mm:ss) ..... 0 00:28:40



**Subbasin : CB12-DA**

**Input Data**

Area (ac) ..... 0.4  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.5  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.4	-	95.5
Composite Area & Weighted CN	0.4		95.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.11  
Peak Runoff (cfs) ..... 2.58  
Weighted Curve Number ..... 95.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB13-DA**

**Input Data**

Area (ac) ..... 0.19  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.19	-	98
Composite Area & Weighted CN	0.19		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 1.24  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB13L-DA**

**Input Data**

Area (ac) ..... 7.68  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 76.9  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	7.68	-	76.9
Composite Area & Weighted CN	7.68		76.9

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.4	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.03	0	0
Computed Flow Time (min) :	24.88	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	744	0	0
Slope (%) :	1.5	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.86	0	0
Computed Flow Time (min) :	14.42	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	243	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.34	0	0
Total TOC (min) .....	39.64		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.94  
 Peak Runoff (cfs) ..... 22.4  
 Weighted Curve Number ..... 76.9  
 Time of Concentration (days hh:mm:ss) ..... 0 00:39:38

**Subbasin : CB14-DA**

**Input Data**

Area (ac) ..... 0.21  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.6  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.21	-	95.6
Composite Area & Weighted CN	0.21		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.12  
Peak Runoff (cfs) ..... 1.35  
Weighted Curve Number ..... 95.6  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB15-DA**

**Input Data**

Area (ac) ..... 0.07  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.07	-	98
Composite Area & Weighted CN	0.07		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.41  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB15L-DA**

**Input Data**

Area (ac) ..... 4.6  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 73.7  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	4.6	-	73.7
Composite Area & Weighted CN	4.6		73.7

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	706	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.89	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	35	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	33.94		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.58  
 Peak Runoff (cfs) ..... 13.43  
 Weighted Curve Number ..... 73.7  
 Time of Concentration (days hh:mm:ss) ..... 0 00:33:56

**Subbasin : CB16-DA**

**Input Data**

Area (ac) ..... 0.05  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.05	-	98
Composite Area & Weighted CN	0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.33  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB16L-DA**

**Input Data**

Area (ac) ..... 2.01  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 76.4  
Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	2.01	-	76.4
Composite Area & Weighted CN	2.01		76.4

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	20.77	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	659	0	0
Slope (%) :	2.2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.04	0	0
Computed Flow Time (min) :	10.56	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	104	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.1	0	0
Total TOC (min) .....	31.43		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 4.89  
Peak Runoff (cfs) ..... 6.49  
Weighted Curve Number ..... 76.4  
Time of Concentration (days hh:mm:ss) ..... 0 00:31:26



**Subbasin : CB17-DA**

**Input Data**

Area (ac) ..... 0.17  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.7  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.17	-	95.7
Composite Area & Weighted CN	0.17		95.7

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.14  
Peak Runoff (cfs) ..... 1.06  
Weighted Curve Number ..... 95.7  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB18-DA**

**Input Data**

Area (ac) ..... 0.03  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.03	-	98
Composite Area & Weighted CN	0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.38  
Peak Runoff (cfs) ..... 0.17  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB18L-DA**

**Input Data**

Area (ac) ..... 0.5  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 73.7  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.5	-	73.7
Composite Area & Weighted CN	0.5		73.7

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.05	0	0
Computed Flow Time (min) :	18.35	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	406	0	0
Slope (%) :	3	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.21	0	0
Computed Flow Time (min) :	5.59	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	20	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	23.96		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.58  
 Peak Runoff (cfs) ..... 1.71  
 Weighted Curve Number ..... 73.7  
 Time of Concentration (days hh:mm:ss) ..... 0 00:23:58

**Subbasin : CB19-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.09	-	98
Composite Area & Weighted CN	0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.54  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB19L-DA**

**Input Data**

Area (ac) ..... 2.56  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 72.1  
Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	2.56	-	72.1
Composite Area & Weighted CN	2.56		72.1

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	498	0	0
Slope (%) :	3.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.15	0	0
Computed Flow Time (min) :	2.63	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	59	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.05	0	0
Total TOC (min) .....	12.28		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 4.4  
Peak Runoff (cfs) ..... 10.36  
Weighted Curve Number ..... 72.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:12:17

**Subbasin : CB20-DA**

**Input Data**

Area (ac) ..... 0.12  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.2  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.12	-	96.2
Composite Area & Weighted CN	0.12		96.2

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.19  
Peak Runoff (cfs) ..... 0.74  
Weighted Curve Number ..... 96.2  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB21-DA**

**Input Data**

Area (ac) ..... 1.31  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 74.6  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	1.31	-	74.6
Composite Area & Weighted CN	1.31		74.6

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	403	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.26	0	0
Total TOC (min) .....	10.84		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.68  
 Peak Runoff (cfs) ..... 5.78  
 Weighted Curve Number ..... 74.6  
 Time of Concentration (days hh:mm:ss) ..... 0 00:10:50

**Subbasin : CB22-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.5  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	95.5
Composite Area & Weighted CN	0.13		95.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.11  
Peak Runoff (cfs) ..... 0.82  
Weighted Curve Number ..... 95.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : CB23-DA**

**Input Data**

Area (ac) ..... 2.06  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 75.5  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.06	-	75.5
Composite Area & Weighted CN	2.06		75.5

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	3.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	9.69	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	575	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.79	0	0
Total TOC (min) .....	11.48		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.78  
 Peak Runoff (cfs) ..... 9.15  
 Weighted Curve Number ..... 75.5  
 Time of Concentration (days hh:mm:ss) ..... 0 00:11:29

**Subbasin : CB24-DA**

**Input Data**

Area (ac) ..... 2.61  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 76.3  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	2.61	-	76.3
Composite Area & Weighted CN	2.61		76.3

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.12	0	0
Computed Flow Time (min) :	6.79	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	552	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.72	0	0
Total TOC (min) .....	8.51		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.88  
 Peak Runoff (cfs) ..... 12.46  
 Weighted Curve Number ..... 76.3  
 Time of Concentration (days hh:mm:ss) ..... 0 00:08:31

**Subbasin : CB25-DA**

**Input Data**

Area (ac) ..... 0.43  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 92.4  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.43	-	92.4
Composite Area & Weighted CN		0.43		92.4

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 6.74  
Peak Runoff (cfs) ..... 2.73  
Weighted Curve Number ..... 92.4  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB26-DA**

**Input Data**

Area (ac) ..... 0.07  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.8  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.07	-	96.8
Composite Area & Weighted CN		0.07		96.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.26  
Peak Runoff (cfs) ..... 0.41  
Weighted Curve Number ..... 96.8  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB26L-DA**

**Input Data**

Area (ac) .....	3.73
Peak Rate Factor .....	484
Weighted Curve Number .....	77.2
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		3.73	-	77.2
Composite Area & Weighted CN		3.73		77.2

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	8.59	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	628	0	0
Slope (%) :	9.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.05	0	0
Computed Flow Time (min) :	2.07	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	109	0	0
Channel Slope (%) :	5.9	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	19.49	0	0
Computed Flow Time (min) :	0.09	0	0
Total TOC (min) .....	10.76		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.98
Peak Runoff (cfs) .....	17.42
Weighted Curve Number .....	77.2
Time of Concentration (days hh:mm:ss) .....	0 00:10:46

**Subbasin : CB27-DA**

**Input Data**

Area (ac) .....	0.05
Peak Rate Factor .....	484
Weighted Curve Number .....	96.8
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.05	-	96.8
Composite Area & Weighted CN		0.05		96.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.26
Peak Runoff (cfs) .....	0.33
Weighted Curve Number .....	96.8
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB27L-DA**

**Input Data**

Area (ac) .....	0.78
Peak Rate Factor .....	484
Weighted Curve Number .....	72.2
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		0.78	-	72.2
Composite Area & Weighted CN		0.78		72.2

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	389	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.21	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	37	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	7.51		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.41
Peak Runoff (cfs) .....	3.43
Weighted Curve Number .....	72.2
Time of Concentration (days hh:mm:ss) .....	0 00:07:31

**Subbasin : CB28-DA**

**Input Data**

Area (ac) ..... 0.23  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 84.3  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.23	-	84.3
Composite Area & Weighted CN		0.23		84.3

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 5.79  
Peak Runoff (cfs) ..... 1.32  
Weighted Curve Number ..... 84.3  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : CB31-DA**

**Input Data**

Area (ac) .....	0.26
Peak Rate Factor .....	484
Weighted Curve Number .....	91.1
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	91.1
Composite Area & Weighted CN		0.26		91.1

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	6.59
Peak Runoff (cfs) .....	1.59
Weighted Curve Number .....	91.1
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB3-DA**

**Input Data**

Area (ac) .....	1.14
Peak Rate Factor .....	484
Weighted Curve Number .....	83.2
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		1.14	-	83.2
Composite Area & Weighted CN		1.14		83.2

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.07	0	0
Computed Flow Time (min) :	12.39	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	135	0	0
Slope (%) :	5	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.61	0	0
Computed Flow Time (min) :	0.62	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	205	0	0
Channel Slope (%) :	4	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	16.05	0	0
Computed Flow Time (min) :	0.21	0	0
Total TOC (min) .....	13.23		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	5.67
Peak Runoff (cfs) .....	5.66
Weighted Curve Number .....	83.2
Time of Concentration (days hh:mm:ss) .....	0 00:13:14

**Subbasin : CB5-DA**

**Input Data**

Area (ac) ..... 0.14  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.91  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB6-DA**

**Input Data**

Area (ac) .....	0.25
Peak Rate Factor .....	484
Weighted Curve Number .....	91.6
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.25	-	91.6
Composite Area & Weighted CN		0.25		91.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	6.65
Peak Runoff (cfs) .....	1.51
Weighted Curve Number .....	91.6
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : CB7-DA**

**Input Data**

Area (ac) ..... 0.18  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.5  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.18	-	97.5
Composite Area & Weighted CN		0.18		97.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.35  
Peak Runoff (cfs) ..... 1.15  
Weighted Curve Number ..... 97.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB8-DA**

**Input Data**

Area (ac) ..... 0.04  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.4  
Peak Runoff (cfs) ..... 0.25  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CB8L-DA**

**Input Data**

Area (ac) .....	0.64
Peak Rate Factor .....	484
Weighted Curve Number .....	83.6
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.64	-	83.6
Composite Area & Weighted CN		0.64		83.6

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	23.02	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	125	0
Slope (%) :	1.7	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.91	0	0
Computed Flow Time (min) :	2.29	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	93	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.13	0	0
Total TOC (min) .....	25.44		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	5.71
Peak Runoff (cfs) .....	2.6
Weighted Curve Number .....	83.6
Time of Concentration (days hh:mm:ss) .....	0 00:25:26

**Subbasin : CB9-DA**

**Input Data**

Area (ac) .....	0.03
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.4
Peak Runoff (cfs) .....	0.21
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00



**Subbasin : CB9L-DA**

**Input Data**

Area (ac) .....	0.58
Peak Rate Factor .....	484
Weighted Curve Number .....	84.9
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.58	-	84.9
Composite Area & Weighted CN		0.58		84.9

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	293	0
Slope (%) :	1.9	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.96	0	0
Computed Flow Time (min) :	5.09	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	17	0	0
Channel Slope (%) :	0.65	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	6.47	0	0
Computed Flow Time (min) :	0.04	0	0
Total TOC (min) .....	27.15		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	5.86
Peak Runoff (cfs) .....	2.31
Weighted Curve Number .....	84.9
Time of Concentration (days hh:mm:ss) .....	0 00:27:09

**Subbasin : CBFS**

**Input Data**

Area (ac) ..... 0.26  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.6  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	95.6
Composite Area & Weighted CN		0.26		95.6

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.12  
Peak Runoff (cfs) ..... 1.64  
Weighted Curve Number ..... 95.6  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : CD7L-DA**

**Input Data**

Area (ac) .....	0.63
Peak Rate Factor .....	484
Weighted Curve Number .....	83
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.63	-	83
Composite Area & Weighted CN		0.63		83

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.22	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	84	0
Slope (%) :	1.7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.1	0	0
Computed Flow Time (min) :	0.67	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	110	0	0
Channel Slope (%) :	0.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	5.67	0	0
Computed Flow Time (min) :	0.32	0	0
Total TOC (min) .....	14.21		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	5.64
Peak Runoff (cfs) .....	3.08
Weighted Curve Number .....	83
Time of Concentration (days hh:mm:ss) .....	0 00:14:13

**Subbasin : Culvert1-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.9  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.16	-	97.9
Composite Area & Weighted CN		0.16		97.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.4  
Peak Runoff (cfs) ..... 1.07  
Weighted Curve Number ..... 97.9  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Culvert1L-DA**

**Input Data**

Area (ac) .....	6.61
Peak Rate Factor .....	484
Weighted Curve Number .....	74.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		6.61	-	74.3
Composite Area & Weighted CN		6.61		74.3

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	12.93	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	623	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	3.59	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	344	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.32	0	0
Total TOC (min) .....	16.84		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.65
Peak Runoff (cfs) .....	25.71
Weighted Curve Number .....	74.3
Time of Concentration (days hh:mm:ss) .....	0 00:16:50

**Subbasin : Culvert2-DA**

**Input Data**

Area (ac) ..... 0.26  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 96.9  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	96.9
Composite Area & Weighted CN		0.26		96.9

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.28  
Peak Runoff (cfs) ..... 1.69  
Weighted Curve Number ..... 96.9  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Culvert2L-DA**

**Input Data**

Area (ac) .....	3.78
Peak Rate Factor .....	484
Weighted Curve Number .....	71.5
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		3.78	-	71.5
Composite Area & Weighted CN		3.78		71.5

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	392	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.22	0	0
Total TOC (min) .....	7.49		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.33
Peak Runoff (cfs) .....	16.45
Weighted Curve Number .....	71.5
Time of Concentration (days hh:mm:ss) .....	0 00:07:29

**Subbasin : Culvert2P-DA**

**Input Data**

Area (ac) .....	2.87
Peak Rate Factor .....	484
Weighted Curve Number .....	73.5
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.87	-	73.5
Composite Area & Weighted CN		2.87		73.5

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	317	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.04	0	0
Total TOC (min) .....	7.55		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.56
Peak Runoff (cfs) .....	13.08
Weighted Curve Number .....	73.5
Time of Concentration (days hh:mm:ss) .....	0 00:07:33



**Subbasin : EX32-DA**

**Input Data**

Area (ac) .....	0.49
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.49	-	98
Composite Area & Weighted CN		0.49		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.41
Peak Runoff (cfs) .....	3.18
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : EX33-DA**

**Input Data**

Area (ac) ..... 0.27  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 93.8  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.27	-	93.8
Composite Area & Weighted CN		0.27		93.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 6.91  
Peak Runoff (cfs) ..... 1.7  
Weighted Curve Number ..... 93.8  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Hildreth-DA**

**Input Data**

Area (ac) .....	2.35
Peak Rate Factor .....	484
Weighted Curve Number .....	87
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.35	-	87
Composite Area & Weighted CN		2.35		87

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.4	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	96	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	0.55	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.013	0
Flow Length (ft) :	553	0	0
Channel Slope (%) :	3	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.785	0	0
Wetted Perimeter (ft) :	3	0	0
Velocity (ft/sec) :	8.12	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	15.59		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	6.11
Peak Runoff (cfs) .....	11.82
Weighted Curve Number .....	87
Time of Concentration (days hh:mm:ss) .....	0 00:15:35

**Subbasin : Out1-DA**

**Input Data**

Area (ac) ..... 0.36  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 95.3  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.36	-	95.3
Composite Area & Weighted CN		0.36		95.3

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.09  
Peak Runoff (cfs) ..... 2.29  
Weighted Curve Number ..... 95.3  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Out2\_1-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 86.8  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	86.8
Composite Area & Weighted CN		0.09		86.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 6.08  
Peak Runoff (cfs) ..... 0.53  
Weighted Curve Number ..... 86.8  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Out2\_2-DA**

**Input Data**

Area (ac) ..... 0.25  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 85.5  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.25	-	85.5
Composite Area & Weighted CN		0.25		85.5

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 5.93  
Peak Runoff (cfs) ..... 1.42  
Weighted Curve Number ..... 85.5  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Out2\_3-DA**

**Input Data**

Area (ac) .....	0.26
Peak Rate Factor .....	484
Weighted Curve Number .....	89
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.26	-	89
Composite Area & Weighted CN		0.26		89

**Time of Concentration**

**Junction Input**

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Culvert1In	332.72	336.00	3.28	0.00	-332.72	336.00	0.00	0.00	0.00
2	Culvert2In	270.70	274.00	3.30	0.00	-270.70	0.00	-274.00	0.00	0.00
3	DMH1	396.00	399.76	3.76	0.00	-396.00	399.76	0.00	0.00	0.00
4	DMH101	394.70	399.00	4.30	0.00	-394.70	399.00	0.00	0.00	0.00
5	DMH102	371.90	375.50	3.60	0.00	-371.90	375.50	0.00	0.00	0.00
6	DMH2	354.80	358.51	3.71	0.00	-354.80	358.51	0.00	0.00	0.00
7	DMH3	268.70	271.83	3.13	0.00	-268.70	271.83	0.00	0.00	0.00
8	DMH4	268.10	271.22	3.12	0.00	-268.10	271.22	0.00	0.00	0.00
9	DMH5	265.90	269.46	3.56	0.00	-265.90	269.46	0.00	0.00	0.00
10	DMH6	253.60	258.48	4.88	0.00	-253.60	258.48	0.00	0.00	0.00
11	DMH8	268.80	272.80	4.00	0.00	-268.80	272.80	0.00	0.00	0.00
12	DMH9	268.90	271.70	2.80	0.00	-268.90	271.70	0.00	0.00	0.00
13	FSP1-Out	273.00	276.00	3.00	0.00	-273.00	276.00	0.00	7794.00	0.00
14	FSP2-Out	272.00	276.00	4.00	0.00	-272.00	276.00	0.00	3746.00	0.00
15	HILDRETH	395.90	399.00	3.10	395.90	0.00	395.90	-3.10	0.00	0.00
16	OUT1	329.09	336.00	6.91	0.00	-329.09	336.00	0.00	0.00	0.00
17	OUT2_1	295.20	301.00	5.80	0.00	-295.20	301.00	0.00	0.00	0.00
18	OUT2_2	268.32	274.00	5.68	0.00	-268.32	0.00	-274.00	0.00	0.00
19	OUT2_3	264.50	269.00	4.50	0.00	-264.50	269.00	0.00	0.00	0.00
20	Outfall_2_1	294.00	300.00	6.00	294.00	0.00	300.00	0.00	0.00	0.00
21	Outfall_2_2	266.00	272.00	6.00	266.00	0.00	272.00	0.00	0.00	0.00
22	Outfall_2_3	262.00	268.00	6.00	262.00	0.00	268.00	0.00	0.00	0.00
23	Outfall_2_4	250.00	256.00	6.00	250.00	0.00	256.00	0.00	0.00	0.00



**Junction Results**

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert1In	43.58	26.35	336.00	3.28	0.00	0.00	332.80	0.08	0 12:02	0 12:11	4.56	28.00
2	Culvert2In	41.41	18.10	273.60	2.90	0.00	0.40	272.64	1.94	0 12:15	0 00:00	0.00	0.00
3	DMH1	2.07	0.00	399.76	3.76	0.00	0.00	397.27	1.27	0 11:43	0 11:53	0.64	59.00
4	DMH101	3.55	0.00	399.00	4.30	0.00	0.00	395.04	0.34	0 11:04	0 12:06	2.78	173.00
5	DMH102	7.07	0.00	375.50	3.60	0.00	0.00	372.26	0.36	0 11:34	0 13:14	2.54	170.00
6	DMH2	12.48	0.00	355.80	1.00	0.00	2.71	355.02	0.22	0 11:29	0 00:00	0.00	0.00
7	DMH3	10.71	0.00	271.83	3.13	0.00	0.00	268.91	0.21	0 12:00	0 12:01	0.26	21.00
8	DMH4	10.08	0.00	269.70	1.60	0.00	1.52	268.27	0.17	0 12:01	0 00:00	0.00	0.00
9	DMH5	11.84	0.00	266.81	0.91	0.00	2.65	266.04	0.14	0 12:01	0 00:00	0.00	0.00
10	DMH6	1.72	0.00	254.48	0.88	0.00	4.00	254.22	0.62	0 12:06	0 00:00	0.00	0.00
11	DMH8	0.93	0.00	272.80	4.00	0.00	0.00	268.95	0.15	0 11:32	0 12:06	0.33	66.00
12	DMH9	13.32	1.74	271.70	2.80	0.00	0.00	269.05	0.15	0 12:01	0 12:09	0.79	19.00
13	FSP1-Out	6.11	0.00	276.13	3.13	0.01	0.00	273.05	0.05	0 12:28	0 12:20	0.03	22.00
14	FSP2-Out	12.03	0.00	273.09	1.09	0.00	3.66	272.04	0.04	0 12:10	0 00:00	0.00	0.00
15	HILDRETH	11.82	11.82	399.00	3.10	0.00	0.00	396.00	0.10	0 11:47	0 12:10	3.42	53.00
16	OUT1	42.11	2.29	332.23	3.14	0.00	3.77	331.51	2.42	0 12:08	0 00:00	0.00	0.00
17	OUT2_1	22.17	0.53	300.91	5.71	0.00	0.19	300.81	5.61	0 12:07	0 00:00	0.00	0.00
18	OUT2_2	42.78	1.42	274.00	5.68	0.00	0.00	268.40	0.08	0 12:06	0 12:07	0.01	2.00
19	OUT2_3	13.34	1.59	265.41	0.91	0.00	3.59	264.55	0.05	0 12:01	0 00:00	0.00	0.00
20	Outfall_2_1	22.17	0.00	295.32	1.32	0.00	4.68	294.11	0.11	0 12:07	0 00:00	0.00	0.00
21	Outfall_2_2	42.51	0.00	267.50	1.50	0.00	4.50	266.08	0.08	0 12:06	0 00:00	0.00	0.00
22	Outfall_2_3	13.29	0.00	262.82	0.82	0.00	5.18	262.05	0.05	0 12:01	0 00:00	0.00	0.00
23	Outfall_2_4	2.74	0.00	250.39	0.39	0.00	5.61	250.03	0.03	0 12:06	0 00:00	0.00	0.00

**Channel Input**

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Shape Slope (%)	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	CB10-bypass	191.61	393.46	3.06	389.50	3.60	3.96	2.0700 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
2	CB11-bypass	478.43	389.50	3.60	378.90	2.50	10.60	2.2200 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
3	CB12-bypass	425.00	388.11	3.91	378.76	4.36	9.35	2.2000 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
4	CB13-bypass	155.71	378.90	2.50	375.33	3.03	3.57	2.2900 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
5	CB14-bypass	318.79	378.76	4.36	370.30	4.90	8.46	2.6500 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
6	CB15-bypass	115.44	375.33	3.03	372.17	3.87	3.16	2.7400 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
7	CB16-bypass	71.28	372.17	3.87	369.76	2.96	2.41	3.3800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
8	CB17-bypass	236.23	370.30	4.90	358.78	3.58	11.52	4.8800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
9	CB18-bypass	213.88	369.76	2.96	359.82	3.12	9.94	4.6500 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
10	CB19-bypass	528.55	359.82	3.12	332.72	0.00	27.10	5.1300 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
11	CB20-bypass	541.70	358.78	3.58	329.09	0.00	29.69	5.4800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
12	CB22-bypass	495.92	330.74	3.04	311.32	5.32	19.42	3.9200 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
13	CB23-bypass	115.97	328.70	4.80	325.59	5.49	3.11	2.6800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
14	CB24-bypass	416.71	325.59	5.49	303.57	4.67	22.02	5.2800 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
15	CB25-bypass	230.21	311.32	5.32	300.80	5.60	10.52	4.5700 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
16	CB26-bypass	68.43	303.57	4.67	300.38	4.88	3.19	4.6600 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
17	CB27-bypass	566.65	300.38	4.88	270.70	0.00	29.68	5.2400 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
18	CB28-bypass	89.54	270.47	1.57	269.04	1.84	1.43	1.6000 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
19	CB31-bypass	611.00	269.04	1.84	257.18	2.18	11.86	1.9400 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
20	CB5-bypass	842.80	398.31	3.11	388.11	3.91	10.20	1.2100 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
21	CB7-bypass	102.09	397.14	2.94	396.62	3.02	0.52	0.5100 Trapezoidal	0.300	19.600	0.0130	0.5000	0.5000	0.0000	0.00	No
22	CB8-bypass	84.93	396.62	3.02	396.20	3.00	0.42	0.4900 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
23	CB9-bypass	195.58	396.20	3.00	393.46	3.06	2.74	1.4000 Trapezoidal	0.300	18.600	0.0130	0.5000	0.5000	0.0000	0.00	No
24	CBFD-bypass	102.51	271.90	271.90	270.47	1.57	1.43	1.3900 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
25	EX32-bypass	156.00	257.18	2.18	255.47	0.00	1.71	1.1000 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
26	EX33-bypass	70.00	256.90	3.80	255.70	0.00	1.20	1.7100 Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
27	Outfall-1	333.49	329.09	0.00	286.00	0.00	43.09	12.9200 Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No
28	Outfall-2_1	50.00	294.50	-0.70	294.00	0.00	0.50	1.0000 Trapezoidal	2.000	8.500	0.0320	0.5000	0.5000	0.0000	0.00	No
29	Outfall-2_2	50.00	268.32	0.00	266.00	0.00	2.32	4.6400 Trapezoidal	1.500	6.500	0.0320	0.5000	0.5000	0.0000	0.00	No
30	Outfall-2_3	50.00	264.50	0.00	262.00	0.00	2.50	5.0000 Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No

**Channel Results**

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	CB10-bypass	3.64	0 12:17	12.94	0.28	3.38	0.94	0.19	0.62	0.00		
2	CB11-bypass	9.14	0 12:20	13.40	0.68	4.39	1.82	0.26	0.87	0.00		
3	CB12-bypass	1.32	0 12:08	13.35	0.10	2.88	2.46	0.13	0.42	0.00		
4	CB13-bypass	13.63	0 12:08	13.63	1.00	4.90	0.53	0.30	1.00	38.00		
5	CB14-bypass	1.19	0 12:08	14.66	0.08	2.94	1.81	0.12	0.39	0.00		
6	CB15-bypass	14.89	0 12:07	14.89	1.00	5.35	0.36	0.30	1.00	40.00		
7	CB16-bypass	15.81	0 12:22	16.55	0.96	5.86	0.20	0.29	0.98	0.00		
8	CB17-bypass	0.95	0 12:07	19.87	0.05	3.40	1.16	0.10	0.32	0.00		
9	CB18-bypass	12.99	0 12:20	19.40	0.67	6.29	0.57	0.26	0.86	0.00		
10	CB19-bypass	17.23	0 12:11	20.38	0.85	7.02	1.25	0.28	0.94	0.00		
11	CB20-bypass	0.55	0 12:09	21.07	0.03	3.36	2.69	0.08	0.25	0.00		
12	CB22-bypass	0.23	0 12:08	17.81	0.01	2.54	3.25	0.06	0.19	0.00		
13	CB23-bypass	5.74	0 12:09	14.74	0.39	4.18	0.46	0.21	0.70	0.00		
14	CB24-bypass	13.05	0 12:09	20.69	0.63	6.66	1.04	0.25	0.84	0.00		
15	CB25-bypass	1.21	0 12:07	19.24	0.06	3.54	1.08	0.11	0.35	0.00		
16	CB26-bypass	19.43	0 12:03	19.43	1.00	6.98	0.16	0.30	1.00	11.00		
17	CB27-bypass	18.10	0 12:08	20.60	0.88	7.21	1.31	0.29	0.95	0.00		
18	CB28-bypass	0.86	0 12:06	9.06	0.10	2.26	0.66	0.12	0.41	0.00		
19	CB31-bypass	0.37	0 12:08	9.99	0.04	2.52	4.04	0.09	0.28	0.00		
20	CB5-bypass	0.32	0 12:10	7.89	0.04	1.98	7.09	0.09	0.29	0.00		
21	CB7-bypass	2.28	0 12:08	7.35	0.31	1.78	0.96	0.19	0.63	0.00		
22	CB8-bypass	2.67	0 12:12	6.33	0.42	1.83	0.77	0.22	0.72	0.00		
23	CB9-bypass	2.62	0 12:15	10.65	0.25	2.70	1.21	0.18	0.59	0.00		
24	CBFD-bypass	0.71	0 12:06	8.47	0.08	2.06	0.83	0.12	0.39	0.00		
25	EX32-bypass	1.78	0 12:07	7.51	0.24	2.38	1.09	0.17	0.58	0.00		
26	EX33-bypass	0.68	0 12:06	9.39	0.07	2.17	0.54	0.11	0.37	0.00		
27	Outfall-1	41.86	0 12:04	450.45	0.09	12.00	0.46	1.10	0.37	0.00		
28	Outfall-2_1	22.17	0 12:07	62.70	0.35	5.37	0.16	1.32	0.66	0.00		
29	Outfall-2_2	42.51	0 12:06	42.51	1.00	8.10	0.10	1.50	1.00	2.00		
30	Outfall-2_3	13.29	0 12:01	280.21	0.05	6.22	0.13	0.82	0.27	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 11-Oct	190.10	390.40	0.00	386.00	0.10	4.40	2.3100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
2 101-7	198.47	394.70	0.00	394.20	0.00	0.50	0.2500	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
3 102-17	166.34	371.90	0.00	366.60	1.20	5.30	3.1900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
4 12-Nov	57.91	385.90	0.00	384.60	0.40	1.30	2.2400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
5 14-Dec	434.45	384.20	0.00	374.40	0.00	9.80	2.2600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
6 13-14	34.67	376.40	0.00	374.70	0.30	1.70	4.9000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
7 14-102	152.21	374.40	0.00	372.00	0.10	2.40	1.5800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
8 5-Jan	110.54	396.00	0.00	395.30	0.10	0.70	0.6300	CIRCULAR	8.040	8.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
9 15-102	32.43	372.30	0.00	372.00	0.10	0.30	0.9300	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
10 16-17	60.89	368.30	0.00	365.50	0.10	2.80	4.6000	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
11 17-2	244.52	365.40	0.00	354.80	0.00	10.60	4.3400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
12 18-17	38.21	366.80	0.00	366.50	1.10	0.30	0.7900	CIRCULAR	8.040	8.040	0.0150	0.5000	0.5000	0.0000	0.00	No	1
13 19-2	30.83	356.70	0.00	354.80	0.00	1.90	6.1600	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
14 20-2	8.74	355.20	0.00	354.90	0.10	0.30	3.4300	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
15 21-22	113.00	330.30	0.00	327.80	0.10	2.50	2.2100	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
16 22-23	113.71	327.70	0.00	324.50	0.60	3.20	2.8100	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
17 23-24	115.91	323.90	0.00	320.20	0.10	3.70	3.1900	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
18 24-25	276.64	320.10	0.00	306.00	0.00	14.10	5.1000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
19 25-26	138.90	306.00	0.00	299.10	0.20	6.90	4.9700	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
20 26-27	68.30	298.90	0.00	295.60	0.10	3.30	4.8300	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
21 27-OUT2_1	35.92	295.50	0.00	294.50	-0.70	1.00	2.7800	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
22 28-3	26.48	268.90	0.00	268.80	0.10	0.10	0.3800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
23 2-OUT1	530.29	354.80	0.00	331.40	2.31	23.40	4.4100	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
24 1-Mar	16.51	397.50	0.00	397.20	1.20	0.30	1.8200	CIRCULAR	8.040	8.040	0.0110	0.5000	0.5000	0.0000	0.00	No	1
25 31-5	10.81	267.20	0.00	266.00	0.10	1.20	11.1000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
26 32-6	18.00	255.00	0.00	254.20	0.60	0.80	4.4400	CIRCULAR	6.000	6.000	0.0110	0.5000	0.5000	0.0000	0.00	No	2
27 33-out	40.00	253.10	0.00	250.00	0.00	3.10	7.7500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
28 4-Mar	62.53	268.70	0.00	268.20	0.10	0.50	0.8000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
29 5-Apr	21.75	268.10	0.00	266.00	0.10	2.10	9.6600	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
30 5-101	26.79	395.20	0.00	394.80	0.10	0.40	1.4900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
31 5-OUT2_3	51.22	265.90	0.00	264.50	0.00	1.40	2.7300	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
32 6-101	28.90	394.90	0.00	394.80	0.10	0.10	0.3500	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
33 6-out	165.00	253.60	0.00	250.00	0.00	3.60	2.1800	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
34 8-Jul	99.78	394.20	0.00	393.60	0.00	0.60	0.6000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
35 3-Aug	59.07	268.80	0.00	268.80	0.10	0.00	0.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
36 9-Aug	84.19	393.60	0.00	393.20	0.00	0.40	0.4800	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
37 10-Sep	194.56	393.20	0.00	390.40	0.00	2.80	1.4400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
38 Blake-3	20.00	268.90	0.00	268.70	0.00	0.20	1.0000	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
39 Culvert1	45.16	332.72	0.00	329.09	0.00	3.63	8.0400	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
40 Culvert2	55.47	270.70	0.00	268.32	0.00	2.38	4.2900	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
41 FH-8	60.93	269.10	269.10	268.80	0.00	0.30	0.4900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
42 FSP1-Out	20.00	273.00	0.00	272.60	1.90	0.40	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
43 FSP2-Out	178.00	272.00	0.00	269.00	0.10	3.00	1.6900	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
44 HILDRETH	100.00	395.90	0.00	394.90	0.00	1.00	1.0000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
45 O2_1	1093.34	294.00	0.00	294.00	45.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
46 O2_2	539.72	266.00	0.00	266.00	17.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
47 O2_3	246.53	262.00	0.00	262.00	13.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
48 O2_4	714.54	250.00	0.00	250.00	1.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 11-Oct	6.36	0 12:17	6.41	0.99	9.49	0.33	0.81	0.81	0.00		Calculated
2 101-7	1.68	0 11:15	1.55	1.08	2.33	1.42	1.00	1.00	161.00		SURCHARGED
3 102-17	5.96	0 11:48	5.51	1.08	8.20	0.34	1.00	1.00	143.00		SURCHARGED
4 12-Nov	6.76	0 12:46	6.31	1.07	9.31	0.10	1.00	1.00	48.00		SURCHARGED
5 14-Dec	5.02	0 11:45	4.64	1.08	6.94	1.04	1.00	1.00	85.00		SURCHARGED
6 13-14	7.00	0 12:25	6.84	1.02	10.03	0.06	0.91	0.91	0.00		> CAPACITY
7 14-102	4.20	0 10:57	3.88	1.08	5.77	0.44	1.00	1.00	263.00		SURCHARGED
8 5-Jan	1.23	0 11:45	1.14	1.08	3.83	0.48	0.67	1.00	56.00		SURCHARGED
9 15-102	3.19	0 13:14	2.97	1.08	4.39	0.12	1.00	1.00	79.00		SURCHARGED
10 16-17	5.68	0 12:22	19.52	0.29	9.57	0.11	0.55	0.37	0.00		Calculated
11 17-2	6.96	0 11:28	6.43	1.08	9.58	0.43	1.00	1.00	240.00		SURCHARGED
12 18-17	0.99	0 11:40	0.93	1.07	3.09	0.21	0.67	1.00	143.00		SURCHARGED
13 19-2	5.00	0 12:10	22.60	0.22	10.27	0.05	0.48	0.32	0.00		Calculated
14 20-2	1.13	0 12:07	5.72	0.20	5.66	0.03	0.30	0.30	0.00		Calculated
15 21-22	5.60	0 12:08	5.30	1.06	7.91	0.24	0.94	0.94	0.00		> CAPACITY
16 22-23	6.27	0 12:10	5.98	1.05	8.87	0.21	0.92	0.92	0.00		> CAPACITY
17 23-24	6.81	0 12:01	6.37	1.07	9.45	0.20	1.00	1.00	16.00		SURCHARGED
18 24-25	8.69	0 12:25	8.04	1.08	12.04	0.38	1.00	1.00	26.00		SURCHARGED
19 25-26	10.07	0 11:58	23.41	0.43	12.91	0.18	0.69	0.46	0.00		Calculated
20 26-27	15.36	0 12:07	49.73	0.31	13.94	0.08	0.76	0.38	0.00		Calculated
21 27-OUT2_1	20.44	0 12:07	20.67	0.99	7.50	0.08	1.62	0.81	0.00		Calculated
22 28-3	1.17	0 12:06	1.90	0.61	2.54	0.17	0.57	0.57	0.00		Calculated
23 2-OUT1	12.48	0 12:08	16.04	0.78	14.46	0.61	0.83	0.66	0.00		Calculated
24 1-Mar	2.07	0 12:31	1.93	1.08	6.35	0.04	0.67	1.00	38.00		SURCHARGED
25 31-5	2.08	0 12:06	11.87	0.18	11.35	0.02	0.28	0.28	0.00		Calculated
26 32-6	1.72	0 12:06	2.80	0.62	7.48	0.04	0.28	0.57	0.00		Calculated
27 33-out	1.02	0 12:06	9.92	0.10	8.15	0.08	0.22	0.22	0.00		Calculated
28 4-Mar	10.08	0 12:17	9.39	1.07	6.20	0.17	1.50	1.00	16.00		SURCHARGED
29 5-Apr	10.00	0 12:17	32.64	0.31	16.28	0.02	0.57	0.38	0.00		Calculated
30 5-101	1.73	0 12:06	3.77	0.46	4.70	0.10	0.48	0.48	0.00		Calculated
31 5-OUT2_3	11.83	0 12:01	17.37	0.68	10.58	0.08	0.91	0.61	0.00		Calculated
32 6-101	1.94	0 12:56	1.82	1.07	2.69	0.18	1.00	1.00	79.00		SURCHARGED
33 6-out	1.72	0 12:06	5.26	0.33	6.00	0.46	0.39	0.39	0.00		Calculated
34 8-Jul	2.59	0 11:57	2.39	1.08	3.57	0.47	1.00	1.00	33.00		SURCHARGED
35 3-Aug	0.19	0 12:40	0.17	1.08	0.27	3.65	1.00	1.00	61.00		SURCHARGED
36 9-Aug	2.30	0 11:37	2.13	1.08	3.16	0.44	1.00	1.00	122.00		SURCHARGED
37 10-Sep	4.01	0 12:07	3.70	1.08	5.53	0.59	1.00	1.00	28.00		SURCHARGED
38 Blake-3	9.75	0 12:18	9.10	1.07	5.94	0.06	1.50	1.00	16.00		SURCHARGED
39 Culvert1	27.82	0 12:03	25.81	1.08	16.83	0.04	1.50	1.00	24.00		SURCHARGED
40 Culvert2	41.40	0 12:07	46.86	0.88	16.83	0.05	1.46	0.73	0.00		Calculated
41 FH-8	0.93	0 12:06	2.17	0.43	2.65	0.38	0.46	0.46	0.00		Calculated
42 FSP1-Out	6.35	0 12:15	5.95	1.07	8.71	0.04	1.00	1.00	20.00		SURCHARGED
43 FSP2-Out	12.02	0 12:10	13.64	0.88	8.71	0.34	1.09	0.73	0.00		Calculated
44 HILDRETH	3.34	0 11:49	3.09	1.08	4.62	0.36	1.00	1.00	50.00		SURCHARGED
45 O2_1	22.17	0 12:07	0.00	1.08	0.00		1.00	1.00	50.00		SURCHARGED
46 O2_2	42.51	0 12:06	0.00	1.08	0.00		1.00	1.00	50.00		SURCHARGED
47 O2_3	13.29	0 12:01	0.00	1.08	0.00		1.00	1.00	50.00		SURCHARGED
48 O2_4	2.74	0 12:06	0.00	1.08	0.00		1.00	1.00	50.00		SURCHARGED

**Inlet Input**

SN ID	Element Manufacturer	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft <sup>2</sup> )	Grate Clogging Factor (%)
1	CB10	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.40	393.46	3.06	0.00	0.00	N/A	0.00
2	CB11	FHWA HEC-22 GENERIC	N/A	On Grade	1	385.90	389.50	3.60	0.00	0.00	N/A	0.00
3	CB12	FHWA HEC-22 GENERIC	N/A	On Grade	1	384.20	388.11	3.91	0.00	0.00	N/A	0.00
4	CB13	FHWA HEC-22 GENERIC	N/A	On Grade	1	376.40	378.90	2.50	0.00	0.00	N/A	0.00
5	CB14	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.40	378.76	4.36	0.00	0.00	N/A	0.00
6	CB15	FHWA HEC-22 GENERIC	N/A	On Grade	1	372.30	375.33	3.03	0.00	0.00	N/A	0.00
7	CB16	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.30	372.17	3.87	0.00	0.00	N/A	0.00
8	CB17	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.40	370.30	4.90	0.00	0.00	N/A	0.00
9	CB18	FHWA HEC-22 GENERIC	N/A	On Grade	1	366.80	369.76	2.96	0.00	0.00	N/A	0.00
10	CB19	FHWA HEC-22 GENERIC	N/A	On Grade	1	356.70	359.82	3.12	0.00	0.00	N/A	0.00
11	CB20	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.20	358.78	3.58	0.00	0.00	N/A	0.00
12	CB21	FHWA HEC-22 GENERIC	N/A	On Sag	1	330.30	333.30	3.00	0.00	0.00	0.00	0.00
13	CB22	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.70	330.74	3.04	0.00	0.00	N/A	0.00
14	CB23	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.90	328.70	4.80	0.00	0.00	N/A	0.00
15	CB24	FHWA HEC-22 GENERIC	N/A	On Grade	1	320.10	325.59	5.49	0.00	0.00	N/A	0.00
16	CB25	FHWA HEC-22 GENERIC	N/A	On Grade	1	306.00	311.32	5.32	0.00	0.00	N/A	0.00
17	CB26	FHWA HEC-22 GENERIC	N/A	On Grade	1	298.90	303.57	4.67	0.00	0.00	N/A	0.00
18	CB27	FHWA HEC-22 GENERIC	N/A	On Grade	1	295.50	300.38	4.88	0.00	0.00	N/A	0.00
19	CB28	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.90	270.47	1.57	0.00	0.00	N/A	0.00
20	CB3	FHWA HEC-22 GENERIC	N/A	On Sag	1	397.50	399.24	1.74	0.00	0.00	0.00	0.00
21	CB31	FHWA HEC-22 GENERIC	N/A	On Grade	1	267.20	269.04	1.84	0.00	0.00	N/A	0.00
22	CB5	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.20	398.31	3.11	0.00	0.00	N/A	0.00
23	CB6	FHWA HEC-22 GENERIC	N/A	On Sag	1	394.90	398.92	4.02	0.00	0.00	0.00	0.00
24	CB7	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.20	397.14	2.94	0.00	0.00	N/A	0.00
25	CB8	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.60	396.62	3.02	0.00	0.00	N/A	0.00
26	CB9	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.20	396.20	3.00	0.00	0.00	N/A	0.00
27	CBFD	FHWA HEC-22 GENERIC	N/A	On Grade	1	0.00	271.90	271.90	269.00	269.00	N/A	0.00
28	EXCB-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	2.18	0.00	0.00	N/A	0.00
29	EXCB-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	3.80	0.00	0.00	N/A	0.00

**Roadway & Gutter Input**

SN Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1 CB10	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
2 CB11	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
3 CB12	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
4 CB13	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
5 CB14	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
6 CB15	0.0260	0.0200	0.0130	0.0200	3.00	0.0000	7.00
7 CB16	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
8 CB17	0.0220	0.0200	0.0130	0.0200	3.00	0.0000	7.00
9 CB18	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
10 CB19	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
11 CB20	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
12 CB21	N/A	0.0200	0.0130	0.0200	3.00	0.0000	7.00
13 CB22	0.0200	0.0200	0.0130	0.0200	3.00	0.0000	7.00
14 CB23	0.0200	0.0200	0.0130	0.0200	3.00	0.0000	7.00
15 CB24	0.0300	0.0200	0.0130	0.0200	3.00	0.0000	7.00
16 CB25	0.0550	0.0200	0.0130	0.0200	3.00	0.0000	7.00
17 CB26	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
18 CB27	0.0500	0.0200	0.0130	0.0200	3.00	0.0000	7.00
19 CB28	0.0170	0.0200	0.0130	0.0200	3.00	0.0000	7.00
20 CB3	N/A	0.0200	0.0130	0.0200	3.00	0.0000	7.00
21 CB31	0.0100	0.0200	0.0130	0.0620	2.00	0.0656	7.00
22 CB5	0.0050	0.0200	0.0130	0.0200	2.00	0.0000	7.00
23 CB6	N/A	0.0200	0.0160	0.0200	2.00	0.0000	7.00
24 CB7	0.0050	0.0200	0.0130	0.0200	3.00	0.0000	7.00
25 CB8	0.0065	0.0200	0.0130	0.0200	3.00	0.0000	7.00
26 CB9	0.0650	0.0200	0.0130	0.0200	3.00	0.0000	7.00
27 CBFD	0.0050	0.0200	0.0130	0.0200	3.00	0.0000	7.00
28 EXCB-32	0.0170	0.0200	0.0130	0.0200	3.00	0.0328	7.00
29 EXCB-33	0.0170	0.0200	0.0130	0.0200	2.00	0.0000	7.00

**Inlet Results**

SN Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Time of Max Depth Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1 CB10	6.30	3.71	2.67	3.63	42.32	11.46	393.69	0.23	0 12:07	0.00	0.00
2 CB11	13.60	10.01	4.46	9.14	32.79	15.37	389.81	0.31	0 11:56	2.35	53.00
3 CB12	2.82	2.58	1.52	1.31	53.72	8.51	388.28	0.17	0 11:37	2.77	94.00
4 CB13	31.23	22.74	6.84	24.39	21.91	20.91	379.32	0.42	0 12:23	0.00	2.00
5 CB14	2.63	1.35	1.44	1.19	54.76	8.30	378.93	0.17	0 10:42	13.49	280.00
6 CB15	27.19	13.56	6.23	20.96	22.91	19.19	375.71	0.38	0 11:53	2.81	85.00
7 CB16	21.49	6.60	5.68	15.81	26.43	18.19	372.53	0.36	0 12:21	0.00	0.00
8 CB17	2.23	1.06	1.28	0.95	57.51	7.76	370.46	0.16	0 10:58	10.47	262.00
9 CB18	17.51	1.78	4.54	12.97	25.91	14.49	370.05	0.29	0 11:37	4.11	150.00
10 CB19	22.25	10.77	4.97	17.27	22.36	15.77	360.14	0.32	0 12:10	0.00	0.00
11 CB20	1.67	0.74	1.13	0.54	67.58	5.98	358.90	0.12	0 12:07	0.00	0.00
12 CB21	5.78	5.78	N/A	N/A	N/A	24.44	333.76	0.46	0 12:05	0.00	0.00
13 CB22	0.82	0.82	0.60	0.22	73.33	5.45	330.85	0.11	0 12:06	0.01	4.00
14 CB23	9.15	9.15	3.41	5.74	37.25	13.40	328.97	0.27	0 12:00	0.59	19.00
15 CB24	18.10	12.46	5.02	13.08	27.72	16.09	325.91	0.32	0 11:56	1.05	28.00
16 CB25	2.94	2.73	1.73	1.21	58.82	7.28	311.47	0.15	0 11:59	0.00	0.00
17 CB26	30.81	17.77	5.61	25.21	18.19	17.82	303.93	0.36	0 11:58	0.00	0.00
18 CB27	23.18	3.75	5.07	18.11	21.88	16.05	300.70	0.32	0 12:07	0.00	0.00
19 CB28	2.03	1.32	1.17	0.86	57.52	7.89	270.63	0.16	0 12:06	0.00	0.00
20 CB3	5.66	5.66	N/A	N/A	N/A	24.12	399.69	0.45	0 11:51	0.00	0.00
21 CB31	1.59	1.59	1.22	0.36	77.15	7.01	269.26	0.22	0 12:06	0.00	0.00
22 CB5	0.91	0.91	0.60	0.31	65.95	7.35	398.46	0.15	0 11:45	0.00	0.00
23 CB6	1.51	1.51	N/A	N/A	N/A	10.59	399.11	0.19	0 11:34	0.00	0.00
24 CB7	4.06	4.06	1.77	2.29	43.67	12.86	397.40	0.26	0 11:50	0.32	41.00
25 CB8	4.62	2.71	1.95	2.67	42.28	12.86	396.88	0.26	0 11:10	1.87	153.00
26 CB9	4.96	2.39	2.33	2.63	46.99	8.56	396.37	0.17	0 12:00	0.28	35.00
27 CBFD	1.64	1.64	0.93	0.71	56.76	9.13	272.08	0.18	0 12:06	0.00	0.00
28 EXCB-32	3.50	3.18	1.72	1.78	49.20	9.68	257.37	0.19	0 12:06	0.00	0.00
29 EXCB-33	1.70	1.70	1.03	0.67	60.34	7.38	257.05	0.15	0 12:06	0.00	0.00



## Storage Nodes

### Storage Node : FSP-1

#### Input Data

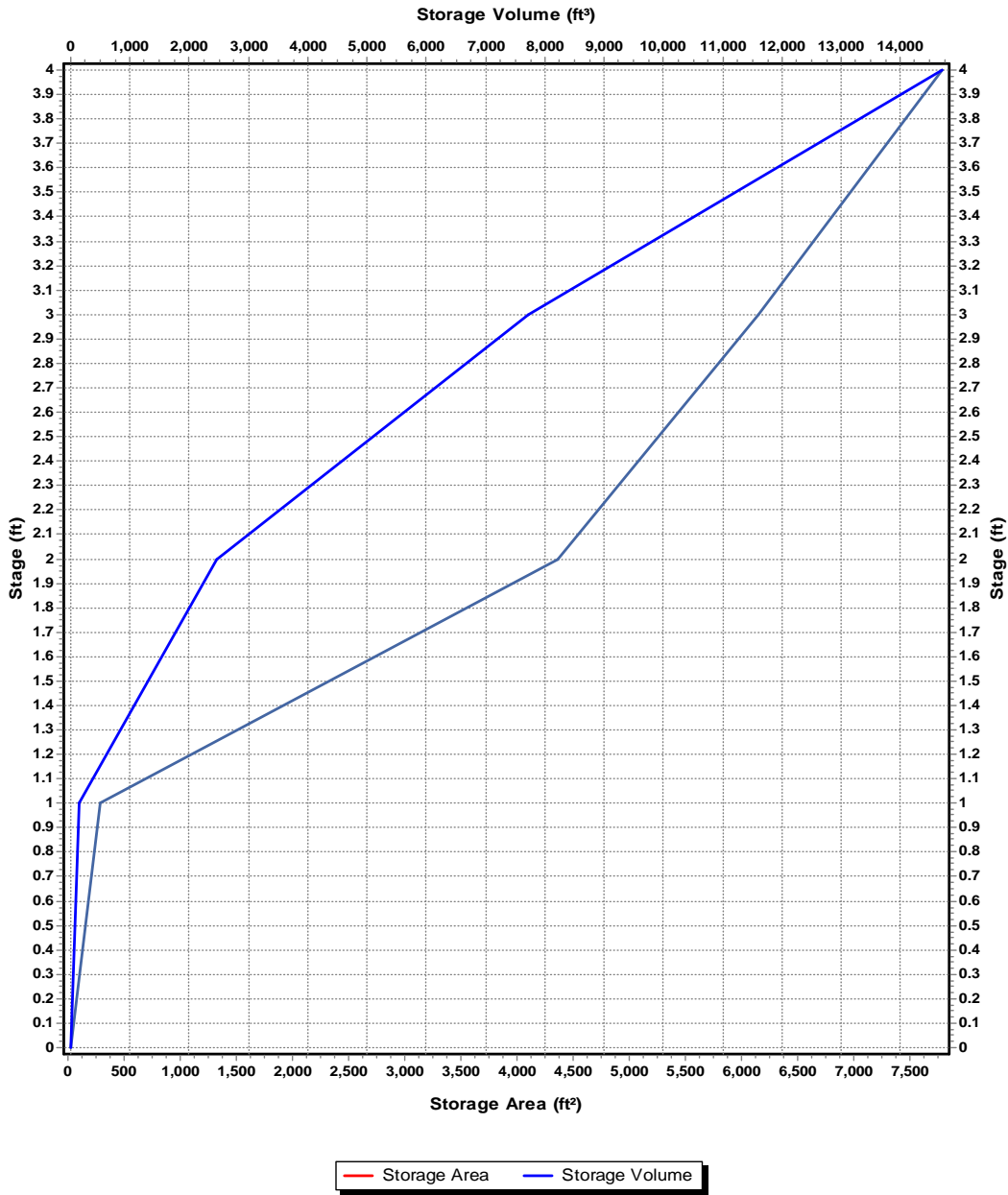
Invert Elevation (ft) ..... 272  
Max (Rim) Elevation (ft) ..... 276  
Max (Rim) Offset (ft) ..... 4  
Initial Water Elevation (ft) ..... 272  
Initial Water Depth (ft) ..... 0  
Ponded Area (ft<sup>2</sup>) ..... 0  
Evaporation Loss ..... 0

#### Storage Area Volume Curves

Storage Curve : FH-Pond1

Stage	Storage Area	Storage Volume
(ft)	(ft <sup>2</sup> )	(ft <sup>3</sup> )
0	20	0
1	277	148.5
2	4361	2467.5
3	6157	7726.5
4	7794	14702

### Storage Area Volume Curves



**Storage Node : FSP-1 (continued)**

**Outflow Orifices**

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	FSP1-1	Side	CIRCULAR	No	8.00			274.00	0.60
2	FSP1-2	Side	CIRCULAR	No	12.00			274.12	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	13.08
Peak Lateral Inflow (cfs) .....	13.08
Peak Outflow (cfs) .....	6.11
Peak Exfiltration Flow Rate (cfm) .....	10.55
Max HGL Elevation Attained (ft) .....	275.79
Max HGL Depth Attained (ft) .....	3.79
Average HGL Elevation Attained (ft) .....	272.58
Average HGL Depth Attained (ft) .....	0.58
Time of Max HGL Occurrence (days hh:mm) .....	0 12:20
Total Exfiltration Volume (1000-ft <sup>3</sup> ) .....	11.253
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : FSP-2**

**Input Data**

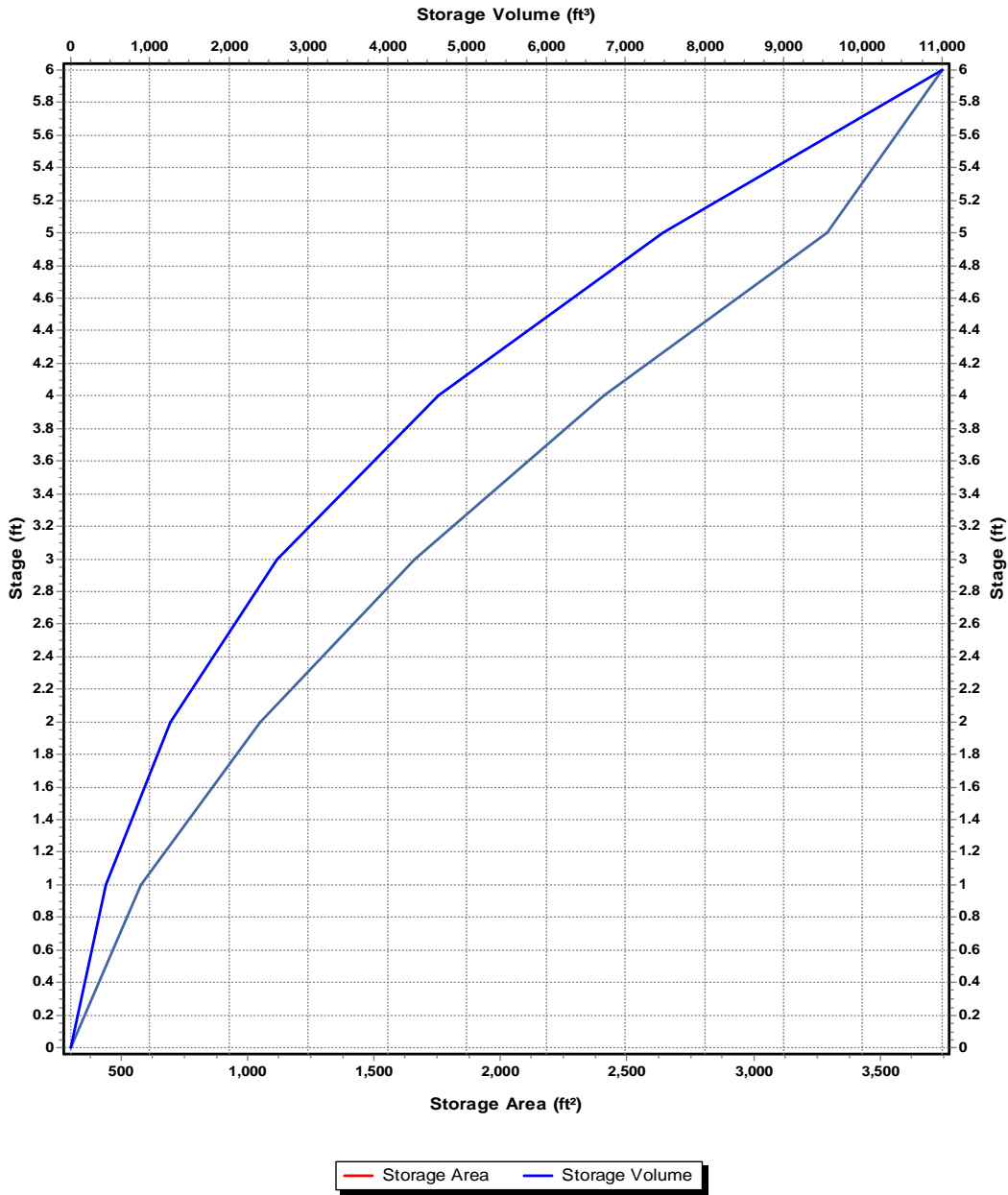
Invert Elevation (ft) .....	270
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	6
Initial Water Elevation (ft) .....	270
Initial Water Depth (ft) .....	0
Ponded Area (ft²) .....	0
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : FH-Pond2

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	300	0
1	578	439
2	1048	1252
3	1659	2605.5
4	2406	4638
5	3289	7485.5
6	3746	11003

### Storage Area Volume Curves



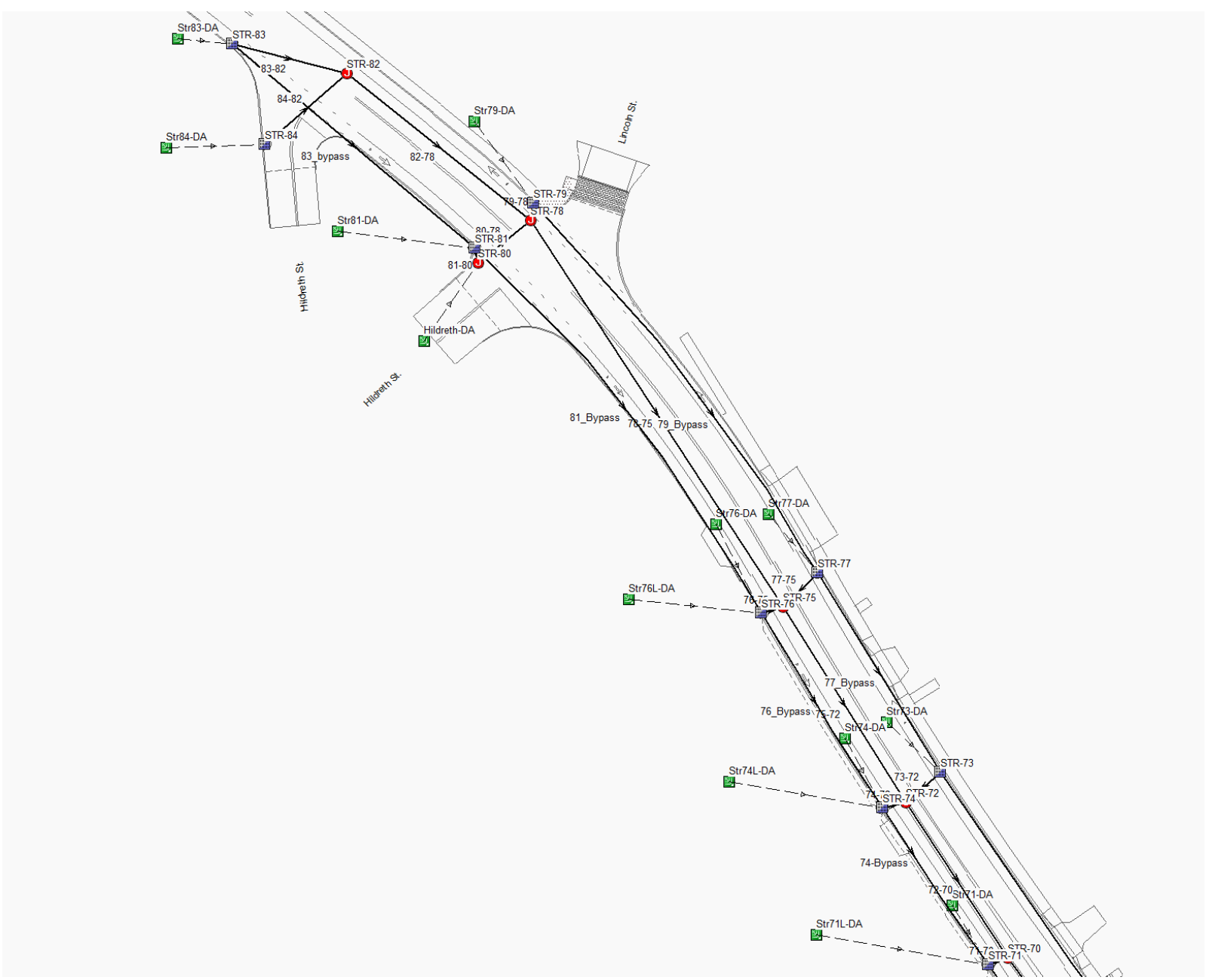
**Storage Node : FSP-2 (continued)**

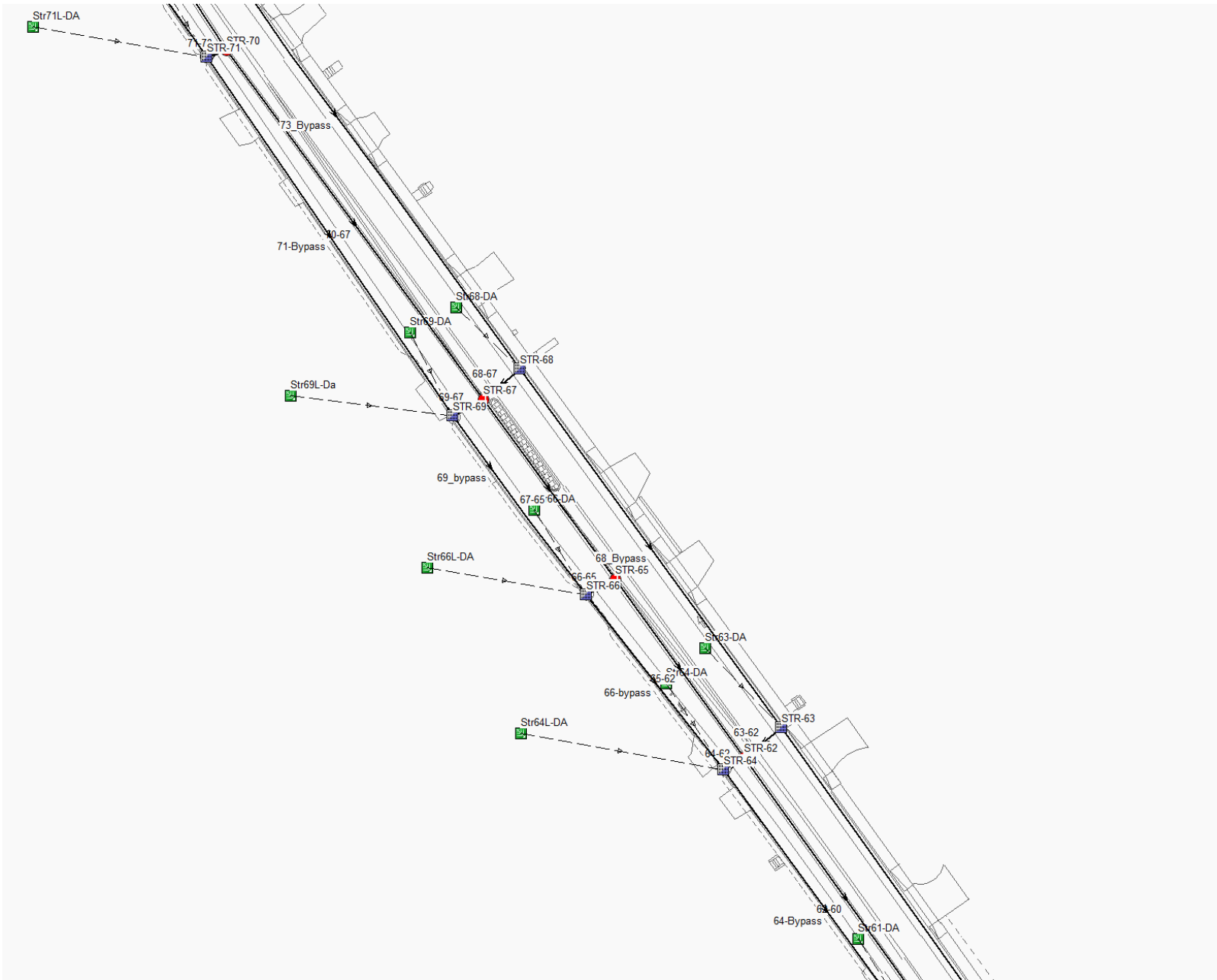
**Outflow Orifices**

SN ID	Element Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	FSP2-1	Side	CIRCULAR No	8.00			273.00	0.60
2	FSP2-2	Side	CIRCULAR No	15.00			273.25	0.60
3	FSP2-3	Side	CIRCULAR No	15.00			273.50	0.60

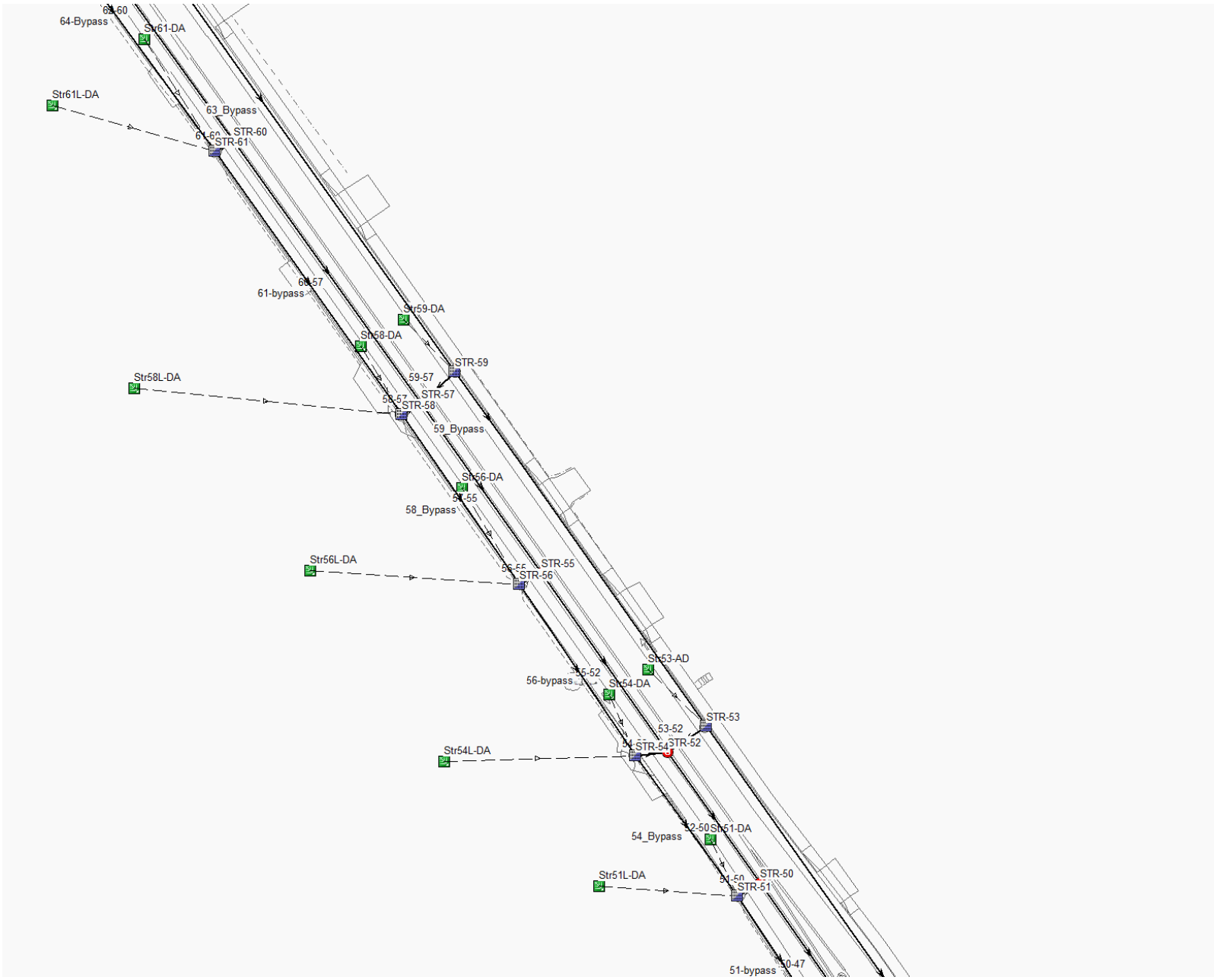
**Output Summary Results**

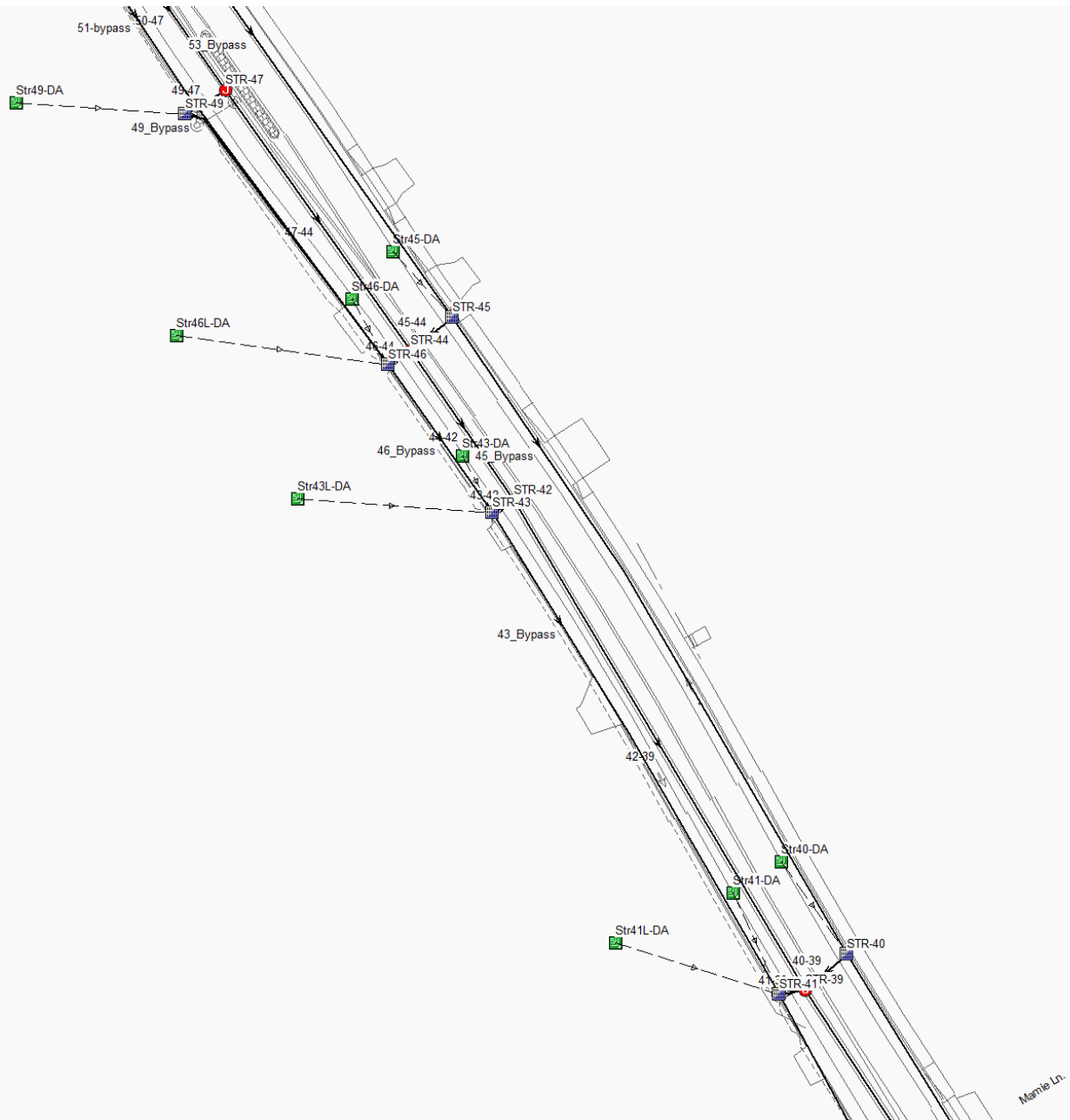
Peak Inflow (cfs) .....	13.48
Peak Lateral Inflow (cfs) .....	13.48
Peak Outflow (cfs) .....	12.03
Peak Exfiltration Flow Rate (cfm) .....	4.32
Max HGL Elevation Attained (ft) .....	274.73
Max HGL Depth Attained (ft) .....	4.73
Average HGL Elevation Attained (ft) .....	270.99
Average HGL Depth Attained (ft) .....	0.99
Time of Max HGL Occurrence (days hh:mm) .....	0 12:10
Total Exfiltration Volume (1000-ft³) .....	6.431
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

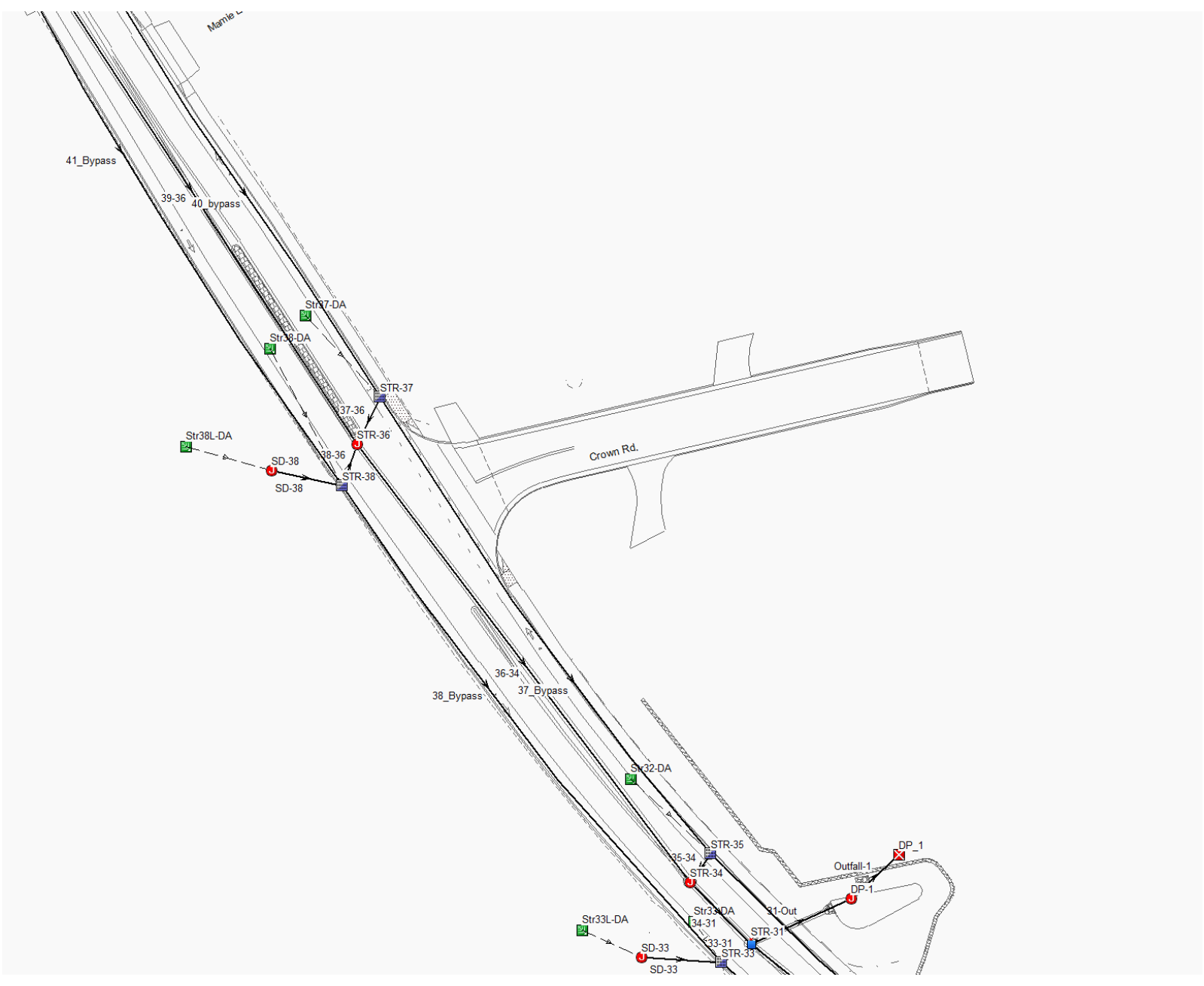


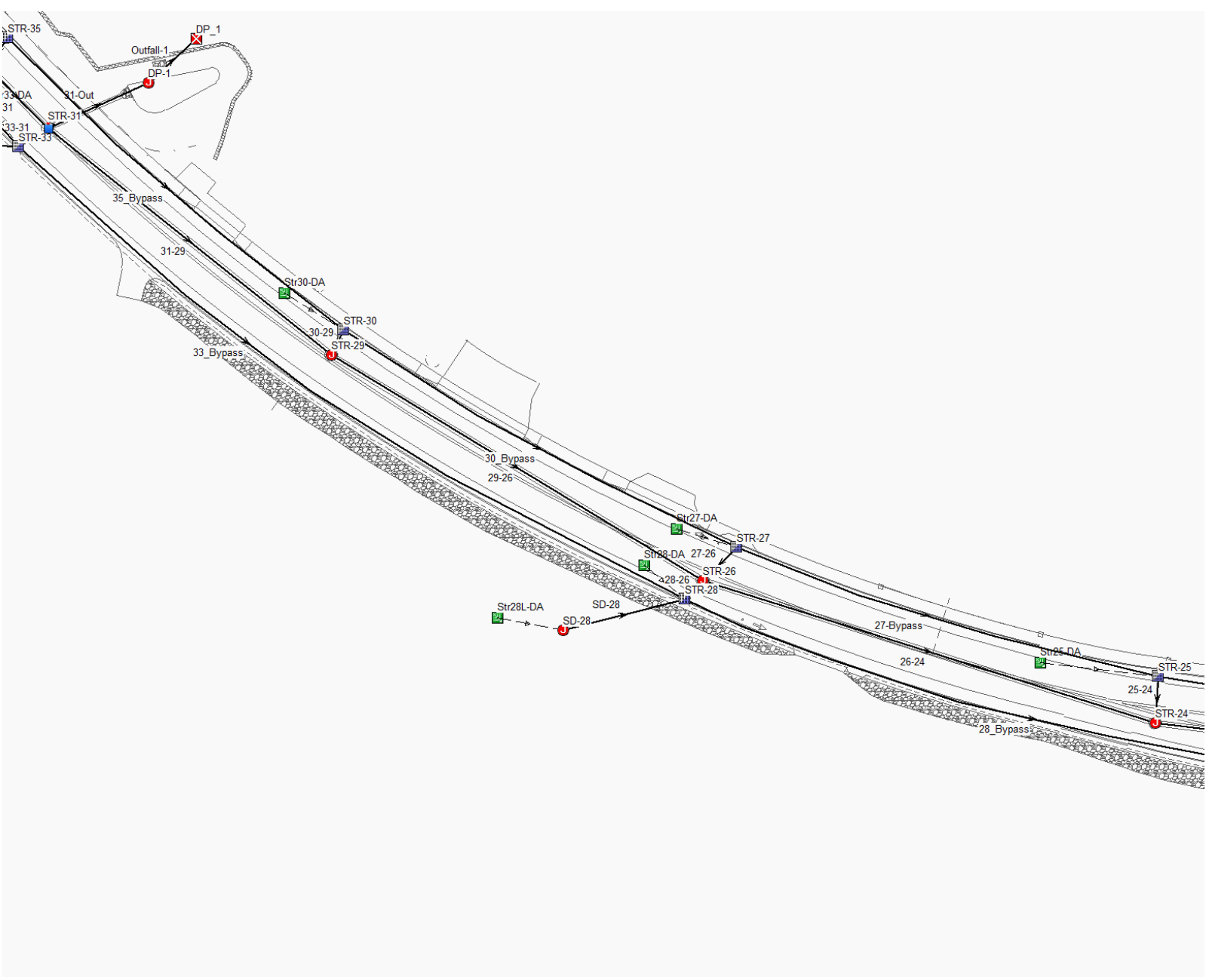


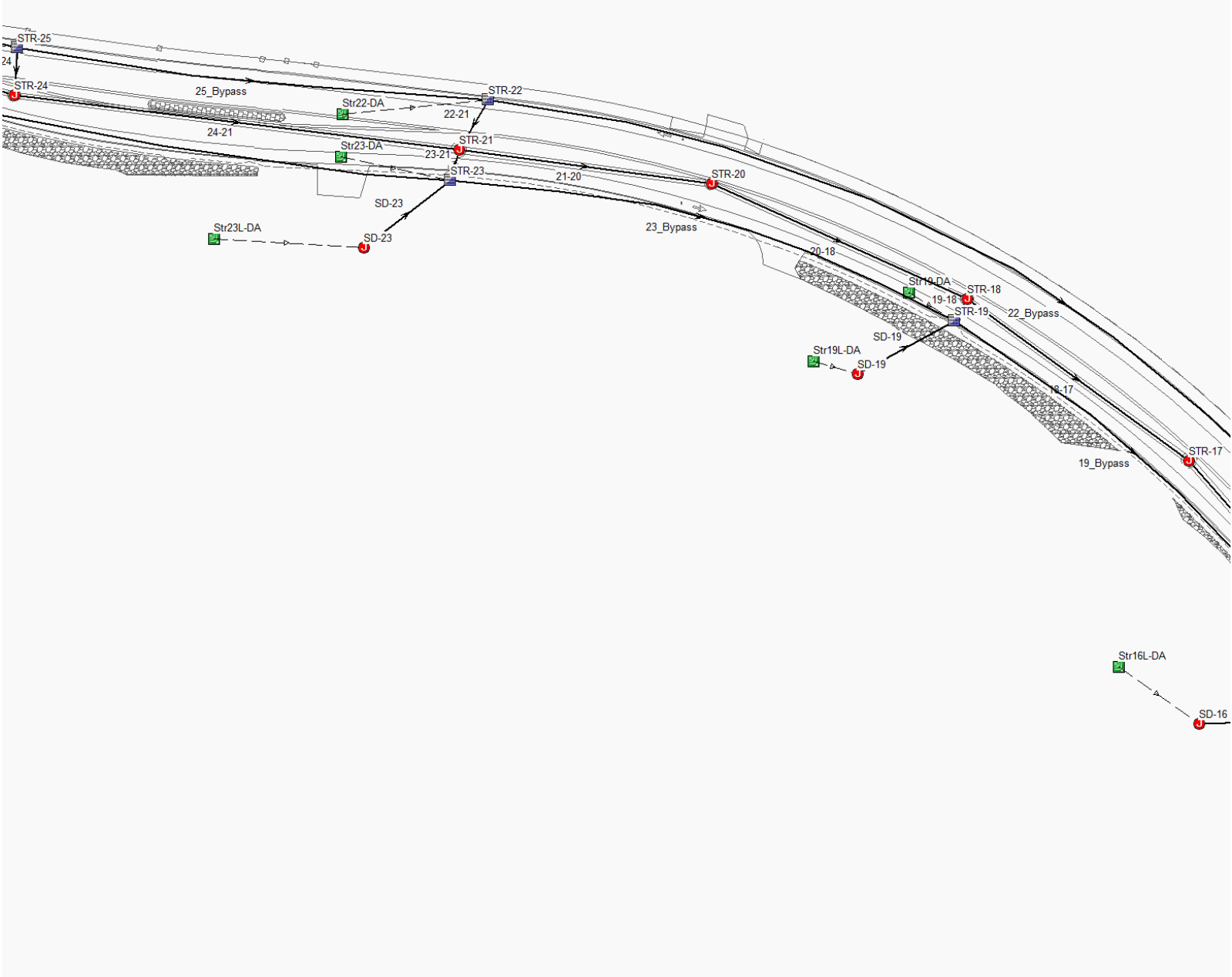


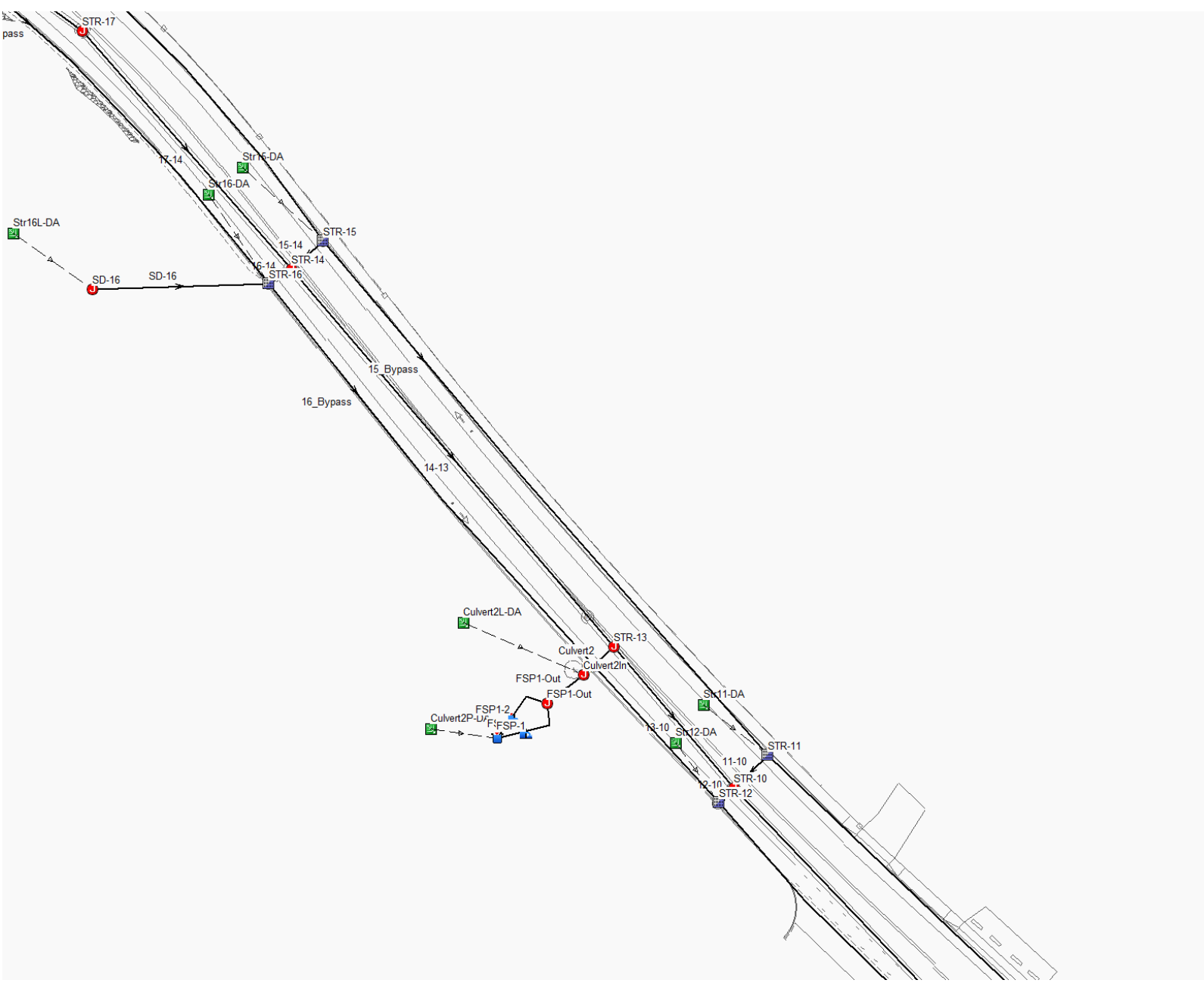


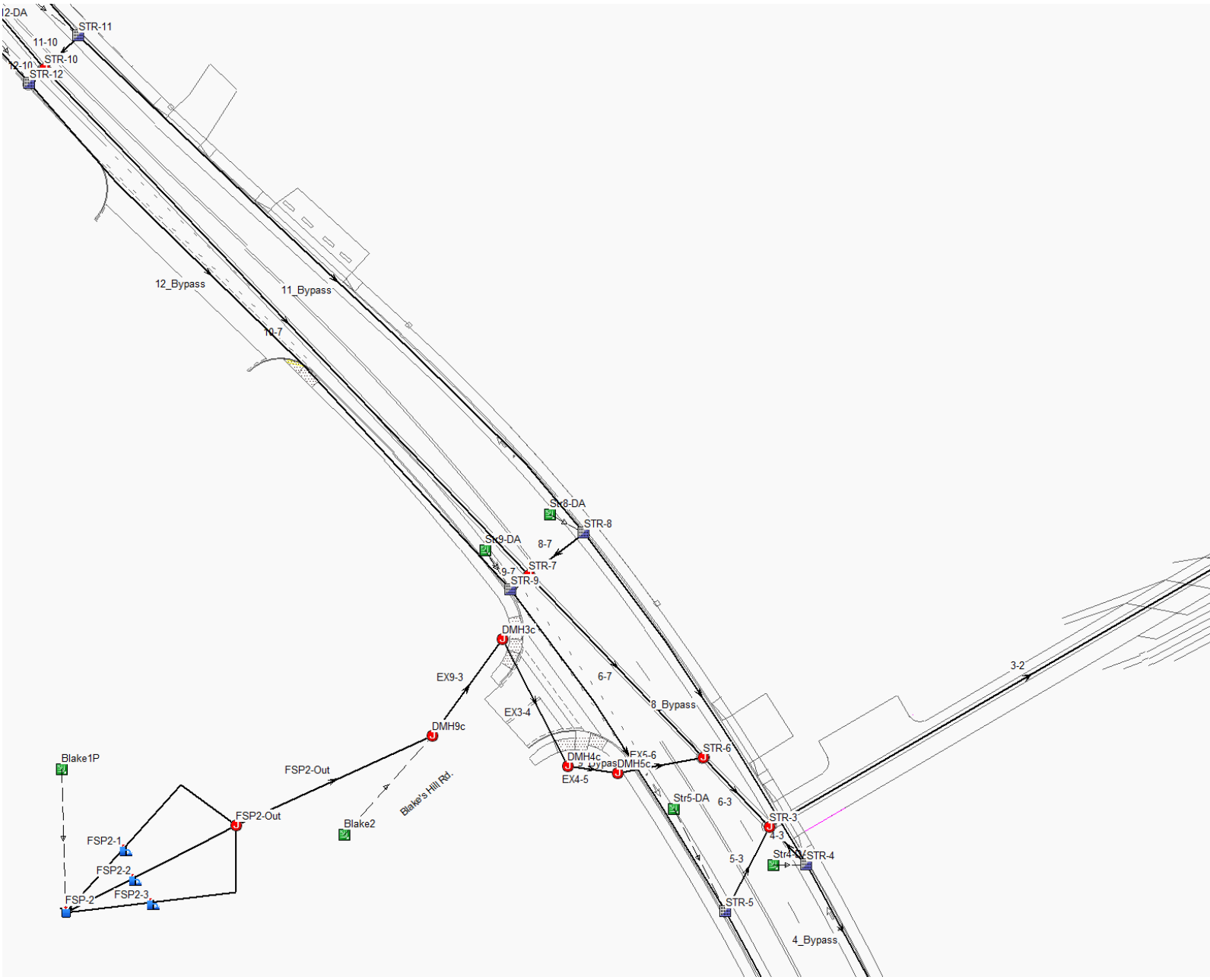






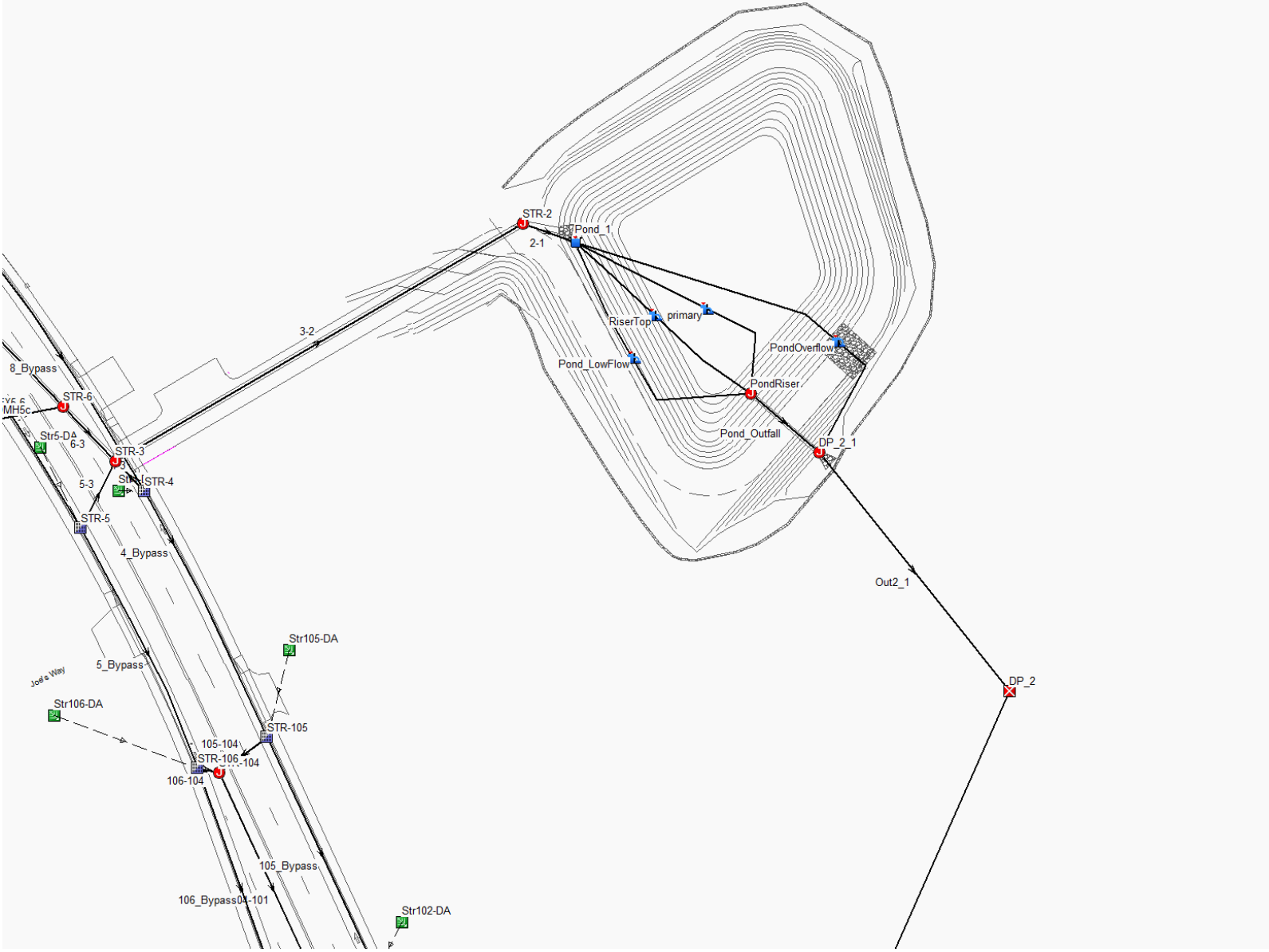












### Project Description

File Name ..... Boston Rd - Post Dev - 20230227.SPF

### Project Options

Flow Units ..... CFS  
 Elevation Type ..... Elevation  
 Hydrology Method ..... SCS TR-55  
 Time of Concentration (TOC) Method ..... SCS TR-55  
 Link Routing Method ..... Kinematic Wave  
 Enable Overflow Ponding at Nodes ..... YES  
 Skip Steady State Analysis Time Periods ... YES

### Analysis Options

Start Analysis On ..... 00:00:00      0:00:00  
 End Analysis On ..... 00:00:00      0:00:00  
 Start Reporting On ..... 00:00:00      0:00:00  
 Antecedent Dry Days ..... 0      days  
 Runoff (Dry Weather) Time Step ..... 0 01:00:00      days hh:mm:ss  
 Runoff (Wet Weather) Time Step ..... 0 00:05:00      days hh:mm:ss  
 Reporting Time Step ..... 0 00:00:02      days hh:mm:ss  
 Routing Time Step ..... 2      seconds

### Number of Elements

Qty  
 Rain Gages ..... 1  
 Subbasins ..... 77  
 Nodes ..... 115  
     *Junctions* ..... 55  
     *Outfalls* ..... 4  
     *Flow Diversions* ..... 0  
     *Inlets* ..... 52  
     *Storage Nodes* ..... 4  
 Links ..... 169  
     *Channels* ..... 52  
     *Pipes* ..... 108  
     *Pumps* ..... 0  
     *Orifices* ..... 8  
     *Weirs* ..... 1  
     *Outlets* ..... 0  
 Pollutants ..... 0  
 Land Uses ..... 0

### Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	002-yr	Cumulative	inches	Massachusetts	Middlesex	2.00	3.17	SCS Type III 24-hr

**Subbasin Summary**

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Blake1P	2.66	484.00	78.70	3.17	1.30	3.44	3.44	0 00:07:38
2	Blake2	0.57	484.00	82.10	3.17	1.52	0.87	0.91	0 00:05:00
3	Culvert2L-DA	1.39	484.00	70.20	3.17	0.82	1.14	1.07	0 00:07:35
4	Culvert2P-DA	2.87	484.00	73.50	3.17	0.99	2.84	2.76	0 00:07:33
5	EX32-DA	0.21	484.00	98.00	3.17	2.94	0.62	0.56	0 00:05:00
6	EX33-DA	0.16	484.00	98.00	3.17	2.94	0.47	0.42	0 00:05:00
7	Hildreth-DA	2.35	484.00	87.00	3.17	1.89	4.43	3.81	0 00:15:35
8	Str102-DA	0.08	484.00	98.00	3.17	2.93	0.24	0.22	0 00:05:00
9	Str103-DA	0.13	484.00	98.00	3.17	2.93	0.37	0.34	0 00:05:00
10	Str105-DA	0.03	484.00	98.00	3.17	2.73	0.08	0.07	0 00:05:00
11	Str106-DA	0.16	484.00	98.00	3.17	2.94	0.46	0.41	0 00:05:00
12	Str11-DA	0.22	484.00	98.00	3.17	2.94	0.65	0.59	0 00:05:00
13	Str12-DA	0.04	484.00	98.00	3.17	2.90	0.11	0.10	0 00:05:00
14	Str15-DA	0.13	484.00	98.00	3.17	2.93	0.37	0.34	0 00:05:00
15	Str16-DA	0.16	484.00	98.00	3.17	2.94	0.48	0.44	0 00:05:00
16	Str16L-DA	1.77	484.00	71.30	3.17	0.88	1.55	1.47	0 00:07:39
17	Str19-DA	0.16	484.00	98.00	3.17	2.94	0.48	0.42	0 00:05:00
18	Str19L-DA	1.85	484.00	74.00	3.17	1.02	1.89	1.84	0 00:07:36
19	Str22-DA	0.14	484.00	97.20	3.17	2.85	0.40	0.37	0 00:05:00
20	Str23-DA	0.08	484.00	98.00	3.17	2.93	0.25	0.22	0 00:05:00
21	Str23L-DA	4.70	484.00	77.10	3.17	1.20	5.62	5.28	0 00:10:18
22	Str25-DA	0.19	484.00	94.00	3.17	2.51	0.47	0.47	0 00:05:00
23	Str27-DA	0.15	484.00	97.80	3.17	2.91	0.44	0.39	0 00:05:00
24	Str28-DA	0.05	484.00	98.00	3.17	2.91	0.14	0.12	0 00:05:00
25	Str28L-DA	4.17	484.00	75.40	3.17	1.10	4.57	3.78	0 00:15:31
26	Str30-DA	0.15	484.00	98.00	3.17	2.94	0.44	0.41	0 00:05:00
27	Str32-DA	0.20	484.00	98.00	3.17	2.94	0.58	0.52	0 00:05:00
28	Str33-DA	0.04	484.00	98.00	3.17	2.91	0.12	0.12	0 00:05:00
29	Str33L-DA	3.18	484.00	75.40	3.17	1.10	3.48	3.25	0 00:09:58
30	Str37-DA	0.13	484.00	98.00	3.17	2.93	0.39	0.36	0 00:05:00
31	Str38-DA	0.13	484.00	98.00	3.17	2.93	0.37	0.34	0 00:05:00
32	Str38L-DA	3.72	484.00	73.30	3.17	0.98	3.65	2.88	0 00:16:32
33	Str40-DA	0.14	484.00	98.00	3.17	2.93	0.42	0.37	0 00:05:00
34	Str41-DA	0.09	484.00	98.00	3.17	2.93	0.25	0.22	0 00:05:00
35	Str41L-DA	2.56	484.00	72.10	3.17	0.92	2.35	1.48	0 00:29:12
36	Str43-DA	0.03	484.00	98.00	3.17	2.73	0.07	0.07	0 00:05:00
37	Str43L-DA	0.50	484.00	73.70	3.17	1.00	0.50	0.33	0 00:28:52
38	Str45-DA	0.14	484.00	98.00	3.17	2.93	0.41	0.37	0 00:05:00
39	Str46-DA	0.09	484.00	98.00	3.17	2.93	0.25	0.24	0 00:05:00
40	Str46L-DA	2.20	484.00	76.40	3.17	1.16	2.54	1.59	0 00:32:46
41	Str49-DA	2.20	484.00	74.20	3.17	1.03	2.26	1.35	0 00:35:03
42	Str4-DA	0.04	484.00	98.00	3.17	2.91	0.12	0.12	0 00:05:00
43	Str51-DA	0.03	484.00	98.00	3.17	2.84	0.09	0.08	0 00:05:00
44	Str51L-DA	2.40	484.00	73.30	3.17	0.98	2.35	1.42	0 00:33:27
45	Str53-AD	0.09	484.00	98.00	3.17	2.93	0.27	0.24	0 00:05:00
46	Str54-DA	0.04	484.00	98.00	3.17	2.84	0.10	0.08	0 00:05:00
47	Str54L-DA	2.11	484.00	77.00	3.17	1.19	2.51	1.51	0 00:35:59
48	Str56-DA	0.04	484.00	98.00	3.17	2.84	0.10	0.08	0 00:05:00
49	Str56L-DA	2.12	484.00	75.30	3.17	1.09	2.32	1.34	0 00:38:02
50	Str58-DA	0.64	484.00	98.00	3.17	2.94	1.88	1.69	0 00:05:00
51	Str58L-DA	1.70	484.00	77.60	3.17	1.23	2.08	1.25	0 00:36:25
52	Str59-DA	0.14	484.00	98.00	3.17	2.93	0.42	0.37	0 00:05:00
53	Str5-DA	0.26	484.00	92.40	3.17	2.36	0.61	0.60	0 00:05:00
54	Str61-DA	0.06	484.00	98.00	3.17	2.92	0.16	0.15	0 00:05:00
55	Str61L-DA	1.75	484.00	78.20	3.17	1.26	2.21	1.38	0 00:33:46
56	Str63-DA	0.10	484.00	98.00	3.17	2.93	0.28	0.25	0 00:05:00
57	Str64-DA	0.05	484.00	98.00	3.17	2.91	0.15	0.14	0 00:05:00
58	Str64L-DA	1.30	484.00	79.10	3.17	1.32	1.72	1.23	0 00:24:45
59	Str66-DA	0.05	484.00	98.00	3.17	2.91	0.13	0.12	0 00:05:00
60	Str66L-DA	1.47	484.00	78.90	3.17	1.31	1.93	1.38	0 00:24:34
61	Str68-DA	0.13	484.00	98.00	3.17	2.93	0.38	0.34	0 00:05:00
62	Str69-DA	0.09	484.00	98.00	3.17	2.93	0.26	0.24	0 00:05:00
63	Str69L-Da	0.93	484.00	80.20	3.17	1.39	1.30	0.95	0 00:23:42
64	Str71-DA	0.03	484.00	98.00	3.17	2.84	0.09	0.08	0 00:05:00
65	Str71L-DA	0.58	484.00	84.90	3.17	1.72	0.99	0.73	0 00:24:16
66	Str73-DA	0.05	484.00	98.00	3.17	2.91	0.15	0.14	0 00:05:00
67	Str74-DA	0.04	484.00	98.00	3.17	2.90	0.11	0.10	0 00:05:00
68	Str74L-DA	0.64	484.00	83.60	3.17	1.63	1.05	0.93	0 00:14:21
69	Str76-DA	0.18	484.00	98.00	3.17	2.94	0.53	0.47	0 00:05:00
70	Str76L-DA	0.63	484.00	83.00	3.17	1.58	1.00	0.89	0 00:14:12
71	Str77-DA	0.10	484.00	98.00	3.17	2.93	0.28	0.25	0 00:05:00
72	Str79-DA	0.15	484.00	98.00	3.17	2.94	0.44	0.39	0 00:05:00
73	Str81-DA	0.28	484.00	89.00	3.17	2.05	0.58	0.59	0 00:05:00
74	Str83-DA	0.10	484.00	89.90	3.17	2.13	0.22	0.22	0 00:05:00
75	Str84-DA	1.00	484.00	82.60	3.17	1.56	1.55	1.35	0 00:14:42

**Subbasin Summary**

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
76 Str8-DA	0.14	484.00	98.00	3.17	2.93	0.42	0.37	0 00:05:00
77 Str9-DA	0.23	484.00	86.30	3.17	1.83	0.42	0.44	0 00:05:00

**Node Summary**

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft <sup>2</sup> )	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert2In	Junction	270.70	274.50	270.70	274.50	0.00	1.07	272.80	0.00	1.70	0 00:00	0.00	0.00
2	DMH3c	Junction	268.70	271.83	268.70	271.83	0.00	2.33	269.21	0.00	2.62	0 00:00	0.00	0.00
3	DMH4c	Junction	268.10	271.22	268.10	271.22	0.00	2.33	268.71	0.00	2.51	0 00:00	0.00	0.00
4	DMH5c	Junction	265.90	269.46	265.90	269.46	0.00	2.33	266.27	0.00	3.19	0 00:00	0.00	0.00
5	DMH6c	Junction	253.60	258.48	253.60	258.48	0.00	1.59	255.49	0.00	2.99	0 00:00	0.00	0.00
6	DMH9c	Junction	268.90	271.70	268.90	271.70	0.00	2.33	269.38	0.00	2.32	0 00:00	0.00	0.00
7	DP_2_1	Junction	249.00	255.00	249.00	255.00	0.00	16.05	250.09	0.00	6.31	0 00:00	0.00	0.00
8	DP_2_2	Junction	250.00	256.00	250.00	256.00	0.00	2.05	250.38	0.00	5.62	0 00:00	0.00	0.00
9	DP-1	Junction	327.00	336.00	327.00	336.00	0.00	15.36	328.68	0.00	7.32	0 00:00	0.00	0.00
10	FSP1-Out	Junction	273.00	276.00	273.00	276.00	7794.00	0.51	273.20	0.00	2.92	0 00:00	0.00	0.00
11	FSP2-Out	Junction	272.00	276.00	272.00	276.00	3746.00	1.90	272.38	0.00	4.37	0 00:00	0.00	0.00
12	PondRiser	Junction	249.50	255.90	249.50	257.50	0.00	16.05	250.59	0.00	5.31	0 00:00	0.00	0.00
13	SD-16	Junction	290.00	294.30	290.00	294.30	0.00	1.47	290.27	0.00	4.03	0 00:00	0.00	0.00
14	SD-19	Junction	302.75	307.59	302.75	307.59	0.00	1.84	303.06	0.00	4.53	0 00:00	0.00	0.00
15	SD-23	Junction	323.75	328.31	323.75	328.31	0.00	5.28	324.23	0.00	4.08	0 00:00	0.00	0.00
16	SD-28	Junction	331.94	335.69	331.94	335.69	0.00	3.78	332.43	0.00	3.26	0 00:00	0.00	0.00
17	SD-33	Junction	341.55	345.42	341.55	345.42	0.00	3.25	341.99	0.00	3.43	0 00:00	0.00	0.00
18	SD-38	Junction	355.60	359.61	355.60	359.61	0.00	2.88	355.98	0.00	3.63	0 00:00	0.00	0.00
19	STR-10	Junction	267.50	273.38	267.50	273.38	0.00	29.39	268.70	0.00	4.68	0 00:00	0.00	0.00
20	STR-100	Junction	256.50	261.94	256.50	261.94	0.00	1.11	257.27	0.00	4.67	0 00:00	0.00	0.00
21	STR-101	Junction	258.50	262.54	258.50	262.54	0.00	1.11	258.91	0.00	3.63	0 00:00	0.00	0.00
22	STR-104	Junction	262.08	265.84	262.08	265.84	0.00	0.54	262.40	0.00	3.44	0 00:00	0.00	0.00
23	STR-13	Junction	269.10	274.10	269.10	274.10	0.00	28.95	270.25	0.00	3.85	0 00:00	0.00	0.00
24	STR-14	Junction	274.00	280.22	274.00	280.22	0.00	27.96	276.10	0.00	4.12	0 00:00	0.00	0.00
25	STR-17	Junction	282.30	287.81	282.30	287.81	0.00	26.01	283.19	0.00	4.62	0 00:00	0.00	0.00
26	STR-18	Junction	289.30	294.76	289.30	294.76	0.00	26.01	290.17	0.00	4.59	0 00:00	0.00	0.00
27	STR-2	Junction	253.60	261.00	253.60	261.00	0.00	31.94	254.79	0.00	6.21	0 00:00	0.00	0.00
28	STR-20	Junction	296.30	301.69	296.30	301.69	0.00	24.05	297.19	0.00	4.50	0 00:00	0.00	0.00
29	STR-21	Junction	302.10	307.72	302.10	307.72	0.00	24.06	303.84	0.00	3.88	0 00:00	0.00	0.00
30	STR-24	Junction	313.50	318.70	313.50	318.70	0.00	18.64	314.32	0.00	4.38	0 00:00	0.00	0.00
31	STR-26	Junction	322.80	328.00	322.80	328.00	0.00	18.38	323.67	0.00	4.33	0 00:00	0.00	0.00
32	STR-29	Junction	326.75	332.13	326.75	332.13	0.00	14.41	327.88	0.00	4.25	0 00:00	0.00	0.00
33	STR-3	Junction	259.30	269.66	259.30	269.66	0.00	31.95	263.69	0.00	5.97	0 00:00	0.00	0.00
34	STR-34	Junction	330.32	336.12	330.32	336.12	0.00	27.09	332.63	0.00	3.49	0 00:00	0.00	0.00
35	STR-36	Junction	341.00	346.20	341.00	346.20	0.00	26.88	341.97	0.00	4.23	0 00:00	0.00	0.00
36	STR-39	Junction	354.40	359.65	354.40	359.65	0.00	23.62	355.34	0.00	4.31	0 00:00	0.00	0.00
37	STR-42	Junction	365.50	370.42	365.50	370.42	0.00	22.19	366.57	0.00	3.85	0 00:00	0.00	0.00
38	STR-44	Junction	367.50	372.84	367.50	372.84	0.00	21.54	368.83	0.00	4.01	0 00:00	0.00	0.00
39	STR-47	Junction	370.40	376.35	370.40	376.35	0.00	20.01	372.95	0.00	3.40	0 00:00	0.00	0.00
40	STR-50	Junction	372.50	378.03	372.50	378.03	0.00	19.00	373.79	0.00	4.24	0 00:00	0.00	0.00
41	STR-52	Junction	374.40	379.58	374.40	379.58	0.00	17.87	375.39	0.00	4.19	0 00:00	0.00	0.00
42	STR-55	Junction	376.70	381.70	376.70	381.70	0.00	16.57	377.80	0.00	3.90	0 00:00	0.00	0.00
43	STR-57	Junction	379.05	383.70	379.05	383.70	0.00	15.42	379.95	0.00	3.75	0 00:00	0.00	0.00
44	STR-6	Junction	260.10	270.06	260.10	270.06	0.00	31.43	265.50	0.00	4.56	0 00:00	0.00	0.00
45	STR-60	Junction	382.35	386.80	382.35	386.80	0.00	13.70	383.16	0.00	3.64	0 00:00	0.00	0.00
46	STR-62	Junction	386.00	390.16	386.00	390.16	0.00	12.62	386.84	0.00	3.32	0 00:00	0.00	0.00
47	STR-65	Junction	388.10	392.29	388.10	392.29	0.00	11.33	388.84	0.00	3.45	0 00:00	0.00	0.00
48	STR-67	Junction	390.10	394.40	390.10	394.40	0.00	10.22	391.15	0.00	3.25	0 00:00	0.00	0.00
49	STR-7	Junction	262.00	271.28	262.00	271.28	0.00	30.01	265.69	0.00	5.59	0 00:00	0.00	0.00
50	STR-70	Junction	391.20	396.78	391.20	396.78	0.00	9.07	392.57	0.00	4.21	0 00:00	0.00	0.00
51	STR-72	Junction	391.70	397.36	391.70	397.36	0.00	8.30	393.16	0.00	4.20	0 00:00	0.00	0.00
52	STR-75	Junction	392.70	397.98	392.70	397.98	0.00	7.14	394.08	0.00	3.90	0 00:00	0.00	0.00
53	STR-78	Junction	393.90	398.98	393.90	398.98	0.00	5.89	395.05	0.00	3.93	0 00:00	0.00	0.00
54	STR-80	Junction	394.90	398.92	394.90	398.92	0.00	4.20	396.08	0.00	2.84	0 00:00	0.00	0.00
55	STR-82	Junction	395.15	399.57	395.15	399.57	0.00	1.48	395.61	0.00	3.96	0 00:00	0.00	0.00
56	DP_1	Outfall	286.00					15.36	286.71					
57	DP_2	Outfall	249.00					16.39	250.00					
58	EX32-bypass(out)	Outfall	255.47					0.16	255.54					
59	EX33-bypass(out)	Outfall	255.70					0.01	255.72					
60	FSP-1	Storage Node	272.00	276.00	272.00		7794.00	2.76	274.30				0.00	0.00
61	FSP-2	Storage Node	270.00	276.00	270.00		3746.00	3.44	273.64				0.00	0.00
62	Pond_1	Storage Node	250.00	257.50	250.00		25046.00	31.94	252.74				0.00	0.00
63	STR-31	Storage Node	327.65	335.28	327.65		0.00	29.57	328.93				0.00	0.00

**Link Summary**

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged (min)	Condition
1	101-100	Pipe	STR-101	STR-100	30.00	258.50	257.00	5.0000	12.000	0.0150	1.11	6.90	0.16	6.44	0.27	0.27	0.00	Calculated
2	102-101	Pipe	STR-102	STR-101	60.00	259.57	258.70	1.4500	12.000	0.0110	0.19	5.07	0.04	3.10	0.13	0.13	0.00	Calculated
3	103-101	Pipe	STR-103	STR-101	30.00	259.63	258.70	3.1000	12.000	0.0110	0.38	7.41	0.05	4.95	0.15	0.15	0.00	Calculated
4	104-101	Pipe	STR-104	STR-101	190.00	262.08	258.70	1.7800	12.000	0.0110	0.54	5.62	0.10	4.53	0.21	0.21	0.00	Calculated
5	105-104	Pipe	STR-105	STR-104	29.00	262.58	262.18	1.3800	12.000	0.0110	0.09	4.95	0.02	2.40	0.09	0.09	0.00	Calculated
6	106-104	Pipe	STR-106	STR-104	6.00	262.24	262.18	1.0000	12.000	0.0110	0.45	4.21	0.11	3.49	0.22	0.22	0.00	Calculated
7	7-Oct	Pipe	STR-10	STR-7	303.00	267.50	262.10	1.7800	36.000	0.0110	29.39	105.23	0.28	12.76	1.08	0.36	0.00	Calculated
8	10-Nov	Pipe	STR-11	STR-10	17.00	269.00	268.50	2.9400	12.000	0.0110	0.45	7.22	0.06	5.10	0.17	0.17	0.00	Calculated
9	10-Dec	Pipe	STR-12	STR-10	5.00	268.70	268.50	4.0000	12.000	0.0110	0.12	8.42	0.01	3.84	0.08	0.08	0.00	Calculated
10	13-10	Pipe	STR-13	STR-10	93.00	269.10	267.60	1.6100	36.000	0.0110	28.95	100.11	0.29	12.25	1.10	0.37	0.00	Calculated
11	14-13	Pipe	STR-14	STR-13	195.00	274.00	269.20	2.4600	30.000	0.0110	27.95	76.05	0.37	14.30	1.05	0.42	0.00	Calculated
12	15-14	Pipe	STR-15	STR-14	15.00	276.00	275.90	0.6700	15.000	0.0110	0.34	6.23	0.06	2.73	0.20	0.16	0.00	Calculated
13	16-14	Pipe	STR-16	STR-14	7.00	275.00	274.60	5.7100	12.000	0.0110	1.87	10.07	0.19	9.80	0.29	0.29	0.00	Calculated
14	17-14	Pipe	STR-17	STR-14	133.00	282.30	274.50	5.8600	30.000	0.0110	26.01	117.39	0.22	19.22	0.80	0.32	0.00	Calculated
15	18-17	Pipe	STR-18	STR-17	115.00	289.30	282.40	6.0000	30.000	0.0110	26.01	118.74	0.22	19.38	0.79	0.32	0.00	Calculated
16	19-18	Pipe	STR-19	STR-18	7.00	289.75	289.30	6.4300	15.000	0.0110	2.21	19.36	0.11	10.48	0.29	0.23	0.00	Calculated
17	20-18	Pipe	STR-20	STR-18	118.00	296.30	289.40	5.8500	30.000	0.0110	24.05	117.22	0.21	18.77	0.77	0.31	0.00	Calculated
18	1-Feb	Pipe	STR-2	Pond_1	27.00	253.60	253.20	1.4800	36.000	0.0110	31.94	95.94	0.33	12.20	1.19	0.40	0.00	Calculated
19	21-20	Pipe	STR-21	STR-20	106.00	302.10	296.40	5.3800	30.000	0.0110	24.05	112.41	0.21	18.22	0.79	0.31	0.00	Calculated
20	22-21	Pipe	STR-22	STR-21	19.00	304.00	302.10	10.0000	12.000	0.0110	0.39	13.32	0.03	7.59	0.12	0.12	0.00	Calculated
21	23-21	Pipe	STR-23	STR-21	4.00	303.50	303.35	3.7500	18.000	0.0110	5.45	24.04	0.23	11.00	0.49	0.32	0.00	Calculated
22	24-21	Pipe	STR-24	STR-21	192.00	313.50	302.20	5.8900	30.000	0.0110	18.64	117.60	0.16	17.50	0.67	0.27	0.00	Calculated
23	25-24	Pipe	STR-25	STR-24	17.00	314.00	313.50	2.9400	12.000	0.0110	0.48	7.22	0.07	5.18	0.18	0.18	0.00	Calculated
24	26-24	Pipe	STR-26	STR-24	206.00	322.80	313.60	4.4700	30.000	0.0110	18.38	102.44	0.18	15.77	0.72	0.29	0.00	Calculated
25	27-26	Pipe	STR-27	STR-26	16.00	323.50	323.00	3.1300	12.000	0.0110	0.40	7.44	0.05	5.05	0.16	0.16	0.00	Calculated
26	28-26	Pipe	STR-28	STR-26	8.00	323.50	323.00	6.2500	15.000	0.0110	3.85	19.09	0.20	12.17	0.38	0.30	0.00	Calculated
27	29-26	Pipe	STR-29	STR-26	188.00	326.75	322.90	2.0500	30.000	0.0110	14.41	69.37	0.21	11.15	0.77	0.31	0.00	Calculated
28	30-29	Pipe	STR-30	STR-29	8.00	327.75	327.40	4.3800	12.000	0.0110	0.42	8.81	0.05	5.79	0.15	0.15	0.00	Calculated
29	31-29	Pipe	STR-31	STR-29	156.00	327.90	326.85	0.6700	30.000	0.0110	14.21	39.77	0.36	7.42	1.03	0.41	0.00	Calculated
30	31-Out	Pipe	STR-31	DP-1	37.00	327.70	327.45	0.6800	24.000	0.0110	15.36	21.98	0.70	7.56	1.23	0.62	0.00	Calculated
31	2-Mar	Pipe	STR-3	STR-2	260.00	259.30	253.70	2.1500	36.000	0.0110	31.94	115.68	0.28	13.99	1.08	0.36	0.00	Calculated
32	32-6	Pipe	CBEX-32	DMH6c	18.00	255.00	254.20	4.4400	6.000	0.0110	0.48	2.80	0.17	5.33	0.14	0.28	0.00	Calculated
33	33-31	Pipe	STR-33	STR-31	10.00	331.69	330.89	8.0000	12.000	0.0110	3.34	11.91	0.28	13.01	0.36	0.36	0.00	Calculated
34	33-out	Pipe	CBEX-33	DP_2_2	40.00	253.10	250.00	7.7500	12.000	0.0130	0.46	9.92	0.05	6.47	0.15	0.15	0.00	Calculated
35	34-31	Pipe	STR-34	STR-31	34.00	330.72	329.70	3.0000	30.000	0.0110	27.09	83.96	0.32	15.24	0.98	0.39	0.00	Calculated
36	35-34	Pipe	STR-35	STR-34	11.00	332.50	332.40	0.9100	12.000	0.0110	0.45	4.01	0.11	3.38	0.23	0.23	0.00	Calculated
37	36-34	Pipe	STR-36	STR-34	240.00	340.60	330.82	4.0800	30.000	0.0110	26.88	99.84	0.27	17.26	0.89	0.35	0.00	Calculated
38	37-36	Pipe	STR-37	STR-36	18.00	341.90	341.10	4.4400	12.000	0.0110	0.36	8.88	0.04	5.52	0.14	0.14	0.00	Calculated
39	38-36	Pipe	STR-38	STR-36	16.00	341.30	341.10	1.2500	18.000	0.0110	3.22	13.88	0.23	6.39	0.49	0.33	0.00	Calculated
40	39-36	Pipe	STR-39	STR-36	266.00	354.40	341.10	5.0000	24.000	0.0110	23.62	59.78	0.40	17.90	0.87	0.44	0.00	Calculated
41	40-39	Pipe	STR-40	STR-39	17.00	355.35	355.00	2.0600	12.000	0.0110	0.37	6.04	0.06	4.25	0.17	0.17	0.00	Calculated
42	41-39	Pipe	STR-41	STR-39	6.00	355.36	355.00	6.0000	12.000	0.0110	1.34	10.31	0.13	9.06	0.24	0.24	0.00	Calculated
43	42-39	Pipe	STR-42	STR-39	217.00	365.50	354.50	5.0700	24.000	0.0110	22.19	60.19	0.37	17.69	0.84	0.42	0.00	Calculated
44	3-Apr	Pipe	STR-4	STR-3	19.00	265.00	263.50	7.8900	12.000	0.0110	0.18	11.83	0.02	5.49	0.09	0.09	0.00	Calculated
45	43-42	Pipe	STR-43	STR-42	5.00	365.92	365.80	2.4000	12.000	0.0110	0.78	6.52	0.12	5.57	0.23	0.23	0.00	Calculated
46	44-42	Pipe	STR-44	STR-42	66.00	367.50	365.60	2.8800	24.000	0.0110	21.54	45.36	0.47	14.25	0.97	0.49	0.00	Calculated
47	45-44	Pipe	STR-45	STR-44	18.00	368.70	368.50	1.1100	12.000	0.0110	0.37	4.44	0.08	3.43	0.20	0.20	0.00	Calculated

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged (min)	Condition
48 46-44	Pipe	STR-46	STR-44	7.00	368.69	368.50	2.7100	12.000	0.0110	1.61	6.94	0.23	7.18	0.33	0.33	0.00	Calculated
49 47-44	Pipe	STR-47	STR-44	119.00	370.40	367.60	2.3500	24.000	0.0110	20.01	41.01	0.49	12.97	0.99	0.49	0.00	Calculated
50 49-47	Pipe	STR-49	STR-47	14.00	372.80	372.60	1.4300	12.000	0.0110	1.32	5.03	0.26	5.40	0.35	0.35	0.00	Calculated
51 50-47	Pipe	STR-50	STR-47	74.00	372.62	370.90	2.3200	24.000	0.0110	19.00	40.76	0.47	12.74	0.96	0.48	0.00	Calculated
52 51-50	Pipe	STR-51	STR-50	8.00	373.77	373.50	3.3700	12.000	0.0110	1.46	7.74	0.19	7.57	0.29	0.29	0.00	Calculated
53 52-50	Pipe	STR-52	STR-50	67.00	374.40	372.72	2.5100	24.000	0.0110	17.87	42.34	0.42	12.90	0.91	0.45	0.00	Calculated
54 3-May	Pipe	STR-5	STR-3	38.00	264.50	263.50	2.6300	12.000	0.0110	0.51	6.83	0.07	5.12	0.19	0.19	0.00	Calculated
55 53-52	Pipe	STR-53	STR-52	15.00	374.65	374.40	1.6700	12.000	0.0110	0.26	5.44	0.05	3.56	0.15	0.15	0.00	Calculated
56 54-52	Pipe	STR-54	STR-52	11.00	374.68	374.40	2.5500	15.000	0.0110	1.50	12.18	0.12	6.74	0.30	0.24	0.00	Calculated
57 55-52	Pipe	STR-55	STR-52	95.00	376.70	374.50	2.3200	24.000	0.0110	16.57	40.69	0.41	12.29	0.89	0.44	0.00	Calculated
58 56-55	Pipe	STR-56	STR-55	6.00	377.46	377.40	1.0000	12.000	0.0110	1.45	4.21	0.34	4.86	0.40	0.40	0.00	Calculated
59 57-55	Pipe	STR-57	STR-55	95.00	379.05	376.77	2.4000	24.000	0.0110	15.42	41.42	0.37	12.21	0.85	0.42	0.00	Calculated
60 58-57	Pipe	STR-58	STR-57	6.00	379.29	379.17	2.0000	15.000	0.0110	1.69	10.80	0.16	6.40	0.33	0.27	0.00	Calculated
61 59-57	Pipe	STR-59	STR-57	18.00	379.54	379.17	2.0600	12.000	0.0110	0.35	6.04	0.06	4.19	0.16	0.16	0.00	Calculated
62 60-57	Pipe	STR-60	STR-57	140.00	382.35	379.15	2.2900	24.000	0.0110	13.70	40.42	0.34	11.62	0.80	0.40	0.00	Calculated
63 61-60	Pipe	STR-61	STR-60	6.00	382.57	382.50	1.1700	12.000	0.0110	1.35	4.55	0.30	5.04	0.37	0.37	0.00	Calculated
64 62-60	Pipe	STR-62	STR-60	150.00	386.00	382.40	2.4000	24.000	0.0110	12.62	41.42	0.30	11.57	0.76	0.38	0.00	Calculated
65 3-Jun	Pipe	STR-6	STR-3	38.00	260.10	259.40	1.8400	36.000	0.0110	31.43	106.99	0.29	13.15	1.11	0.37	0.00	Calculated
66 63-62	Pipe	STR-63	STR-62	17.00	386.20	386.10	0.5900	12.000	0.0110	0.26	3.23	0.08	2.48	0.19	0.19	0.00	Calculated
67 64-62	Pipe	STR-64	STR-62	6.00	386.15	386.10	0.8300	18.000	0.0110	1.29	11.33	0.11	4.25	0.34	0.23	0.00	Calculated
68 65-62	Pipe	STR-65	STR-62	93.00	388.10	386.10	2.1500	24.000	0.0110	11.33	39.21	0.29	10.80	0.74	0.37	0.00	Calculated
69 66-65	Pipe	STR-66	STR-65	10.00	388.48	388.38	1.0000	12.000	0.0110	1.29	4.21	0.31	4.72	0.38	0.38	0.00	Calculated
70 7-Jun	Pipe	STR-7	STR-6	105.00	262.00	260.20	1.7100	36.000	0.0110	30.01	103.21	0.29	12.65	1.11	0.37	0.00	Calculated
71 67-65	Pipe	STR-67	STR-65	93.00	390.10	388.14	2.1100	24.000	0.0110	10.22	38.81	0.26	10.42	0.70	0.35	0.00	Calculated
72 68-67	Pipe	STR-68	STR-67	17.00	390.70	390.60	0.5900	12.000	0.0110	0.32	3.23	0.10	2.62	0.21	0.21	0.00	Calculated
73 69-67	Pipe	STR-69	STR-67	11.00	390.70	390.60	0.9100	12.000	0.0110	1.00	4.01	0.25	4.25	0.34	0.34	0.00	Calculated
74 6-out	Pipe	DMH6c	DP_2_2	165.00	253.60	250.00	2.1800	12.000	0.0130	1.59	5.26	0.30	5.87	0.38	0.38	0.00	Calculated
75 70-67	Pipe	STR-70	STR-67	185.00	391.20	390.20	0.5400	24.000	0.0110	9.07	19.66	0.46	6.13	0.95	0.48	0.00	Calculated
76 71-70	Pipe	STR-71	STR-70	8.00	392.55	392.34	2.6300	12.000	0.0110	0.82	6.82	0.12	5.85	0.23	0.23	0.00	Calculated
77 72-70	Pipe	STR-72	STR-70	78.00	391.90	391.30	0.7700	24.000	0.0110	8.30	23.45	0.35	6.82	0.82	0.41	0.00	Calculated
78 73-72	Pipe	STR-73	STR-72	18.00	393.04	392.68	2.0000	12.000	0.0110	0.16	5.95	0.03	3.33	0.11	0.11	0.00	Calculated
79 74-72	Pipe	STR-74	STR-72	7.00	393.10	392.90	2.8600	12.000	0.0110	1.02	7.12	0.14	6.42	0.26	0.26	0.00	Calculated
80 75-72	Pipe	STR-75	STR-72	99.00	392.70	392.00	0.7100	24.000	0.0110	7.14	22.48	0.32	6.35	0.78	0.39	0.00	Calculated
81 76-75	Pipe	STR-76	STR-75	6.00	393.74	393.70	0.6700	12.000	0.0110	1.07	3.44	0.31	3.86	0.38	0.38	0.00	Calculated
82 77-75	Pipe	STR-77	STR-75	17.00	393.30	393.13	1.0000	12.000	0.0110	0.26	4.21	0.06	2.97	0.17	0.17	0.00	Calculated
83 78-75	Pipe	STR-78	STR-75	201.00	393.90	392.80	0.5500	24.000	0.0110	5.89	19.78	0.30	5.49	0.75	0.37	0.00	Calculated
84 79-78	Pipe	STR-79	STR-78	4.00	394.98	394.90	2.0000	12.000	0.0110	0.29	5.95	0.05	3.94	0.15	0.15	0.00	Calculated
85 80-78	Pipe	STR-80	STR-78	25.00	394.90	394.40	2.0000	15.000	0.0110	4.20	10.80	0.39	8.24	0.54	0.43	0.00	Calculated
86 81-80	Pipe	STR-81	STR-80	3.00	396.00	395.90	3.3300	12.000	0.0110	0.55	7.69	0.07	5.69	0.18	0.18	0.00	Calculated
87 82-78	Pipe	STR-82	STR-78	107.00	395.15	394.40	0.7000	12.000	0.0110	1.48	3.53	0.42	4.30	0.45	0.45	0.00	Calculated
88 83-82	Pipe	STR-83	STR-82	50.00	395.55	395.25	0.6000	12.000	0.0110	0.18	3.26	0.06	2.25	0.16	0.16	0.00	Calculated
89 84-82	Pipe	STR-84	STR-82	42.00	395.80	395.25	1.3100	12.000	0.0110	1.35	4.82	0.28	5.27	0.36	0.36	0.00	Calculated
90 7-Aug	Pipe	STR-8	STR-7	26.00	265.91	265.50	1.5800	12.000	0.0110	0.42	5.29	0.08	4.04	0.19	0.19	0.00	Calculated
91 7-Sep	Pipe	STR-9	STR-7	6.00	265.99	265.50	8.1700	12.000	0.0110	0.38	12.03	0.03	7.01	0.12	0.12	0.00	Calculated
92 Culvert2	Pipe	Culvert2In	STR-13	25.00	270.70	269.63	4.2800	24.000	0.0130	1.07	46.80	0.02	5.96	0.21	0.11	0.00	Calculated
93 EX1-6	Pipe	STR-100	DMH6c	153.00	256.50	255.10	0.9200	12.000	0.0130	1.11	3.41	0.32	3.89	0.39	0.39	0.00	Calculated
94 EX3-4	Pipe	DMH3c	DMH4c	62.00	268.60	268.20	0.6500	18.000	0.0130	2.33	9.43	0.25	4.42	0.51	0.34	0.00	Calculated

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
95	EX4-5	Pipe	DMH4c	DMH5c	22.00	268.10	266.00	9.5500	18.000	0.0130	2.33	32.45	0.07	10.67	0.27	0.18	0.00	Calculated
96	EX5-6	Pipe	DMH5c	STR-6	28.00	265.90	265.13	2.7500	18.000	0.0130	2.33	17.42	0.13	6.86	0.37	0.25	0.00	Calculated
97	EX9-3	Pipe	DMH9c	DMH3c	20.00	268.90	268.70	1.0000	18.000	0.0130	2.33	10.50	0.22	4.78	0.48	0.32	0.00	Calculated
98	FSP1-Out	Pipe	FSP1-Out	Culvert2In	20.00	273.00	272.60	2.0000	12.000	0.0110	0.51	5.95	0.09	4.63	0.20	0.20	0.00	Calculated
99	FSP2-Out	Pipe	FSP2-Out	DMH9c	178.00	272.00	269.00	1.6900	18.000	0.0130	1.90	13.64	0.14	5.43	0.38	0.25	0.00	Calculated
100	Out2_1	Pipe	DP_2_1	DP_2	297.73	249.00	249.00	0.0000	0.000	0.0150	16.05	0.00	0.14	0.00	0.38	0.25	0.00	Calculated
101	Out2_2	Pipe	DP_2_2	DP_2	345.60	250.00	250.00	0.0000	0.000	0.0150	2.05	0.00	0.14	0.00	0.38	0.25	0.00	Calculated
102	Pond_Outfall	Pipe	PondRiser	DP_2_1	50.00	249.50	249.00	1.0000	30.000	0.0130	16.05	41.02	0.39	7.84	1.09	0.43	0.00	Calculated
103	SD-16	Pipe	SD-16	STR-16	250.00	290.00	275.10	5.9600	10.000	0.0110	1.47	6.32	0.23	9.45	0.27	0.33	0.00	Calculated
104	SD-19	Pipe	SD-19	STR-19	224.00	302.75	290.00	5.6900	10.000	0.0110	1.84	6.18	0.30	9.90	0.31	0.37	0.00	Calculated
105	SD-23	Pipe	SD-23	STR-23	411.00	323.75	302.75	5.1100	15.000	0.0110	5.27	16.95	0.31	12.21	0.48	0.38	0.00	Calculated
106	SD-28	Pipe	SD-28	STR-28	357.00	331.94	323.75	2.2900	15.000	0.0110	3.78	11.56	0.33	8.44	0.49	0.39	0.00	Calculated
107	SD-33	Pipe	SD-33	STR-33	268.00	341.55	331.94	3.5900	12.000	0.0110	3.25	7.97	0.41	9.65	0.44	0.44	0.00	Calculated
108	SD-38	Pipe	SD-38	STR-38	284.00	355.60	341.55	4.9500	12.000	0.0110	2.88	9.37	0.31	10.50	0.38	0.38	0.00	Calculated
109	102_Bypass	Channel	STR-102	CBEX-33	233.14	263.07	256.90	2.6500	3.600	0.0130	0.05	11.66	0.00	1.40	0.04	0.13	0.00	
110	103_bypass	Channel	STR-103	CBEX-32	238.82	263.13	257.18	2.4900	3.840	0.0320	0.09	5.46	0.02	0.87	0.07	0.21	0.00	
111	105_Bypass	Channel	STR-105	STR-102	144.56	266.08	263.07	2.0800	3.600	0.0130	0.02	10.34	0.00	1.03	0.03	0.10	0.00	
112	106_Bypass	Channel	STR-106	STR-103	143.60	265.74	263.13	1.8200	3.840	0.0130	0.13	11.48	0.01	1.57	0.06	0.19	0.00	
113	11_Bypass	Channel	STR-11	STR-8	310.73	272.87	272.08	0.2500	3.840	0.0130	0.19	4.29	0.04	0.91	0.10	0.30	0.00	
114	12_Bypass	Channel	STR-12	STR-9	306.16	273.43	270.92	0.8200	1.200	0.0130	0.04	0.35	0.11	0.90	0.04	0.44	0.00	
115	15_Bypass	Channel	STR-15	STR-11	299.12	280.19	272.87	2.4500	3.840	0.0130	0.05	13.32	0.00	1.38	0.04	0.12	0.00	
116	16_Bypass	Channel	STR-16	STR-12	302.37	280.17	273.43	2.2300	1.200	0.0130	0.06	0.57	0.11	1.43	0.04	0.43	0.00	
117	19_Bypass	Channel	STR-19	STR-16	252.79	294.30	280.17	5.5900	3.840	0.0130	0.06	20.13	0.00	1.91	0.04	0.11	0.00	
118	22_Bypass	Channel	STR-22	STR-15	494.76	307.33	280.19	5.4900	1.200	0.0130	0.06	0.90	0.06	2.00	0.03	0.35	0.00	
119	23_Bypass	Channel	STR-23	STR-19	228.51	307.59	294.30	5.8200	3.840	0.0130	0.03	20.53	0.00	1.65	0.03	0.09	0.00	
120	25_Bypass	Channel	STR-25	STR-22	205.10	318.10	307.33	5.2500	3.840	0.0130	0.08	19.51	0.00	2.10	0.04	0.13	0.00	
121	27_Bypass	Channel	STR-27	STR-25	194.95	327.02	318.10	4.5800	3.840	0.0130	0.09	18.20	0.01	1.97	0.04	0.14	0.00	
122	28_Bypass	Channel	STR-28	STR-23	408.97	328.31	307.59	5.0700	1.200	0.0130	0.03	0.86	0.03	1.58	0.03	0.27	0.00	
123	30_Bypass	Channel	STR-30	STR-27	198.67	331.70	327.02	2.3600	3.840	0.0130	0.11	13.08	0.01	1.62	0.05	0.17	0.00	
124	33_Bypass	Channel	STR-33	STR-28	357.58	335.69	328.31	2.0600	1.200	0.0130	0.03	0.55	0.05	1.14	0.03	0.31	0.00	
125	35_Bypass	Channel	STR-35	STR-30	196.77	335.63	331.70	2.0000	3.840	0.0130	0.13	12.03	0.01	1.64	0.06	0.18	0.00	
126	37_Bypass	Channel	STR-37	STR-35	249.72	346.40	335.63	4.3100	3.840	0.0130	0.05	17.75	0.00	1.72	0.04	0.11	0.00	
127	38_Bypass	Channel	STR-38	STR-33	270.06	345.42	335.69	3.6000	1.200	0.0130	0.02	0.73	0.03	1.22	0.03	0.26	0.00	
128	4_Bypass	Channel	STR-4	STR-105	153.05	269.29	266.08	2.1000	1.200	0.0130	0.04	0.55	0.08	1.23	0.04	0.39	0.00	
129	40_bypass	Channel	STR-40	STR-37	261.30	359.60	346.40	5.0500	3.840	0.0130	0.06	19.08	0.00	1.83	0.04	0.11	0.00	
130	41_Bypass	Channel	STR-41	STR-38	286.28	359.61	345.42	4.9600	3.840	0.0130	0.32	18.96	0.02	2.68	0.07	0.22	0.00	
131	43_Bypass	Channel	STR-43	STR-41	214.88	370.25	359.61	4.9500	3.840	0.0130	0.11	18.95	0.01	2.05	0.05	0.14	0.00	
132	45_Bypass	Channel	STR-45	STR-40	287.18	372.97	359.60	4.6600	3.840	0.0130	0.06	18.37	0.00	1.80	0.04	0.11	0.00	
133	46_Bypass	Channel	STR-46	STR-43	69.33	373.15	370.25	4.1800	3.840	0.0130	0.54	17.41	0.03	2.86	0.09	0.27	0.00	
134	49_Bypass	Channel	STR-49	STR-46	115.00	376.30	373.15	2.7400	3.840	0.0320	0.03	5.72	0.01	0.61	0.04	0.14	0.00	
135	5_Bypass	Channel	STR-5	STR-106	149.01	268.12	265.74	1.6000	3.840	0.0130	0.18	10.76	0.02	1.60	0.07	0.21	0.00	
136	51-bypass	Channel	STR-51	STR-46	200.00	377.77	373.15	2.3100	3.840	0.0130	0.47	12.94	0.04	2.21	0.09	0.29	0.00	
137	53_Bypass	Channel	STR-53	STR-45	266.58	379.35	372.97	2.3900	3.840	0.0130	0.06	13.17	0.00	1.42	0.04	0.13	0.00	
138	54_Bypass	Channel	STR-54	STR-51	73.90	379.95	377.77	2.9500	3.840	0.0130	0.49	14.62	0.03	2.45	0.09	0.28	0.00	
139	56-bypass	Channel	STR-56	STR-54	94.37	381.80	379.95	1.9600	3.840	0.0130	0.46	10.77	0.04	1.92	0.10	0.31	0.00	
140	58_Bypass	Channel	STR-58	STR-56	86.78	383.51	381.80	1.9700	3.840	0.0130	0.67	12.93	0.05	2.43	0.11	0.33	0.00	
141	59_Bypass	Channel	STR-59	STR-53	188.00	383.54	379.35	2.2300	3.840	0.0130	0.08	12.71	0.01	1.46	0.05	0.15	0.00	



Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged (min)	Condition
142	61-bypass	Channel	STR-61	STR-58	153.24	386.90	383.51	2.2100	3.840	0.0130	0.38	12.13	0.03	2.00	0.09	0.27	0.00	
143	63_Bypass	Channel	STR-63	STR-59	295.23	389.71	383.54	2.0900	3.840	0.0130	0.06	12.31	0.00	1.38	0.04	0.13	0.00	
144	64-Bypass	Channel	STR-64	STR-61	140.44	389.96	386.90	2.1800	3.840	0.0130	0.34	13.13	0.03	2.06	0.08	0.25	0.00	
145	66-bypass	Channel	STR-66	STR-64	100.35	392.10	389.96	2.1300	3.840	0.0130	0.34	12.23	0.03	1.96	0.08	0.26	0.00	
146	68_Bypass	Channel	STR-68	STR-63	193.86	394.22	389.71	2.3300	3.840	0.0130	0.07	12.99	0.01	1.44	0.05	0.14	0.00	
147	69_bypass	Channel	STR-69	STR-66	94.31	394.12	392.10	2.1400	3.840	0.0130	0.21	12.64	0.02	1.77	0.07	0.21	0.00	
148	71-Bypass	Channel	STR-71	STR-69	190.28	396.60	394.12	1.3000	3.840	0.0130	0.15	9.84	0.02	1.38	0.07	0.21	0.00	
149	73_Bypass	Channel	STR-73	STR-68	272.03	397.14	394.22	1.0700	3.840	0.0130	0.05	8.82	0.01	1.05	0.05	0.14	0.00	
150	74-Bypass	Channel	STR-74	STR-71	83.69	397.05	396.60	0.5400	3.840	0.0130	0.26	6.58	0.04	1.15	0.10	0.30	0.00	
151	76_Bypass	Channel	STR-76	STR-74	101.19	397.78	397.05	0.7200	3.840	0.0130	0.29	6.77	0.04	1.22	0.10	0.31	0.00	
152	77_Bypass	Channel	STR-77	STR-73	98.85	397.80	397.14	0.6700	3.840	0.0130	0.08	6.96	0.01	0.92	0.06	0.19	0.00	
153	79_Bypass	Channel	STR-79	STR-77	265.71	398.87	397.80	0.4000	3.840	0.0130	0.10	5.40	0.02	0.88	0.07	0.22	0.00	
154	8_Bypass	Channel	STR-8	STR-4	175.38	272.08	269.29	1.5900	1.200	0.0130	0.11	0.48	0.23	1.41	0.06	0.58	0.00	
155	81_Bypass	Channel	STR-81	STR-76	207.03	398.90	397.78	0.5400	3.840	0.0130	0.08	6.23	0.01	0.97	0.06	0.19	0.00	
156	83_bypass	Channel	STR-83	STR-81	139.00	399.62	398.90	0.5200	3.840	0.0130	0.04	6.04	0.01	0.72	0.05	0.15	0.00	
157	9_Bypass	Channel	STR-9	STR-5	169.63	270.92	268.12	1.6500	3.840	0.0130	0.09	10.94	0.01	1.36	0.05	0.17	0.00	
158	EX32-bypass	Channel	CBEX-32	EX32-bypass(out)	156.00	257.18	255.47	1.1000	3.600	0.0130	0.16	7.51	0.02	1.39	0.07	0.23	0.00	
159	EX33-bypass	Channel	CBEX-33	EX33-bypass(out)	70.00	256.90	255.70	1.7100	3.600	0.0130	0.01	9.39	0.00	0.67	0.02	0.06	0.00	
160	Outfall-1	Channel	DP-1	DP_1	333.49	327.00	286.00	12.2900	36.000	0.0320	15.36	439.39	0.03	8.99	0.71	0.24	0.00	
161	FSP1-1	Orifice	FSP-1	FSP1-Out		272.00	273.00		8.000		0.30							
162	FSP1-2	Orifice	FSP-1	FSP1-Out		272.00	273.00		12.000		0.21							
163	FSP2-1	Orifice	FSP-2	FSP2-Out		270.00	272.00		8.000		0.91							
164	FSP2-2	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		0.81							
165	FSP2-3	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		0.17							
166	Pond_LowFlow	Orifice	Pond_1	PondRiser		250.00	249.50		18.000		15.95							
167	primary	Orifice	Pond_1	PondRiser		250.00	249.50		17.000		0.10							
168	RiserTop	Orifice	Pond_1	PondRiser		250.00	249.50		48.000		0.00							
169	PondOverflow	Weir	Pond_1	DP_2_1		250.00	249.00				0.00							

**Inlet Summary**

SN	Element	Inlet	Manufacturer	Inlet	Number of	Catchbasin	Max (Rim)	Initial	Ponded	Peak	Peak Flow	Peak Flow	Inlet	Allowable	Max Gutter	Max Gutter
ID		Manufacturer	Part	Location	Inlets	Invert	Elevation	Water	Area	Flow	Intercepted	Bypassing	Efficiency	Spread	Spread	Water Elev.
			Number			Elevation		Elevation	(ft²)	(cfs)	by	Inlet	during Peak	(ft)	during Peak	during Peak
						(ft)	(ft)	(ft)			Inlet	(cfs)	Flow	(ft)	Flow	Flow
											(cfs)		(%)		(ft)	(ft)
1	CBEX-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	0.00	N/A	0.64	0.49	0.15	76.44	10.50	5.12	257.28
2	CBEX-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	0.00	N/A	0.47	0.01	0.46	1.17	10.50	2.25	256.94
3	STR-102	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.57	263.07	0.00	N/A	0.24	0.22	0.02	90.96	10.50	3.54	263.14
4	STR-103	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.63	263.13	0.00	N/A	0.47	0.38	0.09	81.42	10.50	4.56	263.22
5	STR-105	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.58	266.08	0.00	N/A	0.11	0.11	0.00	98.12	10.50	2.66	266.13
6	STR-106	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.24	265.74	0.00	N/A	0.58	0.45	0.13	78.02	10.50	4.94	265.84
7	STR-11	FHWA HEC-22 GENERIC	N/A	On Grade	1	269.00	272.87	0.00	N/A	0.64	0.46	0.18	71.58	10.50	6.44	273.00
8	STR-12	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.70	273.43	0.00	N/A	0.16	0.15	0.01	91.00	10.50	3.84	273.51
9	STR-15	FHWA HEC-22 GENERIC	N/A	On Grade	1	276.00	280.19	0.00	N/A	0.39	0.36	0.03	91.55	10.50	3.37	280.26
10	STR-16	FHWA HEC-22 GENERIC	N/A	On Grade	1	275.00	280.17	0.00	N/A	0.50	0.44	0.06	88.03	10.50	3.72	280.24
11	STR-19	FHWA HEC-22 GENERIC	N/A	On Grade	1	289.75	294.30	0.00	N/A	0.45	0.40	0.05	89.26	10.50	3.60	294.37
12	STR-22	FHWA HEC-22 GENERIC	N/A	On Grade	1	304.00	307.33	0.00	N/A	0.45	0.40	0.05	89.30	10.50	3.60	307.40
13	STR-23	FHWA HEC-22 GENERIC	N/A	On Grade	1	303.50	307.59	0.00	N/A	0.25	0.24	0.01	96.30	10.50	2.86	307.65
14	STR-25	FHWA HEC-22 GENERIC	N/A	On Grade	1	314.00	318.10	0.00	N/A	0.56	0.48	0.08	86.17	10.50	3.90	318.18
15	STR-27	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	327.01	0.00	N/A	0.49	0.40	0.09	81.62	10.50	4.50	327.10
16	STR-28	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	328.31	0.00	N/A	0.14	0.14	0.00	96.94	10.50	2.83	328.37
17	STR-30	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.75	331.70	0.00	N/A	0.53	0.43	0.11	79.99	10.50	4.69	331.79
18	STR-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	331.69	335.69	0.00	N/A	0.14	0.13	0.00	97.13	10.50	2.81	335.75
19	STR-35	FHWA HEC-22 GENERIC	N/A	On Grade	1	332.50	335.63	0.00	N/A	0.58	0.45	0.12	78.66	10.50	4.84	335.73
20	STR-37	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.90	346.48	0.00	N/A	0.41	0.37	0.04	89.96	10.50	3.54	346.55
21	STR-38	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.30	345.42	0.00	N/A	0.43	0.41	0.01	96.78	10.50	2.79	345.50
22	STR-4	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.00	269.29	0.00	N/A	0.23	0.21	0.02	91.63	10.50	3.48	269.36
23	STR-40	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.35	359.60	0.00	N/A	0.43	0.38	0.05	89.39	10.50	3.59	359.67
24	STR-41	FHWA HEC-22 GENERIC	N/A	On Grade	2	355.36	359.61	0.00	N/A	1.66	1.34	0.31	81.08	10.50	4.63	359.75
25	STR-43	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.92	370.25	0.00	N/A	0.88	0.78	0.10	88.33	10.50	3.67	370.36
26	STR-45	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.70	372.97	0.00	N/A	0.43	0.38	0.05	89.38	10.50	3.60	373.04
27	STR-46	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.69	373.15	0.00	N/A	2.15	1.23	0.92	57.23	10.50	5.12	373.25
28	STR-49	FHWA HEC-22 GENERIC	N/A	N/A	1	372.80	376.30	0.00	N/A	1.35	1.32	0.03	99.00	10.50	2.32	376.46
29	STR-5	FHWA HEC-22 GENERIC	N/A	On Grade	1	264.50	268.12	0.00	N/A	0.69	0.52	0.17	75.24	10.50	5.26	268.23
30	STR-51	FHWA HEC-22 GENERIC	N/A	On Grade	2	373.77	377.77	0.00	N/A	1.93	1.39	0.54	72.02	10.50	5.72	377.88
31	STR-53	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.65	379.35	0.00	N/A	0.31	0.28	0.04	88.76	10.50	3.74	379.42
32	STR-54	FHWA HEC-22 GENERIC	N/A	On Grade	2	374.68	379.95	0.00	N/A	1.99	1.42	0.57	71.42	10.50	5.80	380.07
33	STR-56	FHWA HEC-22 GENERIC	N/A	On Grade	2	377.46	381.46	0.00	N/A	1.91	1.38	0.53	72.17	10.50	5.70	381.57
34	STR-58	FHWA HEC-22 GENERIC	N/A	On Grade	2	379.29	383.46	0.00	N/A	2.36	1.69	0.67	71.66	10.50	6.74	383.64
35	STR-59	FHWA HEC-22 GENERIC	N/A	On Grade	1	379.54	383.54	0.00	N/A	0.43	0.36	0.07	84.23	10.50	4.21	383.62
36	STR-61	FHWA HEC-22 GENERIC	N/A	On Grade	2	382.57	386.57	0.00	N/A	1.73	1.28	0.45	73.88	10.50	5.48	386.68
37	STR-63	FHWA HEC-22 GENERIC	N/A	On Grade	1	386.20	389.71	0.00	N/A	0.32	0.29	0.04	88.40	10.50	3.78	389.79
38	STR-64	FHWA HEC-22 GENERIC	N/A	On Grade	2	386.15	389.91	0.00	N/A	1.63	1.22	0.41	74.83	10.50	5.36	390.02
39	STR-66	FHWA HEC-22 GENERIC	N/A	On Grade	2	388.48	391.98	0.00	N/A	1.64	1.22	0.41	74.77	10.50	5.37	392.09
40	STR-68	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.70	394.22	0.00	N/A	0.39	0.33	0.05	85.91	10.50	4.03	394.30
41	STR-69	FHWA HEC-22 GENERIC	N/A	On Grade	2	390.70	394.06	0.00	N/A	1.21	1.00	0.22	82.23	10.50	4.82	394.20
42	STR-71	FHWA HEC-22 GENERIC	N/A	On Grade	2	392.55	396.60	0.00	N/A	0.98	0.77	0.21	78.38	10.50	5.58	396.71
43	STR-73	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.04	397.14	0.00	N/A	0.22	0.19	0.03	88.23	10.50	4.08	397.22
44	STR-74	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.10	397.10	0.00	N/A	1.28	1.02	0.26	79.94	10.50	6.73	397.28
45	STR-76	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.74	397.74	0.00	N/A	1.36	1.07	0.29	78.94	10.50	6.93	397.93
46	STR-77	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.30	397.80	0.00	N/A	0.34	0.28	0.06	81.80	10.50	4.86	397.90
47	STR-79	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.98	398.87	0.00	N/A	0.39	0.31	0.08	79.23	10.50	5.34	398.98

**Inlet Summary**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft <sup>2</sup> )	Peak Flow (cfs)	Peak Flow Intercepted (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
48	STR-8	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.91	272.08	0.00	N/A	0.54	0.43	0.11	79.35	10.50	4.79	272.18
49	STR-81	FHWA HEC-22 GENERIC	N/A	On Grade	2	396.00	398.85	0.00	N/A	0.63	0.56	0.07	88.73	10.50	4.95	399.00
50	STR-83	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.55	399.55	0.00	N/A	0.22	0.21	0.01	93.65	10.50	3.36	399.65
51	STR-84	FHWA HEC-22 GENERIC	N/A	On Sag	2	395.80	399.80	0.00	0.00	1.35	N/A	N/A	N/A	10.50	6.25	399.95
52	STR-9	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.99	270.92	0.00	N/A	0.47	0.39	0.09	81.31	10.50	4.57	271.01

**Subbasin Hydrology**

**Subbasin : Blake1P**

**Input Data**

Area (ac) ..... 2.66  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 78.7  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.66	-	78.7
Composite Area & Weighted CN	2.66		78.7

**Time of Concentration**

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

- Tc = Time of Concentration (hr)
- n = Manning's roughness
- Lf = Flow Length (ft)
- P = 2 yr, 24 hr Rainfall (inches)
- Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

- V = 16.1345 \* (Sf<sup>0.5</sup>) (unpaved surface)
- V = 20.3282 \* (Sf<sup>0.5</sup>) (paved surface)
- V = 15.0 \* (Sf<sup>0.5</sup>) (grassed waterway surface)
- V = 10.0 \* (Sf<sup>0.5</sup>) (nearly bare & untilled surface)
- V = 9.0 \* (Sf<sup>0.5</sup>) (cultivated straight rows surface)
- V = 7.0 \* (Sf<sup>0.5</sup>) (short grass pasture surface)
- V = 5.0 \* (Sf<sup>0.5</sup>) (woodland surface)
- V = 2.5 \* (Sf<sup>0.5</sup>) (forest w/heavy litter surface)
- Tc = (Lf / V) / (3600 sec/hr)

Where:

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)

Channel Flow Equation :

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

$$R = A_q / W_p$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where :

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- R = Hydraulic Radius (ft)
- Aq = Flow Area (ft<sup>2</sup>)
- Wp = Wetted Perimeter (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)
- n = Manning's roughness

	Subarea A	Subarea B	Subarea C
<b>Sheet Flow Computations</b>			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0
<b>Shallow Concentrated Flow Computations</b>			
Flow Length (ft) :	346	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	7.64		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.3
Peak Runoff (cfs) .....	3.44
Weighted Curve Number .....	78.7
Time of Concentration (days hh:mm:ss) .....	0 00:07:38

**Subbasin : Blake2**

**Input Data**

Area (ac) ..... 0.57  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 82.1  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.57	-	82.1
Composite Area & Weighted CN	0.57		82.1

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 1.52  
Peak Runoff (cfs) ..... 0.91  
Weighted Curve Number ..... 82.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Culvert2L-DA**

**Input Data**

Area (ac) ..... 1.39  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 70.2  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	1.39	-	70.2
Composite Area & Weighted CN	1.39		70.2

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	426	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.33	0	0
Total TOC (min) .....	7.59		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 0.82  
 Peak Runoff (cfs) ..... 1.07  
 Weighted Curve Number ..... 70.2  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:35

**Subbasin : Culvert2P-DA**

**Input Data**

Area (ac) ..... 2.87  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 73.5  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.87	-	73.5
Composite Area & Weighted CN	2.87		73.5

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	317	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.04	0	0
Total TOC (min) .....	7.55		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 0.99  
 Peak Runoff (cfs) ..... 2.76  
 Weighted Curve Number ..... 73.5  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:33



**Subbasin : EX32-DA**

**Input Data**

Area (ac) ..... 0.21  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.21	-	98
Composite Area & Weighted CN	0.21		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.56  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : EX33-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	5	-	98
Composite Area & Weighted CN	5		98

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.42  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Hildreth-DA**

**Input Data**

Area (ac) ..... 2.35  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 87  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	2.35	-	87
Composite Area & Weighted CN	2.35		87

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	96	0	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	0.55	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.013	0	0
Flow Length (ft) :	553	0	0
Channel Slope (%) :	3	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.785	0	0
Wetted Perimeter (ft) :	3	0	0
Velocity (ft/sec) :	8.12	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	15.59		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 1.89  
 Peak Runoff (cfs) ..... 3.81  
 Weighted Curve Number ..... 87  
 Time of Concentration (days hh:mm:ss) ..... 0 00:15:35

**Subbasin : Str102-DA**

**Input Data**

Area (ac) ..... 0.08  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.08	-	98
Composite Area & Weighted CN	0.08		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.93  
Peak Runoff (cfs) ..... 0.22  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str103-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	98
Composite Area & Weighted CN	0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.93  
Peak Runoff (cfs) ..... 0.34  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str105-DA**

**Input Data**

Area (ac) ..... 0.03  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.03	-	98
Composite Area & Weighted CN	0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.73  
Peak Runoff (cfs) ..... 0.07  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str106-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.41  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str11-DA**

**Input Data**

Area (ac) ..... 0.22  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.22	-	98
Composite Area & Weighted CN	0.22		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.59  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str12-DA**

**Input Data**

Area (ac) ..... 0.04  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.04	-	98
Composite Area & Weighted CN	0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.9  
Peak Runoff (cfs) ..... 0.1  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str15-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	98
Composite Area & Weighted CN	0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.93  
Peak Runoff (cfs) ..... 0.34  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str16-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.44  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str16L-DA**

**Input Data**

Area (ac) ..... 1.77  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 71.3  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.77	-	71.3
Composite Area & Weighted CN	1.77		71.3

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	381	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.19	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	223	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.2	0	0
Total TOC (min) .....	7.65		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 0.88  
 Peak Runoff (cfs) ..... 1.47  
 Weighted Curve Number ..... 71.3  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:39

**Subbasin : Str19-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.42  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str19L-DA**

**Input Data**

Area (ac) ..... 1.85  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 74  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	1.85	-	74
Composite Area & Weighted CN	1.85		74

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	389	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.21	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	144	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.13	0	0
Total TOC (min) .....	7.61		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 1.02  
 Peak Runoff (cfs) ..... 1.84  
 Weighted Curve Number ..... 74  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:37

**Subbasin : Str22-DA**

**Input Data**

Area (ac) ..... 0.14  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.2  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.14	-	97.2
Composite Area & Weighted CN	0.14		97.2

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.85  
Peak Runoff (cfs) ..... 0.37  
Weighted Curve Number ..... 97.2  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str23-DA**

**Input Data**

Area (ac) ..... 0.08  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.08	-	98
Composite Area & Weighted CN	0.08		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.93  
Peak Runoff (cfs) ..... 0.22  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str23L-DA**

**Input Data**

Area (ac) ..... 4.7  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 77.1  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	4.7	-	77.1
Composite Area & Weighted CN	4.7		77.1

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	8.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	463	0	0
Slope (%) :	9.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.05	0	0
Computed Flow Time (min) :	1.53	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	221	0	0
Channel Slope (%) :	5.9	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	19.49	0	0
Computed Flow Time (min) :	0.19	0	0
Total TOC (min) .....	10.31		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 1.2  
 Peak Runoff (cfs) ..... 5.28  
 Weighted Curve Number ..... 77.1  
 Time of Concentration (days hh:mm:ss) ..... 0 00:10:19

**Subbasin : Str25-DA**

**Input Data**

Area (ac) ..... 0.19  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 94  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.19	-	94
Composite Area & Weighted CN	0.19		94

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.51  
Peak Runoff (cfs) ..... 0.47  
Weighted Curve Number ..... 94  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str27-DA**

**Input Data**

Area (ac) ..... 0.15  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.8  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.15	-	97.8
Composite Area & Weighted CN	0.15		97.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.91  
Peak Runoff (cfs) ..... 0.39  
Weighted Curve Number ..... 97.8  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str28-DA**

**Input Data**

Area (ac) ..... 0.05  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.05	-	98
Composite Area & Weighted CN	0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.91  
Peak Runoff (cfs) ..... 0.12  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str28L-DA**

**Input Data**

Area (ac) ..... 4.17  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 75.4  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	4.17	-	75.4
Composite Area & Weighted CN	4.17		75.4

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	367	0	0
Slope (%) :	10.3	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.18	0	0
Computed Flow Time (min) :	1.18	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	294	0	0
Channel Slope (%) :	2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.35	0	0
Computed Flow Time (min) :	0.43	0	0
Total TOC (min) .....	15.52		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
 Total Runoff (in) ..... 1.1  
 Peak Runoff (cfs) ..... 3.78  
 Weighted Curve Number ..... 75.4  
 Time of Concentration (days hh:mm:ss) ..... 0 00:15:31

**Subbasin : Str30-DA**

**Input Data**

Area (ac) ..... 0.15  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.15	-	98
Composite Area & Weighted CN	0.15		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.41  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str32-DA**

**Input Data**

Area (ac) ..... 0.2  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.2	-	98
Composite Area & Weighted CN	0.2		98

**Time of Concentration**

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.94  
Peak Runoff (cfs) ..... 0.52  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:00:00

**Subbasin : Str33-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.91
Peak Runoff (cfs) .....	0.12
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00



**Subbasin : Str33L-DA**

**Input Data**

Area (ac) .....	3.18
Peak Rate Factor .....	484
Weighted Curve Number .....	75.4
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		3.18	-	75.4
Composite Area & Weighted CN		3.18		75.4

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	6	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	7.99	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	497	0	0
Slope (%) :	7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.27	0	0
Computed Flow Time (min) :	1.94	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	39	0	0
Channel Slope (%) :	3.6	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	15.23	0	0
Computed Flow Time (min) :	0.04	0	0
Total TOC (min) .....	9.97		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.1
Peak Runoff (cfs) .....	3.25
Weighted Curve Number .....	75.4
Time of Concentration (days hh:mm:ss) .....	0 00:09:58

**Subbasin : Str37-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.13	-	98
Composite Area & Weighted CN		0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 3.17  
Total Runoff (in) ..... 2.93  
Peak Runoff (cfs) ..... 0.36  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str38-DA**

**Input Data**

Area (ac) .....	0.13
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.13	-	98
Composite Area & Weighted CN		0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.93
Peak Runoff (cfs) .....	0.34
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str38L-DA**

**Input Data**

Area (ac) .....	3.72
Peak Rate Factor .....	484
Weighted Curve Number .....	73.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		3.72	-	73.3
Composite Area & Weighted CN		3.72		73.3

**Time of Concentration**

	Subarea		
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	12.93	0	0

	Subarea		
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	623	0	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	3.59	0	0

	Subarea		
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	23	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	16.54		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	0.98
Peak Runoff (cfs) .....	2.88
Weighted Curve Number .....	73.3
Time of Concentration (days hh:mm:ss) .....	0 00:16:32

**Subbasin : Str40-DA**

**Input Data**

Area (ac) .....	0.14
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.93
Peak Runoff (cfs) .....	0.37
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str41-DA**

**Input Data**

Area (ac) .....	0.09
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	98
Composite Area & Weighted CN		0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.93
Peak Runoff (cfs) .....	0.22
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str41L-DA**

**Input Data**

Area (ac) .....	2.56
Peak Rate Factor .....	484
Weighted Curve Number .....	72.1
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.56	-	72.1
Composite Area & Weighted CN		2.56		72.1

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	20.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	498	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	8.38	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	59	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.05	0	0
Total TOC (min) .....	29.21		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	0.92
Peak Runoff (cfs) .....	1.48
Weighted Curve Number .....	72.1
Time of Concentration (days hh:mm:ss) .....	0 00:29:13

**Subbasin : Str43-DA**

**Input Data**

Area (ac) .....	0.03
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.73
Peak Runoff (cfs) .....	0.07
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00



**Subbasin : Str43L-DA**

**Input Data**

Area (ac) .....	0.5
Peak Rate Factor .....	484
Weighted Curve Number .....	73.7
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.5	-	73.7
Composite Area & Weighted CN		0.5		73.7

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	406	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	6.84	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	20	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	28.88		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1
Peak Runoff (cfs) .....	0.33
Weighted Curve Number .....	73.7
Time of Concentration (days hh:mm:ss) .....	0 00:28:53

**Subbasin : Str45-DA**

**Input Data**

Area (ac) .....	0.14
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.93
Peak Runoff (cfs) .....	0.37
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str46-DA**

**Input Data**

Area (ac) .....	0.09
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.05	-	98
Composite Area & Weighted CN		0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.93
Peak Runoff (cfs) .....	0.24
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str46L-DA**

**Input Data**

Area (ac) .....	2.2
Peak Rate Factor .....	484
Weighted Curve Number .....	76.4
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		2.01	-	76.4
Composite Area & Weighted CN		2.01		76.4

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	659	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.09	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	104	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.1	0	0
Total TOC (min) .....	32.77		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.16
Peak Runoff (cfs) .....	1.59
Weighted Curve Number .....	76.4
Time of Concentration (days hh:mm:ss) .....	0 00:32:46

**Subbasin : Str49-DA**

**Input Data**

Area (ac) .....	2.2
Peak Rate Factor .....	484
Weighted Curve Number .....	74.2
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.2	-	74.2
Composite Area & Weighted CN		2.2		74.2

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.5	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	706	0
Slope (%) :	1.8	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.94	0	0
Computed Flow Time (min) :	12.52	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	35	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	35.05		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.03
Peak Runoff (cfs) .....	1.35
Weighted Curve Number .....	74.2
Time of Concentration (days hh:mm:ss) .....	0 00:35:03

**Subbasin : Str4-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.91
Peak Runoff (cfs) .....	0.12
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str51-DA**

**Input Data**

Area (ac) .....	0.03
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.84
Peak Runoff (cfs) .....	0.08
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str51L-DA**

**Input Data**

Area (ac) .....	2.4
Peak Rate Factor .....	484
Weighted Curve Number .....	73.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.4	-	73.3
Composite Area & Weighted CN		2.4		73.3

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	706	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.89	0	0
Total TOC (min) .....	33.46		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	0.98
Peak Runoff (cfs) .....	1.42
Weighted Curve Number .....	73.3
Time of Concentration (days hh:mm:ss) .....	0 00:33:28



**Subbasin : Str53-AD**

**Input Data**

Area (ac) .....	0.09
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	98
Composite Area & Weighted CN		0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.93
Peak Runoff (cfs) .....	0.24
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str54-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.84
Peak Runoff (cfs) .....	0.08
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str54L-DA**

**Input Data**

Area (ac) .....	2.11
Peak Rate Factor .....	484
Weighted Curve Number .....	77
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		2.11	-	77
Composite Area & Weighted CN		2.11		77

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	23.02	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	714	0	0
Slope (%) :	1.8	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.94	0	0
Computed Flow Time (min) :	12.66	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	219	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.31	0	0
Total TOC (min) .....	35.99		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.19
Peak Runoff (cfs) .....	1.51
Weighted Curve Number .....	77
Time of Concentration (days hh:mm:ss) .....	0 00:35:59

**Subbasin : Str56-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.84
Peak Runoff (cfs) .....	0.08
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str56L-DA**

**Input Data**

Area (ac) .....	2.12
Peak Rate Factor .....	484
Weighted Curve Number .....	75.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.12	-	75.3
Composite Area & Weighted CN		2.12		75.3

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.03	0	0
Computed Flow Time (min) :	24.21	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	714	0
Slope (%) :	1.5	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.86	0	0
Computed Flow Time (min) :	13.84	0	0
Total TOC (min) .....	38.04		

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	1.09
Peak Runoff (cfs) .....	1.34
Weighted Curve Number .....	75.3
Time of Concentration (days hh:mm:ss) .....	0 00:38:02

**Subbasin : Str58-DA**

**Input Data**

Area (ac) .....	0.64
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.12	-	98
Composite Area & Weighted CN		0.12		98

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) .....	3.17
Total Runoff (in) .....	2.94
Peak Runoff (cfs) .....	1.69
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str58L-DA**

**Input Data**

Area (ac) .....	1.7
Peak Rate Factor .....	484
Weighted Curve Number .....	77.6
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		1.7	-	77.6
Composite Area & Weighted CN		1.7		77.6

**Time of Concentration**

**Junction Input**

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft <sup>2</sup> )	Minimum Pipe Cover (in)
1	Culvert2In	270.70	274.50	3.80	270.70	0.00	274.50	0.00	0.00	0.00
2	DMH3c	268.70	271.83	3.13	268.70	0.00	271.83	0.00	0.00	0.00
3	DMH4c	268.10	271.22	3.12	268.10	0.00	271.22	0.00	0.00	0.00
4	DMH5c	265.90	269.46	3.56	265.90	0.00	269.46	0.00	0.00	0.00
5	DMH6c	253.60	258.48	4.88	253.60	0.00	258.48	0.00	0.00	0.00
6	DMH9c	268.90	271.70	2.80	268.90	0.00	271.70	0.00	0.00	0.00
7	DP_2_1	249.00	255.00	6.00	249.00	0.00	255.00	0.00	0.00	0.00
8	DP_2_2	250.00	256.00	6.00	250.00	0.00	256.00	0.00	0.00	0.00
9	DP-1	327.00	336.00	9.00	327.00	0.00	336.00	0.00	0.00	0.00
10	FSP1-Out	273.00	276.00	3.00	273.00	0.00	276.00	0.00	7794.00	0.00
11	FSP2-Out	272.00	276.00	4.00	272.00	0.00	276.00	0.00	3746.00	0.00
12	PondRiser	249.50	255.90	6.40	249.50	0.00	257.50	1.60	0.00	0.00
13	SD-16	290.00	294.30	4.30	290.00	0.00	294.30	0.00	0.00	0.00
14	SD-19	302.75	307.59	4.84	302.75	0.00	307.59	0.00	0.00	0.00
15	SD-23	323.75	328.31	4.56	323.75	0.00	328.31	0.00	0.00	0.00
16	SD-28	331.94	335.69	3.75	331.94	0.00	335.69	0.00	0.00	0.00
17	SD-33	341.55	345.42	3.87	341.55	0.00	345.42	0.00	0.00	0.00
18	SD-38	355.60	359.61	4.01	355.60	0.00	359.61	0.00	0.00	0.00
19	STR-10	267.50	273.38	5.88	267.50	0.00	273.38	0.00	0.00	0.00
20	STR-100	256.50	261.94	5.44	256.50	0.00	261.94	0.00	0.00	0.00
21	STR-101	258.50	262.54	4.04	258.50	0.00	262.54	0.00	0.00	0.00
22	STR-104	262.08	265.84	3.76	262.08	0.00	265.84	0.00	0.00	0.00
23	STR-13	269.10	274.10	5.00	269.10	0.00	274.10	0.00	0.00	0.00
24	STR-14	274.00	280.22	6.22	274.00	0.00	280.22	0.00	0.00	0.00
25	STR-17	282.30	287.81	5.51	282.30	0.00	287.81	0.00	0.00	0.00
26	STR-18	289.30	294.76	5.46	289.30	0.00	294.76	0.00	0.00	0.00
27	STR-2	253.60	261.00	7.40	253.60	0.00	261.00	0.00	0.00	0.00
28	STR-20	296.30	301.69	5.39	296.30	0.00	301.69	0.00	0.00	0.00
29	STR-21	302.10	307.72	5.62	302.10	0.00	307.72	0.00	0.00	0.00
30	STR-24	313.50	318.70	5.20	313.50	0.00	318.70	0.00	0.00	0.00
31	STR-26	322.80	328.00	5.20	322.80	0.00	328.00	0.00	0.00	0.00
32	STR-29	326.75	332.13	5.38	326.75	0.00	332.13	0.00	0.00	0.00
33	STR-3	259.30	269.66	10.36	259.30	0.00	269.66	0.00	0.00	0.00
34	STR-34	330.32	336.12	5.80	330.32	0.00	336.12	0.00	0.00	0.00
35	STR-36	341.00	346.20	5.20	341.00	0.00	346.20	0.00	0.00	0.00
36	STR-39	354.40	359.65	5.25	354.40	0.00	359.65	0.00	0.00	0.00
37	STR-42	365.50	370.42	4.92	365.50	0.00	370.42	0.00	0.00	0.00
38	STR-44	367.50	372.84	5.34	367.50	0.00	372.84	0.00	0.00	0.00
39	STR-47	370.40	376.35	5.95	370.40	0.00	376.35	0.00	0.00	0.00
40	STR-50	372.50	378.03	5.53	372.50	0.00	378.03	0.00	0.00	0.00
41	STR-52	374.40	379.58	5.18	374.40	0.00	379.58	0.00	0.00	0.00
42	STR-55	376.70	381.70	5.00	376.70	0.00	381.70	0.00	0.00	0.00
43	STR-57	379.05	383.70	4.65	379.05	0.00	383.70	0.00	0.00	0.00
44	STR-6	260.10	270.06	9.96	260.10	0.00	270.06	0.00	0.00	0.00
45	STR-60	382.35	386.80	4.45	382.35	0.00	386.80	0.00	0.00	0.00
46	STR-62	386.00	390.16	4.16	386.00	0.00	390.16	0.00	0.00	0.00
47	STR-65	388.10	392.29	4.19	388.10	0.00	392.29	0.00	0.00	0.00
48	STR-67	390.10	394.40	4.30	390.10	0.00	394.40	0.00	0.00	0.00
49	STR-7	262.00	271.28	9.28	262.00	0.00	271.28	0.00	0.00	0.00
50	STR-70	391.20	396.78	5.58	391.20	0.00	396.78	0.00	0.00	0.00
51	STR-72	391.70	397.36	5.66	391.70	0.00	397.36	0.00	0.00	0.00
52	STR-75	392.70	397.98	5.28	392.70	0.00	397.98	0.00	0.00	0.00
53	STR-78	393.90	398.98	5.08	393.90	0.00	398.98	0.00	0.00	0.00
54	STR-80	394.90	398.92	4.02	394.90	0.00	398.92	0.00	0.00	0.00
55	STR-82	395.15	399.57	4.42	395.15	0.00	399.57	0.00	0.00	0.00



**Junction Results**

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert2In	1.07	1.07	272.80	2.10	0.00	1.70	272.63	1.93	0 12:36	0 00:00	0.00	0.00
2	DMH3c	2.33	0.00	269.21	0.51	0.00	2.62	268.78	0.08	0 12:17	0 00:00	0.00	0.00
3	DMH4c	2.33	0.00	268.71	0.61	0.00	2.51	268.28	0.18	0 12:17	0 00:00	0.00	0.00
4	DMH5c	2.33	0.00	266.27	0.37	0.00	3.19	266.04	0.14	0 12:17	0 00:00	0.00	0.00
5	DMH6c	1.59	0.00	255.49	1.89	0.00	2.99	255.16	1.56	0 12:07	0 00:00	0.00	0.00
6	DMH9c	2.33	0.91	269.38	0.48	0.00	2.32	269.05	0.15	0 12:17	0 00:00	0.00	0.00
7	DP_2_1	16.05	0.00	250.09	1.09	0.00	6.31	249.23	0.23	0 12:37	0 00:00	0.00	0.00
8	DP_2_2	2.05	0.00	250.38	0.38	0.00	5.62	250.06	0.06	0 12:07	0 00:00	0.00	0.00
9	DP-1	15.36	0.00	328.68	1.68	0.00	7.32	327.72	0.72	0 12:15	0 00:00	0.00	0.00
10	FSP1-Out	0.51	0.00	273.20	0.20	0.00	2.92	273.03	0.03	0 12:36	0 00:00	0.00	0.00
11	FSP2-Out	1.90	0.00	272.38	0.38	0.00	4.37	272.05	0.05	0 12:17	0 00:00	0.00	0.00
12	PondRiser	16.05	0.00	250.59	1.09	0.00	5.31	249.73	0.23	0 12:37	0 00:00	0.00	0.00
13	SD-16	1.47	1.47	290.27	0.27	0.00	4.03	290.04	0.04	0 12:08	0 00:00	0.00	0.00
14	SD-19	1.84	1.84	303.06	0.31	0.00	4.53	302.79	0.04	0 12:07	0 00:00	0.00	0.00
15	SD-23	5.28	5.28	324.23	0.48	0.00	4.08	323.82	0.07	0 12:08	0 00:00	0.00	0.00
16	SD-28	3.78	3.78	332.43	0.49	0.00	3.26	332.01	0.07	0 12:11	0 00:00	0.00	0.00
17	SD-33	3.25	3.25	341.99	0.44	0.00	3.43	341.61	0.06	0 12:08	0 00:00	0.00	0.00
18	SD-38	2.88	2.88	355.98	0.38	0.00	3.63	355.66	0.06	0 12:13	0 00:00	0.00	0.00
19	STR-10	29.39	0.00	268.70	1.20	0.00	4.68	268.53	1.03	0 12:10	0 00:00	0.00	0.00
20	STR-100	1.11	0.00	257.27	0.77	0.00	4.67	257.05	0.55	0 12:06	0 00:00	0.00	0.00
21	STR-101	1.11	0.00	258.91	0.41	0.00	3.63	258.74	0.24	0 12:07	0 00:00	0.00	0.00
22	STR-104	0.54	0.00	262.40	0.32	0.00	3.44	262.22	0.14	0 12:06	0 00:00	0.00	0.00
23	STR-13	28.95	0.00	270.25	1.15	0.00	3.85	269.68	0.58	0 12:10	0 00:00	0.00	0.00
24	STR-14	27.96	0.00	276.10	2.10	0.00	4.12	275.94	1.94	0 12:06	0 00:00	0.00	0.00
25	STR-17	26.01	0.00	283.19	0.89	0.00	4.62	282.52	0.22	0 12:10	0 00:00	0.00	0.00
26	STR-18	26.01	0.00	290.17	0.87	0.00	4.59	289.51	0.21	0 12:10	0 00:00	0.00	0.00
27	STR-2	31.94	0.00	254.79	1.19	0.00	6.21	253.87	0.27	0 12:11	0 00:00	0.00	0.00
28	STR-20	24.05	0.00	297.19	0.89	0.00	4.50	296.52	0.22	0 12:10	0 00:00	0.00	0.00
29	STR-21	24.06	0.00	303.84	1.74	0.00	3.88	303.42	1.32	0 12:09	0 00:00	0.00	0.00
30	STR-24	18.64	0.00	314.32	0.82	0.00	4.38	313.70	0.20	0 12:14	0 00:00	0.00	0.00
31	STR-26	18.38	0.00	323.67	0.87	0.00	4.33	323.08	0.28	0 12:15	0 00:00	0.00	0.00
32	STR-29	14.41	0.00	327.88	1.13	0.00	4.25	327.44	0.69	0 12:15	0 00:00	0.00	0.00
33	STR-3	31.95	0.00	263.69	4.39	0.00	5.97	263.53	4.23	0 12:06	0 00:00	0.00	0.00
34	STR-34	27.09	0.00	332.63	2.31	0.00	3.49	332.44	2.12	0 12:06	0 00:00	0.00	0.00
35	STR-36	26.88	0.00	341.97	0.97	0.00	4.23	341.27	0.27	0 12:18	0 00:00	0.00	0.00
36	STR-39	23.62	0.00	355.34	0.94	0.00	4.31	355.06	0.66	0 12:17	0 00:00	0.00	0.00
37	STR-42	22.19	0.00	366.57	1.07	0.00	3.85	365.87	0.37	0 12:16	0 00:00	0.00	0.00
38	STR-44	21.54	0.00	368.83	1.33	0.00	4.01	368.57	1.07	0 12:25	0 00:00	0.00	0.00
39	STR-47	20.01	0.00	372.95	2.55	0.00	3.40	372.66	2.26	0 12:27	0 00:00	0.00	0.00
40	STR-50	19.00	0.00	373.79	1.29	0.00	4.24	373.55	1.05	0 12:26	0 00:00	0.00	0.00
41	STR-52	17.87	0.00	375.39	0.99	0.00	4.19	374.67	0.27	0 12:14	0 00:00	0.00	0.00
42	STR-55	16.57	0.00	377.80	1.10	0.00	3.90	377.48	0.78	0 12:25	0 00:00	0.00	0.00
43	STR-57	15.42	0.00	379.95	0.90	0.00	3.75	379.30	0.25	0 12:13	0 00:00	0.00	0.00
44	STR-6	31.43	0.00	265.50	5.40	0.00	4.56	265.19	5.09	0 12:17	0 00:00	0.00	0.00
45	STR-60	13.70	0.00	383.16	0.81	0.00	3.64	382.58	0.23	0 12:12	0 00:00	0.00	0.00
46	STR-62	12.62	0.00	386.84	0.84	0.00	3.32	386.23	0.23	0 12:10	0 00:00	0.00	0.00
47	STR-65	11.33	0.00	388.84	0.74	0.00	3.45	388.45	0.35	0 12:10	0 00:00	0.00	0.00
48	STR-67	10.22	0.00	391.15	1.05	0.00	3.25	390.67	0.57	0 12:10	0 00:00	0.00	0.00
49	STR-7	30.01	0.00	265.69	3.69	0.00	5.59	265.53	3.53	0 12:06	0 00:00	0.00	0.00
50	STR-70	9.07	0.00	392.57	1.37	0.00	4.21	392.38	1.18	0 12:13	0 00:00	0.00	0.00
51	STR-72	8.30	0.00	393.16	1.46	0.00	4.20	392.94	1.24	0 12:09	0 00:00	0.00	0.00
52	STR-75	7.14	0.00	394.08	1.38	0.00	3.90	393.77	1.07	0 12:07	0 00:00	0.00	0.00
53	STR-78	5.89	0.00	395.05	1.15	0.00	3.93	394.93	1.03	0 12:05	0 00:00	0.00	0.00
54	STR-80	4.20	3.81	396.08	1.18	0.00	2.84	395.93	1.03	0 12:06	0 00:00	0.00	0.00
55	STR-82	1.48	0.00	395.61	0.46	0.00	3.96	395.30	0.15	0 12:11	0 00:00	0.00	0.00

**Channel Input**

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 102_Bypass	233.14	263.07	3.50	256.90	3.80	6.17	2.6500	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
2 103_bypass	238.82	263.13	3.50	257.18	2.18	5.95	2.4900	Trapezoidal	0.320	16.000	0.0320	0.5000	0.5000	0.0000	0.00	No
3 105_Bypass	144.56	266.08	3.50	263.07	3.50	3.01	2.0800	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
4 106_Bypass	143.60	265.74	3.50	263.13	3.50	2.61	1.8200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
5 11_Bypass	310.73	272.87	3.87	272.08	6.17	0.79	0.2500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
6 12_Bypass	306.16	273.43	4.73	270.92	4.93	2.51	0.8200	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
7 15_Bypass	299.12	280.19	4.19	272.87	3.87	7.32	2.4500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
8 16_Bypass	302.37	280.17	5.17	273.43	4.73	6.74	2.2300	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
9 19_Bypass	252.79	294.30	4.55	280.17	5.17	14.13	5.5900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
10 22_Bypass	494.76	307.33	3.33	280.19	4.19	27.14	5.4900	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
11 23_Bypass	228.51	307.59	4.09	294.30	4.55	13.29	5.8200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
12 25_Bypass	205.10	318.10	4.10	307.33	3.33	10.77	5.2500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
13 27-Bypass	194.95	327.02	3.52	318.10	4.10	8.92	4.5800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
14 28_Bypass	408.97	328.31	4.81	307.59	4.09	20.72	5.0700	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
15 30_Bypass	198.67	331.70	3.95	327.02	3.52	4.68	2.3600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
16 33_Bypass	357.58	335.69	4.00	328.31	4.81	7.38	2.0600	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
17 35_Bypass	196.77	335.63	3.13	331.70	3.95	3.93	2.0000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
18 37_Bypass	249.72	346.40	4.50	335.63	3.13	10.77	4.3100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
19 38_Bypass	270.06	345.42	4.12	335.69	4.00	9.73	3.6000	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
20 4_Bypass	153.05	269.29	4.29	266.08	3.50	3.21	2.1000	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
21 40_bypass	261.30	359.60	4.25	346.40	4.50	13.20	5.0500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
22 41_Bypass	286.28	359.61	4.25	345.42	4.12	14.19	4.9600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
23 43_Bypass	214.88	370.25	4.33	359.61	4.25	10.64	4.9500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
24 45_Bypass	287.18	372.97	4.27	359.60	4.25	13.37	4.6600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
25 46_Bypass	69.33	373.15	4.46	370.25	4.33	2.90	4.1800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
26 49_Bypass	115.00	376.30	3.50	373.15	4.46	3.15	2.7400	Trapezoidal	0.320	16.000	0.0320	0.5000	0.5000	0.0000	0.00	No
27 5_Bypass	149.01	268.12	3.62	265.74	3.50	2.38	1.6000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
28 51-bypass	200.00	377.77	4.00	373.15	4.46	4.62	2.3100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
29 53_Bypass	266.58	379.35	4.70	372.97	4.27	6.38	2.3900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
30 54_Bypass	73.90	379.95	5.27	377.77	4.00	2.18	2.9500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
31 56-bypass	94.37	381.80	4.34	379.95	5.27	1.85	1.9600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
32 58_Bypass	86.78	383.51	4.22	381.80	4.34	1.71	1.9700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
33 59_Bypass	188.00	383.54	4.00	379.35	4.70	4.19	2.2300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
34 61-bypass	153.24	386.90	4.33	383.51	4.22	3.39	2.2100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
35 63_Bypass	295.23	389.71	3.51	383.54	4.00	6.17	2.0900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
36 64-Bypass	140.44	389.96	3.81	386.90	4.33	3.06	2.1800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
37 66-bypass	100.35	392.10	3.62	389.96	3.81	2.14	2.1300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
38 68_Bypass	193.86	394.22	3.52	389.71	3.51	4.51	2.3300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
39 69_bypass	94.31	394.12	3.42	392.10	3.62	2.02	2.1400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
40 71-Bypass	190.28	396.60	4.05	394.12	3.42	2.48	1.3000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
41 73_Bypass	272.03	397.14	4.10	394.22	3.52	2.92	1.0700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
42 74-Bypass	83.69	397.05	3.95	396.60	4.05	0.45	0.5400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
43 76_Bypass	101.19	397.78	4.04	397.05	3.95	0.73	0.7200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
44 77_Bypass	98.85	397.80	4.50	397.14	4.10	0.66	0.6700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
45 79_Bypass	265.71	398.87	3.89	397.80	4.50	1.07	0.4000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
46 8_Bypass	175.38	272.08	6.17	269.29	4.29	2.79	1.5900	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
47 81_Bypass	207.03	398.90	2.90	397.78	4.04	1.12	0.5400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
48 83_bypass	139.00	399.62	4.07	398.90	2.90	0.72	0.5200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
49 9_Bypass	169.63	270.92	4.93	268.12	3.62	2.80	1.6500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
50 EX32-bypass	156.00	257.18	2.18	255.47	0.00	1.71	1.1000	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
51 EX33-bypass	70.00	256.90	3.80	255.70	0.00	1.20	1.7100	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
52 Outfall-1	333.49	327.00	0.00	286.00	0.00	41.00	12.2900	Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No

**Channel Results**

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 102_Bypass	0.05	0 12:08	11.66	0.00	1.40	2.78	0.04	0.13	0.00		
2 103_bypass	0.09	0 12:09	5.46	0.02	0.87	4.58	0.07	0.21	0.00		
3 105_Bypass	0.02	0 12:08	10.34	0.00	1.03	2.34	0.03	0.10	0.00		
4 106_Bypass	0.13	0 12:07	11.48	0.01	1.57	1.52	0.06	0.19	0.00		
5 11_Bypass	0.19	0 12:09	4.29	0.04	0.91	5.69	0.10	0.30	0.00		
6 12_Bypass	0.04	0 12:09	0.35	0.11	0.90	5.67	0.04	0.44	0.00		
7 15_Bypass	0.05	0 12:08	13.32	0.00	1.38	3.61	0.04	0.12	0.00		
8 16_Bypass	0.06	0 12:08	0.57	0.11	1.43	3.52	0.04	0.43	0.00		
9 19_Bypass	0.06	0 12:07	20.13	0.00	1.91	2.21	0.04	0.11	0.00		
10 22_Bypass	0.06	0 12:09	0.90	0.06	2.00	4.12	0.03	0.35	0.00		
11 23_Bypass	0.03	0 12:07	20.53	0.00	1.65	2.31	0.03	0.09	0.00		
12 25_Bypass	0.08	0 12:07	19.51	0.00	2.10	1.63	0.04	0.13	0.00		
13 27-Bypass	0.09	0 12:07	18.20	0.01	1.97	1.65	0.04	0.14	0.00		
14 28_Bypass	0.03	0 12:09	0.86	0.03	1.58	4.31	0.03	0.27	0.00		
15 30_Bypass	0.11	0 12:07	13.08	0.01	1.62	2.04	0.05	0.17	0.00		
16 33_Bypass	0.03	0 12:09	0.55	0.05	1.14	5.23	0.03	0.31	0.00		
17 35_Bypass	0.13	0 12:07	12.03	0.01	1.64	2.00	0.06	0.18	0.00		
18 37_Bypass	0.05	0 12:07	17.75	0.00	1.72	2.42	0.04	0.11	0.00		
19 38_Bypass	0.02	0 12:26	0.73	0.03	1.22	3.69	0.03	0.26	0.00		
20 4_Bypass	0.04	0 12:08	0.55	0.08	1.23	2.07	0.04	0.39	0.00		
21 40_bypass	0.06	0 12:07	19.08	0.00	1.83	2.38	0.04	0.11	0.00		
22 41_Bypass	0.32	0 12:24	18.96	0.02	2.68	1.78	0.07	0.22	0.00		
23 43_Bypass	0.11	0 12:26	18.95	0.01	2.05	1.75	0.05	0.14	0.00		
24 45_Bypass	0.06	0 12:08	18.37	0.00	1.80	2.66	0.04	0.11	0.00		
25 46_Bypass	0.54	0 12:25	17.41	0.03	2.86	0.40	0.09	0.27	0.00		
26 49_Bypass	0.03	0 12:29	5.72	0.01	0.61	3.14	0.04	0.14	0.00		
27 5_Bypass	0.18	0 12:07	10.76	0.02	1.60	1.55	0.07	0.21	0.00		
28 51-bypass	0.47	0 12:27	12.94	0.04	2.21	1.51	0.09	0.29	0.00		
29 53_Bypass	0.06	0 12:08	13.17	0.00	1.42	3.13	0.04	0.13	0.00		
30 54_Bypass	0.49	0 12:27	14.62	0.03	2.45	0.50	0.09	0.28	0.00		
31 56-bypass	0.46	0 12:26	10.77	0.04	1.92	0.82	0.10	0.31	0.00		
32 58_Bypass	0.67	0 12:07	12.93	0.05	2.43	0.60	0.11	0.33	0.00		
33 59_Bypass	0.08	0 12:07	12.71	0.01	1.46	2.15	0.05	0.15	0.00		
34 61-bypass	0.38	0 12:22	12.13	0.03	2.00	1.28	0.09	0.27	0.00		
35 63_Bypass	0.06	0 12:08	12.31	0.00	1.38	3.57	0.04	0.13	0.00		
36 64-Bypass	0.34	0 12:19	13.13	0.03	2.06	1.14	0.08	0.25	0.00		
37 66-bypass	0.34	0 12:18	12.23	0.03	1.96	0.85	0.08	0.26	0.00		
38 68_Bypass	0.07	0 12:07	12.99	0.01	1.44	2.24	0.05	0.14	0.00		
39 69_bypass	0.21	0 12:16	12.64	0.02	1.77	0.89	0.07	0.21	0.00		
40 71-Bypass	0.15	0 12:15	9.84	0.02	1.38	2.30	0.07	0.21	0.00		
41 73_Bypass	0.05	0 12:09	8.82	0.01	1.05	4.32	0.05	0.14	0.00		
42 74-Bypass	0.26	0 12:10	6.58	0.04	1.15	1.21	0.10	0.30	0.00		
43 76_Bypass	0.29	0 12:08	6.77	0.04	1.22	1.38	0.10	0.31	0.00		
44 77_Bypass	0.08	0 12:07	6.96	0.01	0.92	1.79	0.06	0.19	0.00		
45 79_Bypass	0.10	0 12:09	5.40	0.02	0.88	5.03	0.07	0.22	0.00		
46 8_Bypass	0.11	0 12:08	0.48	0.23	1.41	2.07	0.06	0.58	0.00		
47 81_Bypass	0.08	0 12:08	6.23	0.01	0.97	3.56	0.06	0.19	0.00		
48 83_bypass	0.04	0 12:08	6.04	0.01	0.72	3.22	0.05	0.15	0.00		
49 9_Bypass	0.09	0 12:08	10.94	0.01	1.36	2.08	0.05	0.17	0.00		
50 EX32-bypass	0.16	0 12:07	7.51	0.02	1.39	1.87	0.07	0.23	0.00		
51 EX33-bypass	0.01	0 12:07	9.39	0.00	0.67	1.74	0.02	0.06	0.00		
52 Outfall-1	15.36	0 12:15	439.39	0.03	8.99	0.62	0.71	0.24	0.00		

Proposal No. 609035- 126590

Boston Rd. 609035  
Westford, MA

Post-Development  
2-yr

March 22, 2023

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	101-100	30.00	258.50	0.00	257.00	0.50	1.50	5.0000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	102-101	60.00	259.57	0.00	258.70	0.20	0.87	1.4500	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
3	103-101	30.00	259.63	0.00	258.70	0.20	0.93	3.1000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
4	104-101	190.00	262.08	0.00	258.70	0.20	3.38	1.7800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
5	105-104	29.00	262.58	0.00	262.18	0.10	0.40	1.3800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
6	106-104	6.00	262.24	0.00	262.18	0.10	0.06	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
7	7-Oct	303.00	267.50	0.00	262.10	0.10	5.40	1.7800	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
8	10-Nov	17.00	269.00	0.00	268.50	1.00	0.50	2.9400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
9	10-Dec	5.00	268.70	0.00	268.50	1.00	0.20	4.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
10	13-10	93.00	269.10	0.00	267.60	0.10	1.50	1.6100	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
11	14-13	195.00	274.00	0.00	269.20	0.10	4.80	2.4600	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
12	15-14	15.00	276.00	0.00	275.90	1.90	0.10	0.6700	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
13	16-14	7.00	275.00	0.00	274.60	0.60	0.40	5.7100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
14	17-14	133.00	282.30	0.00	274.50	0.50	7.80	5.8600	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
15	18-17	115.00	289.30	0.00	282.40	0.10	6.90	6.0000	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
16	19-18	7.00	289.75	0.00	289.30	0.00	0.45	6.4300	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
17	20-18	118.00	296.30	0.00	289.40	0.10	6.90	5.8500	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
18	1-Feb	27.00	253.60	0.00	253.20	3.20	0.40	1.4800	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
19	21-20	106.00	302.10	0.00	296.40	0.10	5.70	5.3800	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
20	22-21	19.00	304.00	0.00	302.10	0.00	1.90	10.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
21	23-21	4.00	303.50	0.00	303.35	1.25	0.15	3.7500	CIRCULAR	18.000	18.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
22	24-21	192.00	313.50	0.00	302.20	0.10	11.30	5.8900	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
23	25-24	17.00	314.00	0.00	313.50	0.00	0.50	2.9400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
24	26-24	206.00	322.80	0.00	313.60	0.10	9.20	4.4700	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
25	27-26	16.00	323.50	0.00	323.00	0.20	0.50	3.1300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
26	28-26	8.00	323.50	0.00	323.00	0.20	0.50	6.2500	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
27	29-26	188.00	326.75	0.00	322.90	0.10	3.85	2.0500	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
28	30-29	8.00	327.75	0.00	327.40	0.65	0.35	4.3800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
29	31-29	156.00	327.90	0.25	326.85	0.10	1.05	0.6700	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
30	31-Out	37.00	327.70	0.05	327.45	0.45	0.25	0.6800	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
31	2-Mar	260.00	259.30	0.00	253.70	0.10	5.60	2.1500	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
32	32-6	18.00	255.00	0.00	254.20	0.60	0.80	4.4400	CIRCULAR	6.000	6.000	0.0110	0.5000	0.5000	0.0000	0.00	No	2
33	33-31	10.00	331.69	0.00	330.89	3.24	0.80	8.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
34	33-out	40.00	253.10	0.00	250.00	0.00	3.10	7.7500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
35	34-31	34.00	330.72	0.40	329.70	2.05	1.02	3.0000	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
36	35-34	11.00	332.50	0.00	332.40	2.08	0.10	0.9100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
37	36-34	240.00	340.60	-0.40	330.82	0.50	9.78	4.0800	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
38	37-36	18.00	341.90	0.00	341.10	0.10	0.80	4.4400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
39	38-36	16.00	341.30	0.00	341.10	0.10	0.20	1.2500	CIRCULAR	18.000	18.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
40	39-36	266.00	354.40	0.00	341.10	0.10	13.30	5.0000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
41	40-39	17.00	355.35	0.00	355.00	0.60	0.35	2.0600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
42	41-39	6.00	355.36	0.00	355.00	0.60	0.36	6.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
43	42-39	217.00	365.50	0.00	354.50	0.10	11.00	5.0700	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
44	3-Apr	19.00	265.00	0.00	263.50	4.20	1.50	7.8900	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
45	43-42	5.00	365.92	0.00	365.80	0.30	0.12	2.4000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
46	44-42	66.00	367.50	0.00	365.60	0.10	1.90	2.8800	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
47	45-44	18.00	368.70	0.00	368.50	1.00	0.20	1.1100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
48	46-44	7.00	368.69	0.00	368.50	1.00	0.19	2.7100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
49	47-44	119.00	370.40	0.00	367.60	0.10	2.80	2.3500	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
50	49-47	14.00	372.80	0.00	372.60	2.20	0.20	1.4300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
51	50-47	74.00	372.62	0.12	370.90	0.50	1.72	2.3200	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
52	51-50	8.00	373.77	0.00	373.50	1.00	0.27	3.3700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
53	52-50	67.00	374.40	0.00	372.72	0.22	1.68	2.5100	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
54	3-May	38.00	264.50	0.00	263.50	4.20	1.00	2.6300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
55	53-52	15.00	374.65	0.00	374.40	0.00	0.25	1.6700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
56	54-52	11.00	374.68	0.00	374.40	0.00	0.28	2.5500	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
57	55-52	95.00	376.70	0.00	374.50	0.10	2.20	2.3200	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
58	56-55	6.00	377.46	0.00	377.40	0.70	0.06	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
59	57-55	95.00	379.05	0.00	376.77	0.07	2.28	2.4000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
60	58-57	6.00	379.29	0.00	379.17	0.12	0.12	2.0000	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
61	59-57	18.00	379.54	0.00	379.17	0.12	0.37	2.0600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
62	60-57	140.00	382.35	0.00	379.15	0.10	3.20	2.2900	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
63	61-60	6.00	382.57	0.00	382.50	0.15	0.07	1.1700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
64	62-60	150.00	386.00	0.00	382.40	0.05	3.60	2.4000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
65	3-Jun	38.00	260.10	0.00	259.40	0.10	0.70	1.8400										

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
76 71-70	8.00	392.55	0.00	392.34	1.14	0.21	2.6300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
77 72-70	78.00	391.90	0.20	391.30	0.10	0.60	0.7700	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
78 73-72	18.00	393.04	0.00	392.68	0.98	0.36	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
79 74-72	7.00	393.10	0.00	392.90	1.20	0.20	2.8600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
80 75-72	99.00	392.70	0.00	392.00	0.30	0.70	0.7100	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
81 76-75	6.00	393.74	0.00	393.70	1.00	0.04	0.6700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
82 77-75	17.00	393.30	0.00	393.13	0.43	0.17	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
83 78-75	201.00	393.90	0.00	392.80	0.10	1.10	0.5500	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
84 79-78	4.00	394.98	0.00	394.90	1.00	0.08	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
85 80-78	25.00	394.90	0.00	394.40	0.50	0.50	2.0000	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
86 81-80	3.00	396.00	0.00	395.90	1.00	0.10	3.3300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
87 82-78	107.00	395.15	0.00	394.40	0.50	0.75	0.7000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
88 83-82	50.00	395.55	0.00	395.25	0.10	0.30	0.6000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
89 84-82	42.00	395.80	0.00	395.25	0.10	0.55	1.3100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
90 7-Aug	26.00	265.91	0.00	265.50	3.50	0.41	1.5800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
91 7-Sep	6.00	265.99	0.00	265.50	3.50	0.49	8.1700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
92 Culvert2	25.00	270.70	0.00	269.63	0.53	1.07	4.2800	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
93 EX1-6	153.00	256.50	0.00	255.10	1.50	1.40	0.9200	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
94 EX3-4	62.00	268.60	-0.10	268.20	0.10	0.40	0.6500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
95 EX4-5	22.00	268.10	0.00	266.00	0.10	2.10	9.5500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
96 EX5-6	28.00	265.90	0.00	265.13	5.03	0.77	2.7500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
97 EX9-3	20.00	268.90	0.00	268.70	0.00	0.20	1.0000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
98 FSP1-Out	20.00	273.00	0.00	272.60	1.90	0.40	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
99 FSP2-Out	178.00	272.00	0.00	269.00	0.10	3.00	1.6900	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
100 Out2_1	297.73	249.00	0.00	249.00	0.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
101 Out2_2	345.60	250.00	0.00	250.00	1.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
102 Pond_Outfall	50.00	249.50	0.00	249.00	0.00	0.50	1.0000	CIRCULAR	30.000	30.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
103 SD-16	250.00	290.00	0.00	275.10	0.10	14.90	5.9600	CIRCULAR	9.960	9.960	0.0110	0.5000	0.5000	0.0000	0.00	No	1
104 SD-19	224.00	302.75	0.00	290.00	0.25	12.75	5.6900	CIRCULAR	9.960	9.960	0.0110	0.5000	0.5000	0.0000	0.00	No	1
105 SD-23	411.00	323.75	0.00	302.75	-0.75	21.00	5.1100	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
106 SD-28	357.00	331.94	0.00	323.75	0.25	8.19	2.2900	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
107 SD-33	268.00	341.55	0.00	331.94	0.25	9.61	3.5900	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
108 SD-38	284.00	355.60	0.00	341.55	0.25	14.05	4.9500	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 101-100	1.11	0 12:06	6.90	0.16	6.44	0.08	0.27	0.27	0.00		Calculated
2 102-101	0.19	0 12:06	5.07	0.04	3.10	0.32	0.13	0.13	0.00		Calculated
3 103-101	0.38	0 12:06	7.41	0.05	4.95	0.10	0.15	0.15	0.00		Calculated
4 104-101	0.54	0 12:07	5.62	0.10	4.53	0.70	0.21	0.21	0.00		Calculated
5 105-104	0.09	0 12:06	4.95	0.02	2.40	0.20	0.09	0.09	0.00		Calculated
6 106-104	0.45	0 12:06	4.21	0.11	3.49	0.03	0.22	0.22	0.00		Calculated
7 7-Oct	29.39	0 12:10	105.23	0.28	12.76	0.40	1.08	0.36	0.00		Calculated
8 10-Nov	0.45	0 12:06	7.22	0.06	5.10	0.06	0.17	0.17	0.00		Calculated
9 10-Dec	0.12	0 12:06	8.42	0.01	3.84	0.02	0.08	0.08	0.00		Calculated
10 13-10	28.95	0 12:10	100.11	0.29	12.25	0.13	1.10	0.37	0.00		Calculated
11 14-13	27.95	0 12:10	76.05	0.37	14.30	0.23	1.05	0.42	0.00		Calculated
12 15-14	0.34	0 12:06	6.23	0.06	2.73	0.09	0.20	0.16	0.00		Calculated
13 16-14	1.87	0 12:07	10.07	0.19	9.80	0.01	0.29	0.29	0.00		Calculated
14 17-14	26.01	0 12:10	117.39	0.22	19.22	0.12	0.80	0.32	0.00		Calculated
15 18-17	26.01	0 12:10	118.74	0.22	19.38	0.10	0.79	0.32	0.00		Calculated
16 19-18	2.21	0 12:07	19.36	0.11	10.48	0.01	0.29	0.23	0.00		Calculated
17 20-18	24.05	0 12:10	117.22	0.21	18.77	0.10	0.77	0.31	0.00		Calculated
18 1-Feb	31.94	0 12:11	95.94	0.33	12.20	0.04	1.19	0.40	0.00		Calculated
19 21-20	24.05	0 12:10	112.41	0.21	18.22	0.10	0.79	0.31	0.00		Calculated
20 22-21	0.39	0 12:06	13.32	0.03	7.59	0.04	0.12	0.12	0.00		Calculated
21 23-21	5.45	0 12:09	24.04	0.23	11.00	0.01	0.49	0.32	0.00		Calculated
22 24-21	18.64	0 12:14	117.60	0.16	17.50	0.18	0.67	0.27	0.00		Calculated
23 25-24	0.48	0 12:06	7.22	0.07	5.18	0.05	0.18	0.18	0.00		Calculated
24 26-24	18.38	0 12:14	102.44	0.18	15.77	0.22	0.72	0.29	0.00		Calculated
25 27-26	0.40	0 12:06	7.44	0.05	5.05	0.05	0.16	0.16	0.00		Calculated
26 28-26	3.85	0 12:12	19.09	0.20	12.17	0.01	0.38	0.30	0.00		Calculated
27 29-26	14.41	0 12:15	69.37	0.21	11.15	0.28	0.77	0.31	0.00		Calculated
28 30-29	0.42	0 12:06	8.81	0.05	5.79	0.02	0.15	0.15	0.00		Calculated
29 31-29	14.21	0 12:15	39.77	0.36	7.42	0.35	1.03	0.41	0.00		Calculated
30 31-Out	15.36	0 12:15	21.98	0.70	7.56	0.08	1.23	0.62	0.00		Calculated
31 2-Mar	31.94	0 12:11	115.68	0.28	13.99	0.31	1.08	0.36	0.00		Calculated
32 32-6	0.48	0 12:06	2.80	0.17	5.33	0.06	0.14	0.28	0.00		Calculated
33 33-31	3.34	0 12:09	11.91	0.28	13.01	0.01	0.36	0.36	0.00		Calculated
34 33-out	0.46	0 12:06	9.92	0.05	6.47	0.10	0.15	0.15	0.00		Calculated
35 34-31	27.09	0 12:16	83.96	0.32	15.24	0.04	0.98	0.39	0.00		Calculated
36 35-34	0.45	0 12:06	4.01	0.11	3.38	0.05	0.23	0.23	0.00		Calculated
37 36-34	26.88	0 12:16	99.84	0.27	17.26	0.23	0.89	0.35	0.00		Calculated
38 37-36	0.36	0 12:06	8.88	0.04	5.52	0.05	0.14	0.14	0.00		Calculated
39 38-36	3.22	0 12:13	13.88	0.23	6.39	0.04	0.49	0.33	0.00		Calculated
40 39-36	23.62	0 12:18	59.78	0.40	17.90	0.25	0.87	0.44	0.00		Calculated
41 40-39	0.37	0 12:06	6.04	0.06	4.25	0.07	0.17	0.17	0.00		Calculated
42 41-39	1.34	0 12:23	10.31	0.13	9.06	0.01	0.24	0.24	0.00		Calculated
43 42-39	22.19	0 12:17	60.19	0.37	17.69	0.20	0.84	0.42	0.00		Calculated
44 3-Apr	0.18	0 12:07	11.83	0.02	5.49	0.06	0.09	0.09	0.00		Calculated
45 43-42	0.78	0 12:24	6.52	0.12	5.57	0.01	0.23	0.23	0.00		Calculated
46 44-42	21.54	0 12:16	45.36	0.47	14.25	0.08	0.97	0.49	0.00		Calculated
47 45-44	0.37	0 12:06	4.44	0.08	3.43	0.09	0.20	0.20	0.00		Calculated
48 46-44	1.61	0 12:25	6.94	0.23	7.18	0.02	0.33	0.33	0.00		Calculated
49 47-44	20.01	0 12:15	41.01	0.49	12.97	0.15	0.99	0.49	0.00		Calculated
50 49-47	1.32	0 12:27	5.03	0.26	5.40	0.04	0.35	0.35	0.00		Calculated
51 50-47	19.00	0 12:15	40.76	0.47	12.74	0.10	0.96	0.48	0.00		Calculated
52 51-50	1.46	0 12:26	7.74	0.19	7.57	0.02	0.29	0.29	0.00		Calculated
53 52-50	17.87	0 12:14	42.34	0.42	12.90	0.09	0.91	0.45	0.00		Calculated
54 3-May	0.51	0 12:06	6.83	0.07	5.12	0.12	0.19	0.19	0.00		Calculated
55 53-52	0.26	0 12:06	5.44	0.05	3.56	0.07	0.15	0.15	0.00		Calculated
56 54-52	1.50	0 12:26	12.18	0.12	6.74	0.03	0.30	0.24	0.00		Calculated
57 55-52	16.57	0 12:14	40.69	0.41	12.29	0.13	0.89	0.44	0.00		Calculated
58 56-55	1.45	0 12:25	4.21	0.34	4.86	0.02	0.40	0.40	0.00		Calculated
59 57-55	15.42	0 12:13	41.42	0.37	12.21	0.13	0.85	0.42	0.00		Calculated
60 58-57	1.69	0 12:06	10.80	0.16	6.40	0.02	0.33	0.27	0.00		Calculated
61 59-57	0.35	0 12:06	6.04	0.06	4.19	0.07	0.16	0.16	0.00		Calculated
62 60-57	13.70	0 12:13	40.42	0.34	11.62	0.20	0.80	0.40	0.00		Calculated
63 61-60	1.35	0 12:21	4.55	0.30	5.04	0.02	0.37	0.37	0.00		Calculated
64 62-60	12.62	0 12:12	41.42	0.30	11.57	0.22	0.76	0.38	0.00		Calculated
65 3-Jun	31.43	0 12:10	106.99	0.29	13.15	0.05	1.11	0.37	0.00		Calculated
66 63-62	0.26	0 12:06	3.23	0.08	2.48	0.11	0.19	0.19	0.00		Calculated
67 64-62	1.29	0 12:18	11.33	0.11	4.25	0.02	0.34	0.23	0.00		Calculated
68 65-62	11.33	0 12:10	39.21	0.29	10.80	0.14	0.74	0.37	0.00		Calculated
69 66-65	1.29	0 12:18	4.21	0.31	4.72	0.04	0.38	0.38	0.00		Calculated
70 7-Jun	30.01	0 12:10	103.21	0.29	12.65	0.14	1.11	0.37	0.00		Calculated
71 67-65	10.22	0 12:10	38.81	0.26	10.42	0.15	0.70	0.35	0.00		Calculated
72 68-67	0.32	0 12:06	3.23	0.10	2.62	0.11	0.21	0.21	0.00		Calculated
73 69-67	1.00	0 12:16	4.01	0.25	4.25	0.04	0.34	0.34	0.00		Calculated
74 6-out	1.59	0 12:07	5.26	0.30	5.87	0.47	0.38	0.38	0.00		Calculated

**Pipe Results**

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
75 70-67	9.07	0 12:10	19.66	0.46	6.13	0.50	0.95	0.48	0.00		Calculated
76 71-70	0.82	0 12:13	6.82	0.12	5.85	0.02	0.23	0.23	0.00		Calculated
77 72-70	8.30	0 12:09	23.45	0.35	6.82	0.19	0.82	0.41	0.00		Calculated
78 73-72	0.16	0 12:06	5.95	0.03	3.33	0.09	0.11	0.11	0.00		Calculated
79 74-72	1.02	0 12:09	7.12	0.14	6.42	0.02	0.26	0.26	0.00		Calculated
80 75-72	7.14	0 12:09	22.48	0.32	6.35	0.26	0.78	0.39	0.00		Calculated
81 76-75	1.07	0 12:07	3.44	0.31	3.86	0.03	0.38	0.38	0.00		Calculated
82 77-75	0.26	0 12:06	4.21	0.06	2.97	0.10	0.17	0.17	0.00		Calculated
83 78-75	5.89	0 12:10	19.78	0.30	5.49	0.61	0.75	0.37	0.00		Calculated
84 79-78	0.29	0 12:05	5.95	0.05	3.94	0.02	0.15	0.15	0.00		Calculated
85 80-78	4.20	0 12:09	10.80	0.39	8.24	0.05	0.54	0.43	0.00		Calculated
86 81-80	0.55	0 12:06	7.69	0.07	5.69	0.01	0.18	0.18	0.00		Calculated
87 82-78	1.48	0 12:10	3.53	0.42	4.30	0.41	0.45	0.45	0.00		Calculated
88 83-82	0.18	0 12:06	3.26	0.06	2.25	0.37	0.16	0.16	0.00		Calculated
89 84-82	1.35	0 12:11	4.82	0.28	5.27	0.13	0.36	0.36	0.00		Calculated
90 7-Aug	0.42	0 12:06	5.29	0.08	4.04	0.11	0.19	0.19	0.00		Calculated
91 7-Sep	0.38	0 12:06	12.03	0.03	7.01	0.01	0.12	0.12	0.00		Calculated
92 Culvert2	1.07	0 12:08	46.80	0.02	5.96	0.07	0.21	0.11	0.00		Calculated
93 EX1-6	1.11	0 12:07	3.41	0.32	3.89	0.66	0.39	0.39	0.00		Calculated
94 EX3-4	2.33	0 12:17	9.43	0.25	4.42	0.23	0.51	0.34	0.00		Calculated
95 EX4-5	2.33	0 12:17	32.45	0.07	10.67	0.03	0.27	0.18	0.00		Calculated
96 EX5-6	2.33	0 12:17	17.42	0.13	6.86	0.07	0.37	0.25	0.00		Calculated
97 EX9-3	2.33	0 12:17	10.50	0.22	4.78	0.07	0.48	0.32	0.00		Calculated
98 FSP1-Out	0.51	0 12:36	5.95	0.09	4.63	0.07	0.20	0.20	0.00		Calculated
99 FSP2-Out	1.90	0 12:18	13.64	0.14	5.43	0.55	0.38	0.25	0.00		Calculated
100 Out2_1	16.05	0 12:37	0.00	0.14	0.00		0.38	0.25	0.00		Calculated
101 Out2_2	2.05	0 12:06	0.00	0.14	0.00		0.38	0.25	0.00		Calculated
102 Pond_Outfall	16.05	0 12:37	41.02	0.39	7.84	0.11	1.09	0.43	0.00		Calculated
103 SD-16	1.47	0 12:08	6.32	0.23	9.45	0.44	0.27	0.33	0.00		Calculated
104 SD-19	1.84	0 12:08	6.18	0.30	9.90	0.38	0.31	0.37	0.00		Calculated
105 SD-23	5.27	0 12:09	16.95	0.31	12.21	0.56	0.48	0.38	0.00		Calculated
106 SD-28	3.78	0 12:12	11.56	0.33	8.44	0.70	0.49	0.39	0.00		Calculated
107 SD-33	3.25	0 12:09	7.97	0.41	9.65	0.46	0.44	0.44	0.00		Calculated
108 SD-38	2.88	0 12:13	9.37	0.31	10.50	0.45	0.38	0.38	0.00		Calculated

**Inlet Input**

SN ID	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft <sup>2</sup> )	Grate Clogging Factor (%)
1	CBEX-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	2.18	0.00	0.00	N/A	0.00
2	CBEX-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	3.80	0.00	0.00	N/A	0.00
3	STR-102	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.57	263.07	3.50	0.00	0.00	N/A	0.00
4	STR-103	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.63	263.13	3.50	0.00	0.00	N/A	0.00
5	STR-105	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.58	266.08	3.50	0.00	0.00	N/A	0.00
6	STR-106	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.24	265.74	3.50	0.00	0.00	N/A	0.00
7	STR-11	FHWA HEC-22 GENERIC	N/A	On Grade	1	269.00	272.87	3.87	0.00	0.00	N/A	0.00
8	STR-12	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.70	273.43	4.73	0.00	0.00	N/A	0.00
9	STR-15	FHWA HEC-22 GENERIC	N/A	On Grade	1	276.00	280.19	4.19	0.00	0.00	N/A	0.00
10	STR-16	FHWA HEC-22 GENERIC	N/A	On Grade	1	275.00	280.17	5.17	0.00	0.00	N/A	0.00
11	STR-19	FHWA HEC-22 GENERIC	N/A	On Grade	1	289.75	294.30	4.55	0.00	0.00	N/A	0.00
12	STR-22	FHWA HEC-22 GENERIC	N/A	On Grade	1	304.00	307.33	3.33	0.00	0.00	N/A	0.00
13	STR-23	FHWA HEC-22 GENERIC	N/A	On Grade	1	303.50	307.59	4.09	0.00	0.00	N/A	0.00
14	STR-25	FHWA HEC-22 GENERIC	N/A	On Grade	1	314.00	318.10	4.10	0.00	0.00	N/A	0.00
15	STR-27	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	327.01	3.51	0.00	0.00	N/A	0.00
16	STR-28	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	328.31	4.81	0.00	0.00	N/A	0.00
17	STR-30	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.75	331.70	3.95	0.00	0.00	N/A	0.00
18	STR-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	331.69	335.69	4.00	0.00	0.00	N/A	0.00
19	STR-35	FHWA HEC-22 GENERIC	N/A	On Grade	1	332.50	335.63	3.13	0.00	0.00	N/A	0.00
20	STR-37	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.90	346.48	4.58	0.00	0.00	N/A	0.00
21	STR-38	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.30	345.42	4.12	0.00	0.00	N/A	0.00
22	STR-4	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.00	269.29	4.29	0.00	0.00	N/A	0.00
23	STR-40	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.35	359.60	4.25	0.00	0.00	N/A	0.00
24	STR-41	FHWA HEC-22 GENERIC	N/A	On Grade	2	355.36	359.61	4.25	0.00	0.00	N/A	0.00
25	STR-43	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.92	370.25	4.33	0.00	0.00	N/A	0.00
26	STR-45	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.70	372.97	4.27	0.00	0.00	N/A	0.00
27	STR-46	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.69	373.15	4.46	0.00	0.00	N/A	0.00
28	STR-49	FHWA HEC-22 GENERIC	N/A	N/A	1	372.80	376.30	3.50	0.00	0.00	N/A	0.00
29	STR-5	FHWA HEC-22 GENERIC	N/A	On Grade	1	264.50	268.12	3.62	0.00	0.00	N/A	0.00
30	STR-51	FHWA HEC-22 GENERIC	N/A	On Grade	2	373.77	377.77	4.00	0.00	0.00	N/A	0.00
31	STR-53	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.65	379.35	4.70	0.00	0.00	N/A	0.00
32	STR-54	FHWA HEC-22 GENERIC	N/A	On Grade	2	374.68	379.95	5.27	0.00	0.00	N/A	0.00
33	STR-56	FHWA HEC-22 GENERIC	N/A	On Grade	2	377.46	381.46	4.00	0.00	0.00	N/A	0.00
34	STR-58	FHWA HEC-22 GENERIC	N/A	On Grade	2	379.29	383.46	4.17	0.00	0.00	N/A	0.00
35	STR-59	FHWA HEC-22 GENERIC	N/A	On Grade	1	379.54	383.54	4.00	0.00	0.00	N/A	0.00
36	STR-61	FHWA HEC-22 GENERIC	N/A	On Grade	2	382.57	386.57	4.00	0.00	0.00	N/A	0.00
37	STR-63	FHWA HEC-22 GENERIC	N/A	On Grade	1	386.20	389.71	3.51	0.00	0.00	N/A	0.00
38	STR-64	FHWA HEC-22 GENERIC	N/A	On Grade	2	386.15	389.91	3.76	0.00	0.00	N/A	0.00
39	STR-66	FHWA HEC-22 GENERIC	N/A	On Grade	2	388.48	391.98	3.50	0.00	0.00	N/A	0.00
40	STR-68	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.70	394.22	3.52	0.00	0.00	N/A	0.00
41	STR-69	FHWA HEC-22 GENERIC	N/A	On Grade	2	390.70	394.06	3.36	0.00	0.00	N/A	0.00
42	STR-71	FHWA HEC-22 GENERIC	N/A	On Grade	2	392.55	396.60	4.05	0.00	0.00	N/A	0.00
43	STR-73	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.04	397.14	4.10	0.00	0.00	N/A	0.00
44	STR-74	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.10	397.10	4.00	0.00	0.00	N/A	0.00
45	STR-76	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.74	397.74	4.00	0.00	0.00	N/A	0.00
46	STR-77	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.30	397.80	4.50	0.00	0.00	N/A	0.00
47	STR-79	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.98	398.87	3.89	0.00	0.00	N/A	0.00
48	STR-8	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.91	272.08	6.17	0.00	0.00	N/A	0.00
49	STR-81	FHWA HEC-22 GENERIC	N/A	On Grade	2	396.00	398.85	2.85	0.00	0.00	N/A	0.00
50	STR-83	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.55	399.55	4.00	0.00	0.00	N/A	0.00
51	STR-84	FHWA HEC-22 GENERIC	N/A	On Sag	2	395.80	399.80	4.00	0.00	0.00	0.00	0.00
52	STR-9	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.99	270.92	4.93	0.00	0.00	N/A	0.00



**Roadway & Gutter Input**

SN Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1 CBEX-32	0.0170	0.0200	0.0130	0.0200	3.00	0.0328	10.50
2 CBEX-33	0.0170	0.0200	0.0130	0.0620	2.00	0.0000	10.50
3 STR-102	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
4 STR-103	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
5 STR-105	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
6 STR-106	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
7 STR-11	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
8 STR-12	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
9 STR-15	0.0590	0.0200	0.0130	0.0200	5.00	0.0000	10.50
10 STR-16	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
11 STR-19	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
12 STR-22	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
13 STR-23	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
14 STR-25	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
15 STR-27	0.0200	0.0200	0.0130	0.0200	5.00	0.0000	10.50
16 STR-28	0.0200	0.0200	0.0130	0.0200	5.00	0.0000	10.50
17 STR-30	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
18 STR-33	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
19 STR-35	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
20 STR-37	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
21 STR-38	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
22 STR-4	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
23 STR-40	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
24 STR-41	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
25 STR-43	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
26 STR-45	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
27 STR-46	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
28 STR-5	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
29 STR-51	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
30 STR-53	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
31 STR-54	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
32 STR-56	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
33 STR-58	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
34 STR-59	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
35 STR-61	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
36 STR-63	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
37 STR-64	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
38 STR-66	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
39 STR-68	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
40 STR-69	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
41 STR-71	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
42 STR-73	0.0065	0.0200	0.0130	0.0200	5.00	0.0000	10.50
43 STR-74	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
44 STR-76	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
45 STR-77	0.0065	0.0200	0.0130	0.0200	5.00	0.0000	10.50
46 STR-79	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
47 STR-8	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
48 STR-81	0.0050	0.0200	0.0130	0.0300	5.00	0.0000	10.50
49 STR-83	0.0050	0.0200	0.0130	0.0300	5.00	0.0000	10.50
50 STR-84	N/A	0.0200	0.0130	0.0620	2.00	0.0000	10.50
51 STR-9	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50

### Median & Ditch Input

SN Element ID	Median Ditch Longitudinal Slope (ft/ft)	Median Ditch Bottom Width (ft)	Median Ditch Left Side Slope	Median Ditch Right Side Slope	Median Ditch Manning's Roughness
1 STR-49	0.0250	2.0000	1:01	1:01	0.0160

**Inlet Results**

SN Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Time of Max Depth Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1 CBEX-32	0.64	0.56	0.49	0.15	76.44	5.12	257.28	0.10	0 12:06	0.00	0.00
2 CBEX-33	0.47	0.42	0.01	0.46	1.17	2.25	256.94	0.04	0 12:06	0.00	0.00
3 STR-102	0.24	0.22	0.22	0.02	90.96	3.54	263.14	0.07	0 12:06	0.00	0.00
4 STR-103	0.47	0.34	0.38	0.09	81.42	4.56	263.22	0.09	0 12:06	0.00	0.00
5 STR-105	0.11	0.07	0.11	0.00	98.12	2.66	266.13	0.05	0 12:06	0.00	0.00
6 STR-106	0.58	0.41	0.45	0.13	78.02	4.94	265.84	0.10	0 12:06	0.00	0.00
7 STR-11	0.64	0.59	0.46	0.18	71.58	6.44	273.00	0.13	0 12:06	0.00	0.00
8 STR-12	0.16	0.10	0.15	0.01	91.00	3.84	273.51	0.08	0 12:06	0.00	0.00
9 STR-15	0.39	0.34	0.36	0.03	91.55	3.37	280.26	0.07	0 12:05	0.00	0.00
10 STR-16	0.50	0.44	0.44	0.06	88.03	3.72	280.24	0.07	0 12:08	0.00	0.00
11 STR-19	0.45	0.42	0.40	0.05	89.26	3.60	294.37	0.07	0 12:08	0.00	0.00
12 STR-22	0.45	0.37	0.40	0.05	89.30	3.60	307.40	0.07	0 12:06	0.00	0.00
13 STR-23	0.25	0.22	0.24	0.01	96.30	2.86	307.65	0.06	0 12:09	0.00	0.00
14 STR-25	0.56	0.47	0.48	0.08	86.17	3.90	318.18	0.08	0 12:06	0.00	0.00
15 STR-27	0.49	0.39	0.40	0.09	81.62	4.50	327.10	0.09	0 12:06	0.00	0.00
16 STR-28	0.14	0.12	0.14	0.00	96.94	2.83	328.37	0.06	0 12:12	0.00	0.00
17 STR-30	0.53	0.41	0.43	0.11	79.99	4.69	331.79	0.09	0 12:06	0.00	0.00
18 STR-33	0.14	0.12	0.13	0.00	97.13	2.81	335.75	0.06	0 12:09	0.00	0.00
19 STR-35	0.58	0.53	0.45	0.12	78.66	4.84	335.73	0.10	0 12:06	0.00	0.00
20 STR-37	0.41	0.35	0.37	0.04	89.96	3.54	346.55	0.07	0 12:06	0.00	0.00
21 STR-38	0.43	0.34	0.41	0.01	96.78	2.79	345.50	0.08	0 12:13	0.00	0.00
22 STR-4	0.23	0.12	0.21	0.02	91.63	3.48	269.36	0.07	0 12:07	0.00	0.00
23 STR-40	0.43	0.37	0.38	0.05	89.39	3.59	359.67	0.07	0 12:06	0.00	0.00
24 STR-41	1.66	1.55	1.34	0.31	81.08	4.63	359.75	0.14	0 12:23	0.00	0.00
25 STR-43	0.88	0.35	0.78	0.10	88.33	3.67	370.36	0.11	0 12:24	0.00	0.00
26 STR-45	0.43	0.37	0.38	0.05	89.38	3.60	373.04	0.07	0 12:06	0.00	0.00
27 STR-46	2.15	1.66	1.23	0.92	57.23	5.12	373.25	0.10	0 12:25	0.00	0.00
28 STR-49	1.35	1.35	1.32	0.03	99.00	2.32	376.46	0.16	0 12:27	0.00	0.00
29 STR-5	0.69	0.60	0.52	0.17	75.24	5.26	268.23	0.11	0 12:06	0.00	0.00
30 STR-51	1.93	1.44	1.39	0.54	72.02	5.72	377.88	0.11	0 12:26	0.00	0.00
31 STR-53	0.31	0.24	0.28	0.04	88.76	3.74	379.42	0.07	0 12:06	0.00	0.00
32 STR-54	1.99	1.53	1.42	0.57	71.42	5.80	380.07	0.12	0 12:28	0.00	0.00
33 STR-56	1.91	1.36	1.38	0.53	72.17	5.70	381.57	0.11	0 12:25	0.00	0.00
34 STR-58	2.36	2.23	1.69	0.67	71.66	6.74	383.64	0.18	0 12:06	0.00	0.00
35 STR-59	0.43	0.37	0.36	0.07	84.23	4.21	383.62	0.08	0 12:06	0.00	0.00
36 STR-61	1.73	1.43	1.28	0.45	73.88	5.48	386.68	0.11	0 12:21	0.00	0.00
37 STR-63	0.32	0.25	0.29	0.04	88.40	3.78	389.79	0.08	0 12:06	0.00	0.00
38 STR-64	1.63	1.29	1.22	0.41	74.83	5.36	390.02	0.11	0 12:18	0.00	0.00
39 STR-66	1.64	1.43	1.22	0.41	74.77	5.37	392.09	0.11	0 12:18	0.00	0.00
40 STR-68	0.39	0.34	0.33	0.05	85.91	4.03	394.30	0.08	0 12:05	0.00	0.00
41 STR-69	1.21	1.06	1.00	0.22	82.23	4.82	394.20	0.14	0 12:16	0.00	0.00
42 STR-71	0.98	0.77	0.77	0.21	78.38	5.58	396.71	0.11	0 12:13	0.00	0.00
43 STR-73	0.22	0.14	0.19	0.03	88.23	4.08	397.22	0.08	0 12:01	0.00	0.00
44 STR-74	1.28	0.99	1.02	0.26	79.94	6.73	397.28	0.18	0 12:09	0.00	0.00
45 STR-76	1.36	1.28	1.07	0.29	78.94	6.93	397.93	0.19	0 12:07	0.00	0.00
46 STR-77	0.34	0.25	0.28	0.06	81.80	4.86	397.90	0.10	0 12:06	0.00	0.00
47 STR-79	0.39	0.39	0.31	0.08	79.23	5.34	398.98	0.11	0 12:05	0.00	0.00
48 STR-8	0.54	0.37	0.43	0.11	79.35	4.79	272.18	0.10	0 12:06	0.00	0.00
49 STR-81	0.63	0.59	0.56	0.07	88.73	4.95	399.00	0.15	0 12:06	0.00	0.00
50 STR-83	0.22	0.22	0.21	0.01	93.65	3.36	399.65	0.10	0 12:06	0.00	0.00
51 STR-84	1.35	1.35	N/A	N/A	N/A	6.25	399.95	0.15	0 12:10	0.00	0.00
52 STR-9	0.47	0.44	0.39	0.09	81.31	4.57	271.01	0.09	0 12:06	0.00	0.00

### Storage Nodes

#### Storage Node : FSP-1

##### Input Data

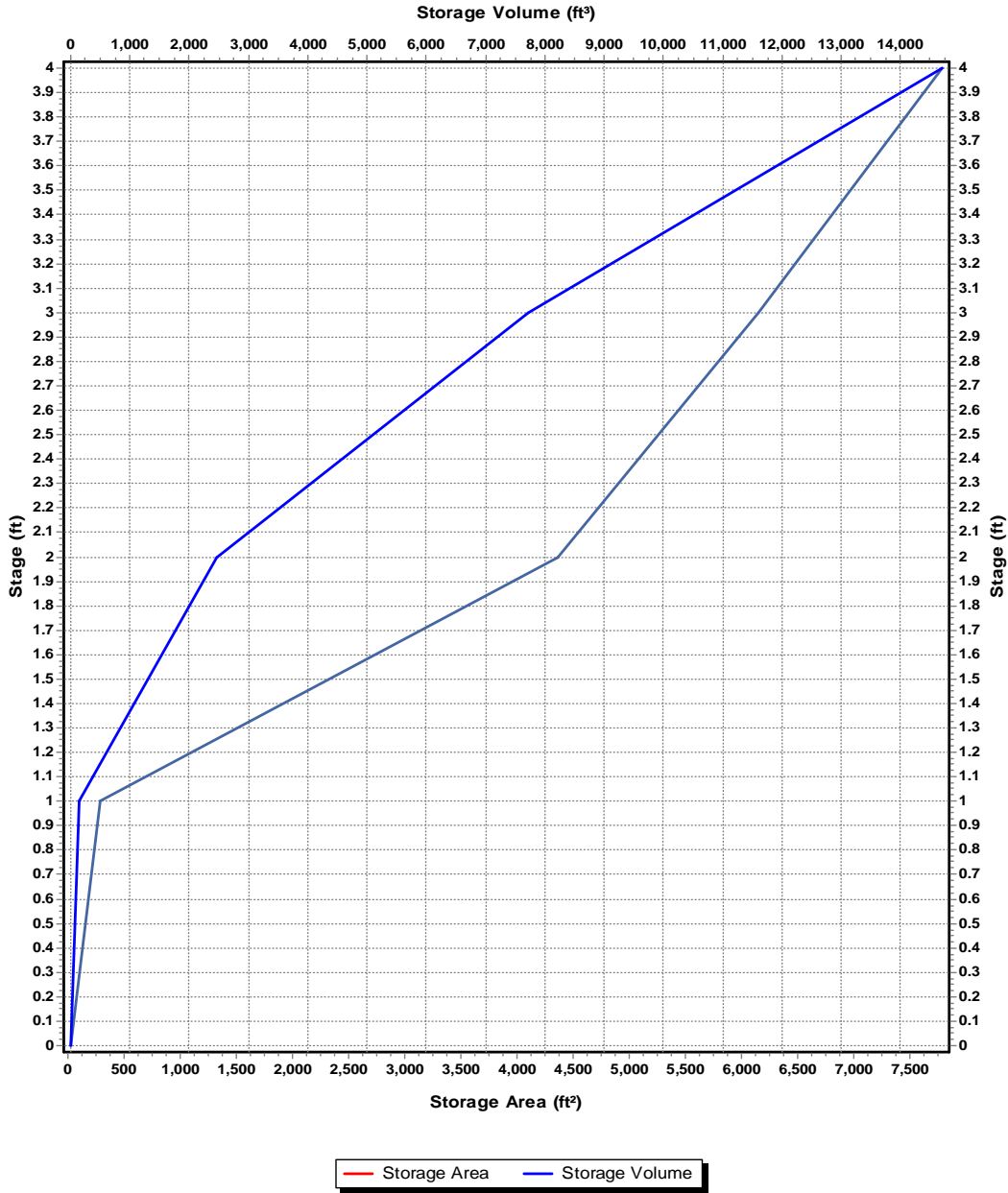
Invert Elevation (ft) .....	272
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	4
Initial Water Elevation (ft) .....	272
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	7794
Evaporation Loss .....	0

##### Storage Area Volume Curves

Storage Curve : FH-Pond1

Stage	Storage Area	Storage Volume
(ft)	(ft <sup>2</sup> )	(ft <sup>3</sup> )
0	20	0
1	277	148.5
2	4361	2467.5
3	6157	7726.5
4	7794	14702

### Storage Area Volume Curves



**Storage Node : FSP-1 (continued)**

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 FSP1-1	Side	CIRCULAR	No	8.00			274.00	0.60
2 FSP1-2	Side	CIRCULAR	No	12.00			274.12	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	2.76
Peak Lateral Inflow (cfs) .....	2.76
Peak Outflow (cfs) .....	0.51
Peak Exfiltration Flow Rate (cfm) .....	6.95
Max HGL Elevation Attained (ft) .....	274.3
Max HGL Depth Attained (ft) .....	2.3
Average HGL Elevation Attained (ft) .....	273.06
Average HGL Depth Attained (ft) .....	1.06
Time of Max HGL Occurrence (days hh:mm) .....	0 12:36
Total Exfiltration Volume (1000-ft³) .....	5.029
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : FSP-2**

**Input Data**

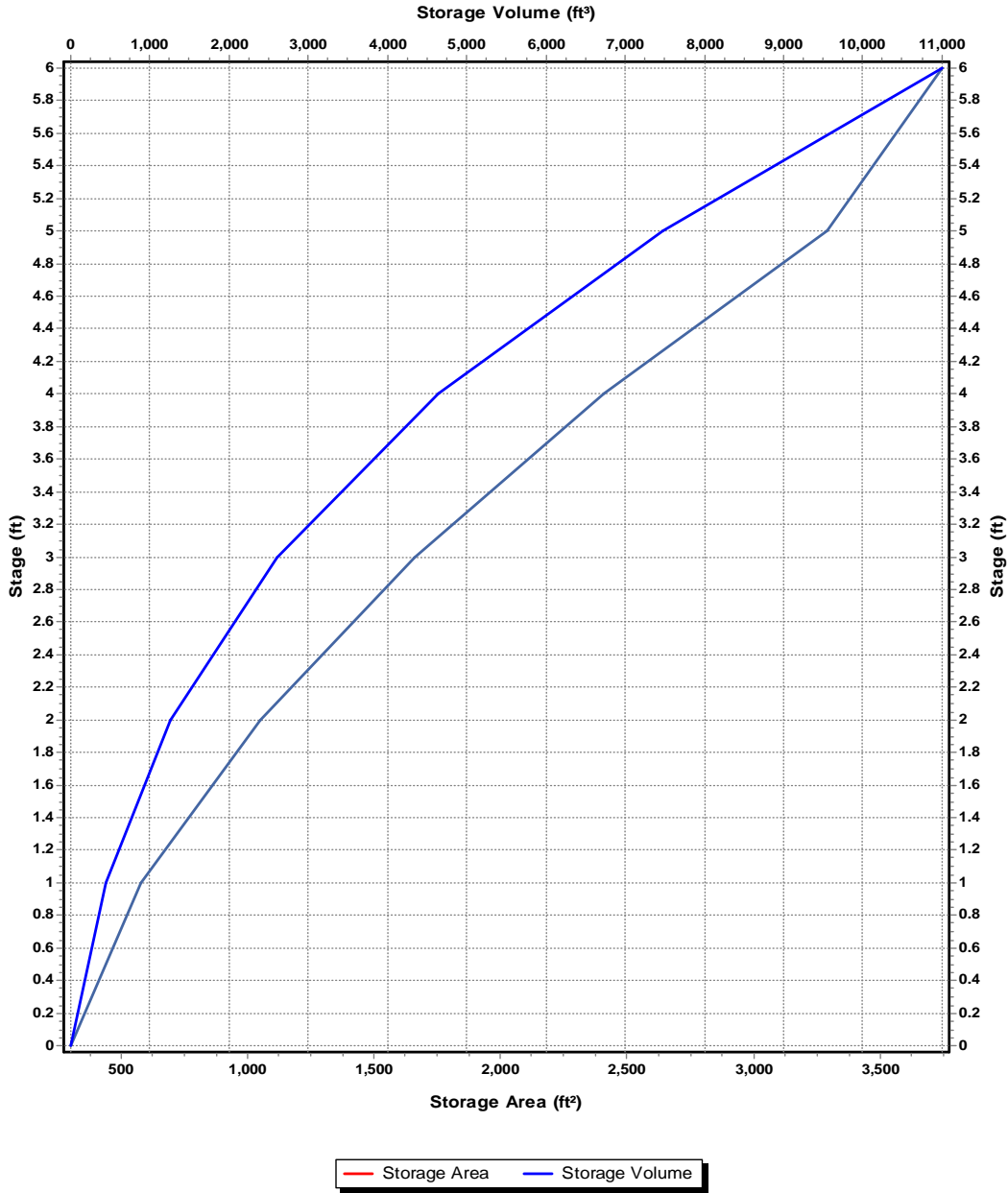
Invert Elevation (ft) .....	270
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	6
Initial Water Elevation (ft) .....	270
Initial Water Depth (ft) .....	0
Ponded Area (ft²) .....	3746
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : FH-Pond2

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	300	0
1	578	439
2	1048	1252
3	1659	2605.5
4	2406	4638
5	3289	7485.5
6	3746	11003

### Storage Area Volume Curves





**Storage Node : FSP-2 (continued)**

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 FSP2-1	Side	CIRCULAR	No	8.00			273.00	0.60
2 FSP2-2	Side	CIRCULAR	No	15.00			273.25	0.60
3 FSP2-3	Side	CIRCULAR	No	15.00			273.50	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	3.44
Peak Lateral Inflow (cfs) .....	3.44
Peak Outflow (cfs) .....	1.9
Peak Exfiltration Flow Rate (cfm) .....	3.03
Max HGL Elevation Attained (ft) .....	273.64
Max HGL Depth Attained (ft) .....	3.64
Average HGL Elevation Attained (ft) .....	271.63
Average HGL Depth Attained (ft) .....	1.63
Time of Max HGL Occurrence (days hh:mm) .....	0 12:17
Total Exfiltration Volume (1000-ft³) .....	2,258
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : Pond\_1**

**Input Data**

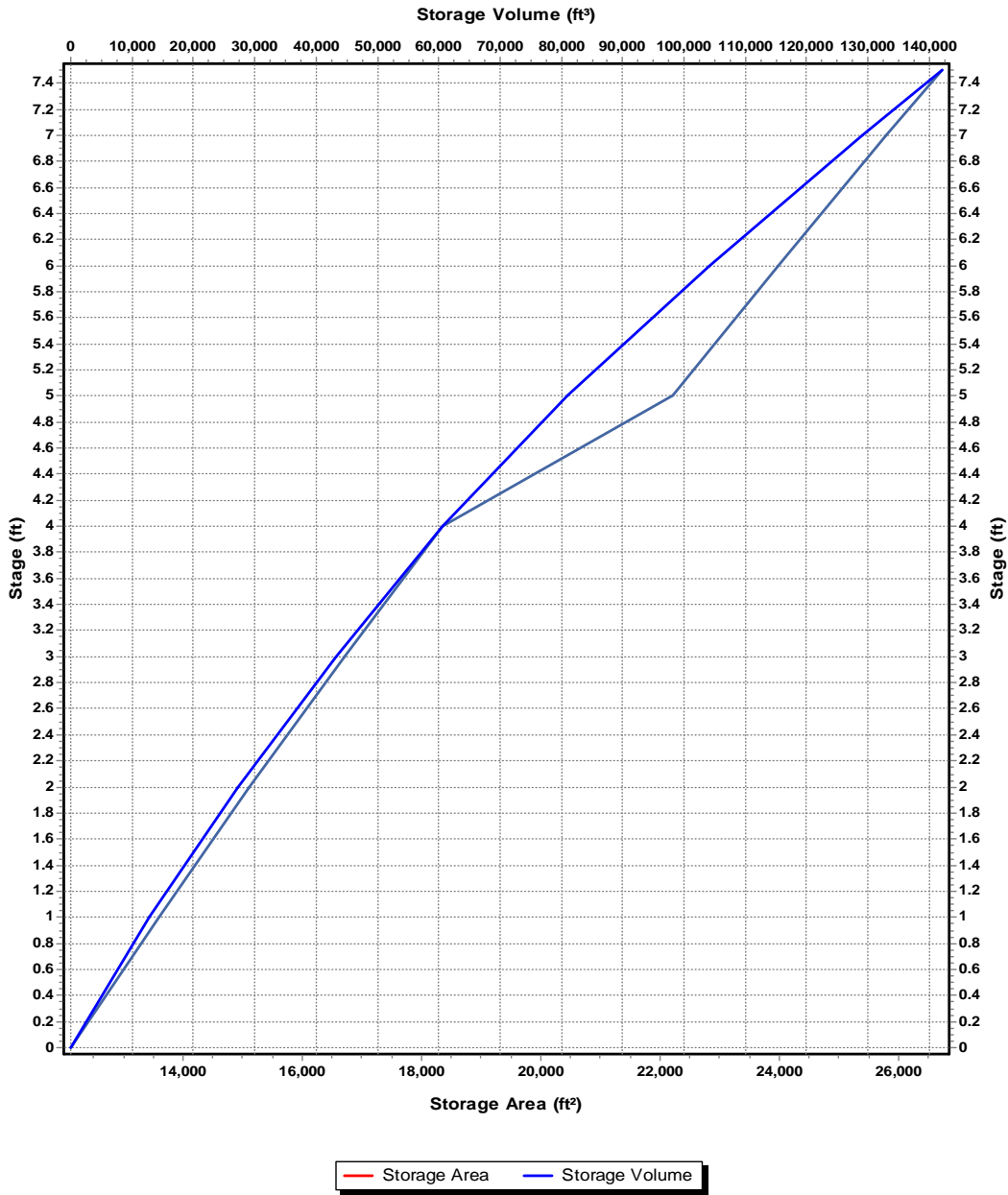
Invert Elevation (ft) .....	250
Max (Rim) Elevation (ft) .....	257.5
Max (Rim) Offset (ft) .....	7.5
Initial Water Elevation (ft) .....	250
Initial Water Depth (ft) .....	0
Ponded Area (ft²) .....	25046
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : Pond 1

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	12130	0
1	13618	12874
2	15124	27245
3	16705	43159.5
4	18355	60689.5
5	22210	80972
6	23978	104066
7	25802	128956
7.5	26736	142090.5

### Storage Area Volume Curves



**Storage Node : Pond\_1 (continued)**

**Outflow Weirs**

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 PondOverflow	Trapezoidal	No	255.90	5.90	20.00	1.50	3.33

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Pond_LowFlow	Side	Rectangular	No		18.00	18.00	250.00	0.63
2 primary	Side	Rectangular	No		17.00	12.00	252.65	0.63
3 RiserTop	Bottom	Rectangular	No		48.00	48.00	255.90	0.63

**Output Summary Results**

Peak Inflow (cfs) .....	31.94
Peak Lateral Inflow (cfs) .....	0
Peak Outflow (cfs) .....	16.05
Peak Exfiltration Flow Rate (cfm) .....	0
Max HGL Elevation Attained (ft) .....	252.74
Max HGL Depth Attained (ft) .....	2.74
Average HGL Elevation Attained (ft) .....	250.35
Average HGL Depth Attained (ft) .....	0.35
Time of Max HGL Occurrence (days hh:mm) .....	0 12:37
Total Exfiltration Volume (1000-ft³) .....	0
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : STR-31**

**Input Data**

Invert Elevation (ft) .....	327.65
Max (Rim) Elevation (ft) .....	335.28
Max (Rim) Offset (ft) .....	7.63
Initial Water Elevation (ft) .....	327.65
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	0
Evaporation Loss .....	0

**Output Summary Results**

Peak Inflow (cfs) .....	29.57
Peak Lateral Inflow (cfs) .....	0
Peak Outflow (cfs) .....	29.57
Peak Exfiltration Flow Rate (cfm) .....	0
Max HGL Elevation Attained (ft) .....	328.93
Max HGL Depth Attained (ft) .....	1.28
Average HGL Elevation Attained (ft) .....	327.97
Average HGL Depth Attained (ft) .....	0.32
Time of Max HGL Occurrence (days hh:mm) .....	0 12:15
Total Exfiltration Volume (1000-ft <sup>3</sup> ) .....	0
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

### Project Description

File Name ..... Boston Rd - Post Dev - 20230227.SPF

### Project Options

Flow Units ..... CFS  
 Elevation Type ..... Elevation  
 Hydrology Method ..... SCS TR-55  
 Time of Concentration (TOC) Method ..... SCS TR-55  
 Link Routing Method ..... Kinematic Wave  
 Enable Overflow Ponding at Nodes ..... YES  
 Skip Steady State Analysis Time Periods ... YES

### Analysis Options

Start Analysis On ..... 00:00:00      0:00:00  
 End Analysis On ..... 00:00:00      0:00:00  
 Start Reporting On ..... 00:00:00      0:00:00  
 Antecedent Dry Days ..... 0      days  
 Runoff (Dry Weather) Time Step ..... 0 01:00:00      days hh:mm:ss  
 Runoff (Wet Weather) Time Step ..... 0 00:05:00      days hh:mm:ss  
 Reporting Time Step ..... 0 00:00:02      days hh:mm:ss  
 Routing Time Step ..... 2      seconds

### Number of Elements

	Qty
Rain Gages .....	1
Subbasins .....	77
Nodes.....	115
<i>Junctions</i> .....	55
<i>Outfalls</i> .....	4
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	52
<i>Storage Nodes</i> .....	4
Links.....	169
<i>Channels</i> .....	52
<i>Pipes</i> .....	108
<i>Pumps</i> .....	0
<i>Orifices</i> .....	8
<i>Weirs</i> .....	1
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

### Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	010-yr	Cumulative	inches	Massachusetts	Middlesex	10.00	4.90	SCS Type III 24-hr

**Subbasin Summary**

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Blake1P	2.66	484.00	78.70	4.90	2.69	7.15	7.18	0 00:07:38
2	Blake2	0.57	484.00	82.10	4.90	3.00	1.71	1.77	0 00:05:00
3	Culvert2L-DA	1.39	484.00	70.20	4.90	1.98	2.75	2.75	0 00:07:35
4	Culvert2P-DA	2.87	484.00	73.50	4.90	2.24	6.44	6.48	0 00:07:33
5	EX32-DA	0.21	484.00	98.00	4.90	4.66	0.98	0.87	0 00:05:00
6	EX33-DA	0.16	484.00	98.00	4.90	4.66	0.75	0.66	0 00:05:00
7	Hildreth-DA	2.35	484.00	87.00	4.90	3.47	8.16	6.90	0 00:15:35
8	Str102-DA	0.08	484.00	98.00	4.90	4.66	0.38	0.34	0 00:05:00
9	Str103-DA	0.13	484.00	98.00	4.90	4.66	0.58	0.53	0 00:05:00
10	Str105-DA	0.03	484.00	98.00	4.90	4.61	0.13	0.11	0 00:05:00
11	Str106-DA	0.16	484.00	98.00	4.90	4.66	0.73	0.63	0 00:05:00
12	Str11-DA	0.22	484.00	98.00	4.90	4.66	1.03	0.92	0 00:05:00
13	Str12-DA	0.04	484.00	98.00	4.90	4.64	0.18	0.16	0 00:05:00
14	Str15-DA	0.13	484.00	98.00	4.90	4.66	0.59	0.53	0 00:05:00
15	Str16-DA	0.16	484.00	98.00	4.90	4.66	0.76	0.68	0 00:05:00
16	Str16L-DA	1.77	484.00	71.30	4.90	2.07	3.65	3.66	0 00:07:39
17	Str19-DA	0.16	484.00	98.00	4.90	4.66	0.76	0.66	0 00:05:00
18	Str19L-DA	1.85	484.00	74.00	4.90	2.29	4.23	4.27	0 00:07:36
19	Str22-DA	0.14	484.00	97.20	4.90	4.57	0.65	0.58	0 00:05:00
20	Str23-DA	0.08	484.00	98.00	4.90	4.66	0.39	0.34	0 00:05:00
21	Str23L-DA	4.70	484.00	77.10	4.90	2.55	11.98	11.46	0 00:10:18
22	Str25-DA	0.19	484.00	94.00	4.90	4.21	0.80	0.76	0 00:05:00
23	Str27-DA	0.15	484.00	97.80	4.90	4.64	0.70	0.61	0 00:05:00
24	Str28-DA	0.05	484.00	98.00	4.90	4.65	0.22	0.18	0 00:05:00
25	Str28L-DA	4.17	484.00	75.40	4.90	2.40	10.02	8.60	0 00:15:31
26	Str30-DA	0.15	484.00	98.00	4.90	4.66	0.70	0.63	0 00:05:00
27	Str32-DA	0.20	484.00	98.00	4.90	4.66	0.92	0.82	0 00:05:00
28	Str33-DA	0.04	484.00	98.00	4.90	4.65	0.20	0.18	0 00:05:00
29	Str33L-DA	3.18	484.00	75.40	4.90	2.40	7.63	7.34	0 00:09:58
30	Str37-DA	0.13	484.00	98.00	4.90	4.66	0.62	0.55	0 00:05:00
31	Str38-DA	0.13	484.00	98.00	4.90	4.66	0.59	0.53	0 00:05:00
32	Str38L-DA	3.72	484.00	73.30	4.90	2.23	8.28	6.92	0 00:16:32
33	Str40-DA	0.14	484.00	98.00	4.90	4.66	0.66	0.58	0 00:05:00
34	Str41-DA	0.09	484.00	98.00	4.90	4.66	0.40	0.34	0 00:05:00
35	Str41L-DA	2.56	484.00	72.10	4.90	2.13	5.46	3.67	0 00:29:12
36	Str43-DA	0.03	484.00	98.00	4.90	4.61	0.12	0.11	0 00:05:00
37	Str43L-DA	0.50	484.00	73.70	4.90	2.26	1.14	0.78	0 00:28:52
38	Str45-DA	0.14	484.00	98.00	4.90	4.66	0.66	0.58	0 00:05:00
39	Str46-DA	0.09	484.00	98.00	4.90	4.66	0.41	0.37	0 00:05:00
40	Str46L-DA	2.20	484.00	76.40	4.90	2.49	5.48	3.54	0 00:32:46
41	Str49-DA	2.20	484.00	74.20	4.90	2.30	5.06	3.16	0 00:35:03
42	Str4-DA	0.04	484.00	98.00	4.90	4.65	0.20	0.18	0 00:05:00
43	Str51-DA	0.03	484.00	98.00	4.90	4.63	0.15	0.13	0 00:05:00
44	Str51L-DA	2.40	484.00	73.30	4.90	2.23	5.34	3.39	0 00:33:27
45	Str53-AD	0.09	484.00	98.00	4.90	4.66	0.42	0.37	0 00:05:00
46	Str54-DA	0.04	484.00	98.00	4.90	4.63	0.16	0.13	0 00:05:00
47	Str54L-DA	2.11	484.00	77.00	4.90	2.54	5.35	3.31	0 00:35:59
48	Str56-DA	0.04	484.00	98.00	4.90	4.63	0.16	0.13	0 00:05:00
49	Str56L-DA	2.12	484.00	75.30	4.90	2.39	5.08	3.06	0 00:38:02
50	Str58-DA	0.64	484.00	98.00	4.90	4.66	2.98	2.63	0 00:05:00
51	Str58L-DA	1.70	484.00	77.60	4.90	2.59	4.40	2.71	0 00:36:25
52	Str59-DA	0.14	484.00	98.00	4.90	4.66	0.66	0.58	0 00:05:00
53	Str5-DA	0.26	484.00	92.40	4.90	4.03	1.04	0.99	0 00:05:00
54	Str61-DA	0.06	484.00	98.00	4.90	4.65	0.26	0.24	0 00:05:00
55	Str61L-DA	1.75	484.00	78.20	4.90	2.65	4.62	2.95	0 00:33:46
56	Str63-DA	0.10	484.00	98.00	4.90	4.66	0.44	0.40	0 00:05:00
57	Str64-DA	0.05	484.00	98.00	4.90	4.65	0.23	0.21	0 00:05:00
58	Str64L-DA	1.30	484.00	79.10	4.90	2.73	3.54	2.58	0 00:24:45
59	Str66-DA	0.05	484.00	98.00	4.90	4.65	0.21	0.18	0 00:05:00
60	Str66L-DA	1.47	484.00	78.90	4.90	2.71	3.98	2.92	0 00:24:34
61	Str68-DA	0.13	484.00	98.00	4.90	4.66	0.61	0.53	0 00:05:00
62	Str69-DA	0.09	484.00	98.00	4.90	4.66	0.41	0.37	0 00:05:00
63	Str69L-DA	0.93	484.00	80.20	4.90	2.82	2.63	1.96	0 00:23:42
64	Str71-DA	0.03	484.00	98.00	4.90	4.63	0.15	0.13	0 00:05:00
65	Str71L-DA	0.58	484.00	84.90	4.90	3.27	1.88	1.37	0 00:24:16
66	Str73-DA	0.05	484.00	98.00	4.90	4.65	0.24	0.21	0 00:05:00
67	Str74-DA	0.04	484.00	98.00	4.90	4.64	0.18	0.16	0 00:05:00
68	Str74L-DA	0.64	484.00	83.60	4.90	3.14	2.02	1.78	0 00:14:21
69	Str76-DA	0.18	484.00	98.00	4.90	4.66	0.84	0.74	0 00:05:00
70	Str76L-DA	0.63	484.00	83.00	4.90	3.08	1.95	1.72	0 00:14:12
71	Str77-DA	0.10	484.00	98.00	4.90	4.66	0.44	0.40	0 00:05:00
72	Str79-DA	0.15	484.00	98.00	4.90	4.66	0.69	0.61	0 00:05:00
73	Str81-DA	0.28	484.00	89.00	4.90	3.68	1.04	1.03	0 00:05:00
74	Str83-DA	0.10	484.00	89.90	4.90	3.76	0.39	0.38	0 00:05:00
75	Str84-DA	1.00	484.00	82.60	4.90	3.05	3.04	2.65	0 00:14:42

**Subbasin Summary**

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
76 Str8-DA	0.14	484.00	98.00	4.90	4.66	0.67	0.58	0 00:05:00
77 Str9-DA	0.23	484.00	86.30	4.90	3.40	0.78	0.79	0 00:05:00



**Node Summary**

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft <sup>2</sup> )	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert2In	Junction	270.70	274.50	270.70	274.50	0.00	4.91	273.10	0.00	1.40	0 00:00	0.00	0.00
2	DMH3c	Junction	268.70	271.83	268.70	271.83	0.00	7.74	269.73	0.00	2.10	0 00:00	0.00	0.00
3	DMH4c	Junction	268.10	271.22	268.10	271.22	0.00	7.74	269.23	0.00	1.99	0 00:00	0.00	0.00
4	DMH5c	Junction	265.90	269.46	265.90	269.46	0.00	7.74	266.60	0.00	2.86	0 00:00	0.00	0.00
5	DMH6c	Junction	253.60	258.48	253.60	258.48	0.00	2.52	255.61	0.00	2.87	0 00:00	0.00	0.00
6	DMH9c	Junction	268.90	271.70	268.90	271.70	0.00	7.74	269.86	0.00	1.84	0 00:00	0.00	0.00
7	DP_2_1	Junction	249.00	255.00	249.00	255.00	0.00	36.84	250.85	0.00	5.55	0 00:00	0.00	0.00
8	DP_2_2	Junction	250.00	256.00	250.00	256.00	0.00	3.19	250.49	0.00	5.51	0 00:00	0.00	0.00
9	DP-1	Junction	327.00	336.00	327.00	336.00	0.00	23.27	329.22	0.00	6.78	0 00:00	0.00	0.00
10	FSP1-Out	Junction	273.00	276.00	273.00	276.00	7794.00	3.01	273.50	0.00	2.62	0 00:00	0.00	0.00
11	FSP2-Out	Junction	272.00	276.00	272.00	276.00	3746.00	6.37	272.72	0.00	4.03	0 00:00	0.00	0.00
12	PondRiser	Junction	249.50	255.90	249.50	257.50	0.00	36.84	251.35	0.00	4.55	0 00:00	0.00	0.00
13	SD-16	Junction	290.00	294.30	290.00	294.30	0.00	3.66	290.45	0.00	3.85	0 00:00	0.00	0.00
14	SD-19	Junction	302.75	307.59	302.75	307.59	0.00	4.27	303.26	0.00	4.33	0 00:00	0.00	0.00
15	SD-23	Junction	323.75	328.31	323.75	328.31	0.00	11.46	324.50	0.00	3.81	0 00:00	0.00	0.00
16	SD-28	Junction	331.94	335.69	331.94	335.69	0.00	8.60	332.74	0.00	2.95	0 00:00	0.00	0.00
17	SD-33	Junction	341.55	345.42	341.55	345.42	0.00	7.34	342.31	0.00	3.11	0 00:00	0.00	0.00
18	SD-38	Junction	355.60	359.61	355.60	359.61	0.00	6.92	356.24	0.00	3.37	0 00:00	0.00	0.00
19	STR-10	Junction	267.50	273.38	267.50	273.38	0.00	73.87	269.51	0.00	3.87	0 00:00	0.00	0.00
20	STR-100	Junction	256.50	261.94	256.50	261.94	0.00	1.78	257.35	0.00	4.59	0 00:00	0.00	0.00
21	STR-101	Junction	258.50	262.54	258.50	262.54	0.00	1.78	258.97	0.00	3.57	0 00:00	0.00	0.00
22	STR-104	Junction	262.08	265.84	262.08	265.84	0.00	0.87	262.46	0.00	3.38	0 00:00	0.00	0.00
23	STR-13	Junction	269.10	274.10	269.10	274.10	0.00	73.22	271.05	0.00	3.05	0 00:00	0.00	0.00
24	STR-14	Junction	274.00	280.22	274.00	280.22	0.00	68.34	276.15	0.00	4.07	0 00:00	0.00	0.00
25	STR-17	Junction	282.30	287.81	282.30	287.81	0.00	64.22	283.71	0.00	4.10	0 00:00	0.00	0.00
26	STR-18	Junction	289.30	294.76	289.30	294.76	0.00	64.22	290.67	0.00	4.09	0 00:00	0.00	0.00
27	STR-2	Junction	253.60	261.00	253.60	261.00	0.00	83.25	255.76	0.00	5.24	0 00:00	0.00	0.00
28	STR-20	Junction	296.30	301.69	296.30	301.69	0.00	60.19	297.70	0.00	3.99	0 00:00	0.00	0.00
29	STR-21	Junction	302.10	307.72	302.10	307.72	0.00	60.19	304.09	0.00	3.63	0 00:00	0.00	0.00
30	STR-24	Junction	313.50	318.70	313.50	318.70	0.00	49.17	314.81	0.00	3.89	0 00:00	0.00	0.00
31	STR-26	Junction	322.80	328.00	322.80	328.00	0.00	48.76	324.26	0.00	3.74	0 00:00	0.00	0.00
32	STR-29	Junction	326.75	332.13	326.75	332.13	0.00	40.01	328.89	0.00	3.24	0 00:00	0.00	0.00
33	STR-3	Junction	259.30	269.66	259.30	269.66	0.00	83.26	263.73	0.00	5.93	0 00:00	0.00	0.00
34	STR-34	Junction	330.32	336.12	330.32	336.12	0.00	56.00	332.68	0.00	3.44	0 00:00	0.00	0.00
35	STR-36	Junction	341.00	346.20	341.00	346.20	0.00	55.67	342.45	0.00	3.75	0 00:00	0.00	0.00
36	STR-39	Junction	354.40	359.65	354.40	359.65	0.00	47.47	355.77	0.00	3.88	0 00:00	0.00	0.00
37	STR-42	Junction	365.50	370.42	365.50	370.42	0.00	44.22	367.12	0.00	3.30	0 00:00	0.00	0.00
38	STR-44	Junction	367.50	372.84	367.50	372.84	0.00	42.03	369.16	0.00	3.68	0 00:00	0.00	0.00
39	STR-47	Junction	370.40	376.35	370.40	376.35	0.00	39.01	373.16	0.00	3.19	0 00:00	0.00	0.00
40	STR-50	Junction	372.50	378.03	372.50	378.03	0.00	36.53	374.10	0.00	3.93	0 00:00	0.00	0.00
41	STR-52	Junction	374.40	379.58	374.40	379.58	0.00	33.82	375.81	0.00	3.77	0 00:00	0.00	0.00
42	STR-55	Junction	376.70	381.70	376.70	381.70	0.00	31.01	378.03	0.00	3.67	0 00:00	0.00	0.00
43	STR-57	Junction	379.05	383.70	379.05	383.70	0.00	28.46	380.30	0.00	3.40	0 00:00	0.00	0.00
44	STR-6	Junction	260.10	270.06	260.10	270.06	0.00	82.39	265.83	0.00	4.23	0 00:00	0.00	0.00
45	STR-60	Junction	382.35	386.80	382.35	386.80	0.00	25.38	383.50	0.00	3.30	0 00:00	0.00	0.00
46	STR-62	Junction	386.00	390.16	386.00	390.16	0.00	23.15	387.13	0.00	3.03	0 00:00	0.00	0.00
47	STR-65	Junction	388.10	392.29	388.10	392.29	0.00	20.63	389.13	0.00	3.16	0 00:00	0.00	0.00
48	STR-67	Junction	390.10	394.40	390.10	394.40	0.00	18.50	391.59	0.00	2.81	0 00:00	0.00	0.00
49	STR-7	Junction	262.00	271.28	262.00	271.28	0.00	74.85	265.73	0.00	5.55	0 00:00	0.00	0.00
50	STR-70	Junction	391.20	396.78	391.20	396.78	0.00	16.36	392.66	0.00	4.12	0 00:00	0.00	0.00
51	STR-72	Junction	391.70	397.36	391.70	397.36	0.00	14.86	393.24	0.00	4.12	0 00:00	0.00	0.00
52	STR-75	Junction	392.70	397.98	392.70	397.98	0.00	12.82	394.20	0.00	3.78	0 00:00	0.00	0.00
53	STR-78	Junction	393.90	398.98	393.90	398.98	0.00	10.77	395.17	0.00	3.81	0 00:00	0.00	0.00
54	STR-80	Junction	394.90	398.92	394.90	398.92	0.00	7.55	396.13	0.00	2.79	0 00:00	0.00	0.00
55	STR-82	Junction	395.15	399.57	395.15	399.57	0.00	2.87	395.84	0.00	3.73	0 00:00	0.00	0.00
56	DP_1	Outfall	286.00					23.09	286.85					
57	DP_2	Outfall	249.00					37.37	250.00					
58	EX32-bypass(out)	Outfall	255.47					0.36	255.57					
59	EX33-bypass(out)	Outfall	255.70					0.06	255.74					
60	FSP-1	Storage Node	272.00	276.00	272.00		7794.00	6.48	274.88				0.00	0.00
61	FSP-2	Storage Node	270.00	276.00	270.00		3746.00	7.18	274.17				0.00	0.00
62	Pond_1	Storage Node	250.00	257.50	250.00		25046.00	83.25	255.87				0.00	0.00
63	STR-31	Storage Node	327.65	335.28	327.65		0.00	61.66	329.94				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged (min)	Condition
1	101-100	Pipe	STR-101	STR-100	30.00	258.50	257.00	5.0000	12.000	0.0150	1.78	6.90	0.26	7.37	0.35	0.35	0.00	Calculated
2	102-101	Pipe	STR-102	STR-101	60.00	259.57	258.70	1.4500	12.000	0.0110	0.30	5.07	0.06	3.55	0.17	0.17	0.00	Calculated
3	103-101	Pipe	STR-103	STR-101	30.00	259.63	258.70	3.1000	12.000	0.0110	0.61	7.41	0.08	5.71	0.19	0.19	0.00	Calculated
4	104-101	Pipe	STR-104	STR-101	190.00	262.08	258.70	1.7800	12.000	0.0110	0.87	5.62	0.16	5.20	0.27	0.27	0.00	Calculated
5	105-104	Pipe	STR-105	STR-104	29.00	262.58	262.18	1.3800	12.000	0.0110	0.15	4.95	0.03	2.86	0.12	0.12	0.00	Calculated
6	106-104	Pipe	STR-106	STR-104	6.00	262.24	262.18	1.0000	12.000	0.0110	0.72	4.21	0.17	4.00	0.28	0.28	0.00	Calculated
7	7-Oct	Pipe	STR-10	STR-7	303.00	267.50	262.10	1.7800	36.000	0.0110	73.86	105.23	0.70	16.12	1.85	0.62	0.00	Calculated
8	10-Nov	Pipe	STR-11	STR-10	17.00	269.00	268.50	2.9400	12.000	0.0110	0.66	7.22	0.09	5.73	0.20	0.20	0.00	Calculated
9	10-Dec	Pipe	STR-12	STR-10	5.00	268.70	268.50	4.0000	12.000	0.0110	0.24	8.42	0.03	4.77	0.12	0.12	0.00	Calculated
10	13-10	Pipe	STR-13	STR-10	93.00	269.10	267.60	1.6100	36.000	0.0110	73.21	100.11	0.73	15.46	1.91	0.64	0.00	Calculated
11	14-13	Pipe	STR-14	STR-13	195.00	274.00	269.20	2.4600	30.000	0.0110	68.33	76.05	0.90	17.52	1.85	0.74	0.00	Calculated
12	15-14	Pipe	STR-15	STR-14	15.00	276.00	275.90	0.6700	15.000	0.0110	0.56	6.23	0.09	3.16	0.25	0.20	0.00	Calculated
13	16-14	Pipe	STR-16	STR-14	7.00	275.00	274.60	5.7100	12.000	0.0110	4.28	10.07	0.42	12.29	0.46	0.46	0.00	Calculated
14	17-14	Pipe	STR-17	STR-14	133.00	282.30	274.50	5.8600	30.000	0.0110	64.22	117.39	0.55	24.44	1.32	0.53	0.00	Calculated
15	18-17	Pipe	STR-18	STR-17	115.00	289.30	282.40	6.0000	30.000	0.0110	64.22	118.74	0.54	24.66	1.31	0.52	0.00	Calculated
16	19-18	Pipe	STR-19	STR-18	7.00	289.75	289.30	6.4300	15.000	0.0110	4.82	19.36	0.25	13.09	0.43	0.34	0.00	Calculated
17	20-18	Pipe	STR-20	STR-18	118.00	296.30	289.40	5.8500	30.000	0.0110	60.19	117.22	0.51	24.03	1.27	0.51	0.00	Calculated
18	1-Feb	Pipe	STR-2	Pond_1	27.00	253.60	253.20	1.4800	36.000	0.0110	83.25	95.94	0.87	15.27	2.16	0.72	0.00	Calculated
19	21-20	Pipe	STR-21	STR-20	106.00	302.10	296.40	5.3800	30.000	0.0110	60.19	112.41	0.54	23.28	1.30	0.52	0.00	Calculated
20	22-21	Pipe	STR-22	STR-21	19.00	304.00	302.10	10.0000	12.000	0.0110	0.64	13.32	0.05	8.76	0.15	0.15	0.00	Calculated
21	23-21	Pipe	STR-23	STR-21	4.00	303.50	303.35	3.7500	18.000	0.0110	11.74	24.04	0.49	13.52	0.74	0.49	0.00	Calculated
22	24-21	Pipe	STR-24	STR-21	192.00	313.50	302.20	5.8900	30.000	0.0110	49.17	117.60	0.42	22.89	1.13	0.45	0.00	Calculated
23	25-24	Pipe	STR-25	STR-24	17.00	314.00	313.50	2.9400	12.000	0.0110	0.77	7.22	0.11	5.99	0.22	0.22	0.00	Calculated
24	26-24	Pipe	STR-26	STR-24	206.00	322.80	313.60	4.4700	30.000	0.0110	48.76	102.44	0.48	20.61	1.21	0.49	0.00	Calculated
25	27-26	Pipe	STR-27	STR-26	16.00	323.50	323.00	3.1300	12.000	0.0110	0.62	7.44	0.08	5.75	0.20	0.20	0.00	Calculated
26	28-26	Pipe	STR-28	STR-26	8.00	323.50	323.00	6.2500	15.000	0.0110	8.73	19.09	0.46	15.20	0.59	0.47	0.00	Calculated
27	29-26	Pipe	STR-29	STR-26	188.00	326.75	322.90	2.0500	30.000	0.0110	40.01	69.37	0.58	14.63	1.36	0.54	0.00	Calculated
28	30-29	Pipe	STR-30	STR-29	8.00	327.75	327.40	4.3800	12.000	0.0110	0.64	8.81	0.07	6.55	0.18	0.18	0.00	Calculated
29	31-29	Pipe	STR-31	STR-29	156.00	327.90	326.85	0.6700	30.000	0.0110	39.68	39.77	1.00	9.24	2.04	0.82	0.00	Calculated
30	31-Out	Pipe	STR-31	DP-1	37.00	327.70	327.45	0.6800	24.000	0.0110	23.27	21.98	1.06	8.16	1.87	0.94	0.00	> CAPACITY
31	2-Mar	Pipe	STR-3	STR-2	260.00	259.30	253.70	2.1500	36.000	0.0110	83.25	115.68	0.72	17.81	1.88	0.63	0.00	Calculated
32	32-6	Pipe	CBEX-32	DMH6c	18.00	255.00	254.20	4.4400	6.000	0.0110	0.74	2.80	0.26	6.01	0.18	0.35	0.00	Calculated
33	33-31	Pipe	STR-33	STR-31	10.00	331.69	330.89	8.0000	12.000	0.0110	7.59	11.91	0.64	16.06	0.58	0.58	0.00	Calculated
34	33-out	Pipe	CBEX-33	DP_2_2	40.00	253.10	250.00	7.7500	12.000	0.0130	0.68	9.92	0.07	7.17	0.18	0.18	0.00	Calculated
35	34-31	Pipe	STR-34	STR-31	34.00	330.72	329.70	3.0000	30.000	0.0110	56.00	83.96	0.67	18.30	1.49	0.60	0.00	Calculated
36	35-34	Pipe	STR-35	STR-34	11.00	332.50	332.40	0.9100	12.000	0.0110	0.66	4.01	0.17	3.78	0.28	0.28	0.00	Calculated
37	36-34	Pipe	STR-36	STR-34	240.00	340.60	330.82	4.0800	30.000	0.0110	55.67	99.84	0.56	20.88	1.33	0.53	0.00	Calculated
38	37-36	Pipe	STR-37	STR-36	18.00	341.90	341.10	4.4400	12.000	0.0110	0.56	8.88	0.06	6.28	0.17	0.17	0.00	Calculated
39	38-36	Pipe	STR-38	STR-36	16.00	341.30	341.10	1.2500	18.000	0.0110	8.14	13.88	0.59	8.16	0.83	0.55	0.00	Calculated
40	39-36	Pipe	STR-39	STR-36	266.00	354.40	341.10	5.0000	24.000	0.0110	47.47	59.78	0.79	21.11	1.35	0.67	0.00	Calculated
41	40-39	Pipe	STR-40	STR-39	17.00	355.35	355.00	2.0600	12.000	0.0110	0.57	6.04	0.09	4.83	0.21	0.21	0.00	Calculated
42	41-39	Pipe	STR-41	STR-39	6.00	355.36	355.00	6.0000	12.000	0.0110	3.29	10.31	0.32	11.66	0.39	0.39	0.00	Calculated
43	42-39	Pipe	STR-42	STR-39	217.00	365.50	354.50	5.0700	24.000	0.0110	44.22	60.19	0.73	20.94	1.27	0.64	0.00	Calculated
44	3-Apr	Pipe	STR-4	STR-3	19.00	265.00	263.50	7.8900	12.000	0.0110	0.36	11.83	0.03	6.81	0.12	0.12	0.00	Calculated
45	43-42	Pipe	STR-43	STR-42	5.00	365.92	365.80	2.4000	12.000	0.0110	2.46	6.52	0.38	7.72	0.43	0.43	0.00	Calculated
46	44-42	Pipe	STR-44	STR-42	66.00	367.50	365.60	2.8800	24.000	0.0110	42.03	45.36	0.93	16.39	1.52	0.76	0.00	Calculated
47	45-44	Pipe	STR-45	STR-44	18.00	368.70	368.50	1.1100	12.000	0.0110	0.55	4.44	0.12	3.85	0.24	0.24	0.00	Calculated

Proposal No. 609035- 126590

Post-Development

10-yr

Boston Rd. 609035  
Westford, MA

March 22, 2023

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged (min)	Condition	
48	46-44	Pipe	STR-46	STR-44	7.00	368.69	368.50	2.7100	12.000	0.0110	3.04	6.94	0.44	8.54	0.46	0.46	0.00	Calculated
49	47-44	Pipe	STR-47	STR-44	119.00	370.40	367.60	2.3500	24.000	0.0110	39.01	41.01	0.95	14.85	1.56	0.78	0.00	Calculated
50	49-47	Pipe	STR-49	STR-47	14.00	372.80	372.60	1.4300	12.000	0.0110	3.01	5.03	0.60	6.69	0.56	0.56	0.00	Calculated
51	50-47	Pipe	STR-50	STR-47	74.00	372.62	370.90	2.3200	24.000	0.0110	36.53	40.76	0.90	14.66	1.48	0.74	0.00	Calculated
52	51-50	Pipe	STR-51	STR-50	8.00	373.77	373.50	3.3700	12.000	0.0110	3.25	7.74	0.42	9.42	0.45	0.45	0.00	Calculated
53	52-50	Pipe	STR-52	STR-50	67.00	374.40	372.72	2.5100	24.000	0.0110	33.82	42.34	0.80	14.97	1.35	0.68	0.00	Calculated
54	3-May	Pipe	STR-5	STR-3	38.00	264.50	263.50	2.6300	12.000	0.0110	0.81	6.83	0.12	5.83	0.23	0.23	0.00	Calculated
55	53-52	Pipe	STR-53	STR-52	15.00	374.65	374.40	1.6700	12.000	0.0110	0.43	5.44	0.08	4.13	0.19	0.19	0.00	Calculated
56	54-52	Pipe	STR-54	STR-52	11.00	374.68	374.40	2.5500	15.000	0.0110	3.14	12.18	0.26	8.32	0.43	0.35	0.00	Calculated
57	55-52	Pipe	STR-55	STR-52	95.00	376.70	374.50	2.3200	24.000	0.0110	31.01	40.69	0.76	14.26	1.31	0.65	0.00	Calculated
58	56-55	Pipe	STR-56	STR-55	6.00	377.46	377.40	1.0000	12.000	0.0110	3.02	4.21	0.72	5.83	0.63	0.63	0.00	Calculated
59	57-55	Pipe	STR-57	STR-55	95.00	379.05	376.77	2.4000	24.000	0.0110	28.46	41.42	0.69	14.20	1.22	0.61	0.00	Calculated
60	58-57	Pipe	STR-58	STR-57	6.00	379.29	379.17	2.0000	15.000	0.0110	3.04	10.80	0.28	7.56	0.45	0.36	0.00	Calculated
61	59-57	Pipe	STR-59	STR-57	18.00	379.54	379.17	2.0600	12.000	0.0110	0.51	6.04	0.09	4.69	0.20	0.20	0.00	Calculated
62	60-57	Pipe	STR-60	STR-57	140.00	382.35	379.15	2.2900	24.000	0.0110	25.38	40.42	0.63	13.58	1.15	0.57	0.00	Calculated
63	61-60	Pipe	STR-61	STR-60	6.00	382.57	382.50	1.1700	12.000	0.0110	2.68	4.55	0.59	6.02	0.55	0.55	0.00	Calculated
64	62-60	Pipe	STR-62	STR-60	150.00	386.00	382.40	2.4000	24.000	0.0110	23.15	41.42	0.56	13.54	1.07	0.53	0.00	Calculated
65	3-Jun	Pipe	STR-6	STR-3	38.00	260.10	259.40	1.8400	36.000	0.0110	82.39	106.99	0.77	16.70	1.97	0.66	0.00	Calculated
66	63-62	Pipe	STR-63	STR-62	17.00	386.20	386.10	0.5900	12.000	0.0110	0.42	3.23	0.13	2.85	0.24	0.24	0.00	Calculated
67	64-62	Pipe	STR-64	STR-62	6.00	386.15	386.10	0.8300	18.000	0.0110	2.50	11.33	0.22	5.15	0.48	0.32	0.00	Calculated
68	65-62	Pipe	STR-65	STR-62	93.00	388.10	386.10	2.1500	24.000	0.0110	20.63	39.21	0.53	12.63	1.03	0.52	0.00	Calculated
69	66-65	Pipe	STR-66	STR-65	10.00	388.48	388.38	1.0000	12.000	0.0110	2.38	4.21	0.57	5.52	0.54	0.54	0.00	Calculated
70	7-Jun	Pipe	STR-7	STR-6	105.00	262.00	260.20	1.7100	36.000	0.0110	74.85	103.21	0.73	15.91	1.89	0.63	0.00	Calculated
71	67-65	Pipe	STR-67	STR-65	93.00	390.10	388.14	2.1100	24.000	0.0110	18.50	38.81	0.48	12.20	0.97	0.49	0.00	Calculated
72	68-67	Pipe	STR-68	STR-67	17.00	390.70	390.60	0.5900	12.000	0.0110	0.47	3.23	0.15	2.93	0.26	0.26	0.00	Calculated
73	69-67	Pipe	STR-69	STR-67	11.00	390.70	390.60	0.9100	12.000	0.0110	1.87	4.01	0.47	5.02	0.48	0.48	0.00	Calculated
74	6-out	Pipe	DMH6c	DP_2_2	165.00	253.60	250.00	2.1800	12.000	0.0130	2.52	5.26	0.48	6.64	0.49	0.49	0.00	Calculated
75	70-67	Pipe	STR-70	STR-67	185.00	391.20	390.20	0.5400	24.000	0.0110	16.36	19.66	0.83	7.00	1.39	0.70	0.00	Calculated
76	71-70	Pipe	STR-71	STR-70	8.00	392.55	392.34	2.6300	12.000	0.0110	1.54	6.82	0.23	7.02	0.32	0.32	0.00	Calculated
77	72-70	Pipe	STR-72	STR-70	78.00	391.90	391.30	0.7700	24.000	0.0110	14.86	23.45	0.63	7.90	1.16	0.58	0.00	Calculated
78	73-72	Pipe	STR-73	STR-72	18.00	393.04	392.68	2.0000	12.000	0.0110	0.27	5.95	0.05	3.85	0.14	0.14	0.00	Calculated
79	74-72	Pipe	STR-74	STR-72	7.00	393.10	392.90	2.8600	12.000	0.0110	1.81	7.12	0.25	7.57	0.34	0.34	0.00	Calculated
80	75-72	Pipe	STR-75	STR-72	99.00	392.70	392.00	0.7100	24.000	0.0110	12.82	22.48	0.57	7.39	1.08	0.54	0.00	Calculated
81	76-75	Pipe	STR-76	STR-75	6.00	393.74	393.70	0.6700	12.000	0.0110	1.74	3.44	0.51	4.39	0.50	0.50	0.00	Calculated
82	77-75	Pipe	STR-77	STR-75	17.00	393.30	393.13	1.0000	12.000	0.0110	0.41	4.21	0.10	3.41	0.21	0.21	0.00	Calculated
83	78-75	Pipe	STR-78	STR-75	201.00	393.90	392.80	0.5500	24.000	0.0110	10.77	19.78	0.54	6.43	1.05	0.53	0.00	Calculated
84	79-78	Pipe	STR-79	STR-78	4.00	394.98	394.90	2.0000	12.000	0.0110	0.43	5.95	0.07	4.42	0.18	0.18	0.00	Calculated
85	80-78	Pipe	STR-80	STR-78	25.00	394.90	394.40	2.0000	15.000	0.0110	7.55	10.80	0.70	9.51	0.77	0.62	0.00	Calculated
86	81-80	Pipe	STR-81	STR-80	3.00	396.00	395.90	3.3300	12.000	0.0110	0.90	7.69	0.12	6.53	0.23	0.23	0.00	Calculated
87	82-78	Pipe	STR-82	STR-78	107.00	395.15	394.40	0.7000	12.000	0.0110	2.87	3.53	0.82	5.01	0.69	0.69	0.00	Calculated
88	83-82	Pipe	STR-83	STR-82	50.00	395.55	395.25	0.6000	12.000	0.0110	0.32	3.26	0.10	2.64	0.21	0.21	0.00	Calculated
89	84-82	Pipe	STR-84	STR-82	42.00	395.80	395.25	1.3100	12.000	0.0110	2.65	4.82	0.55	6.28	0.53	0.53	0.00	Calculated
90	7-Aug	Pipe	STR-8	STR-7	26.00	265.91	265.50	1.5800	12.000	0.0110	0.64	5.29	0.12	4.54	0.24	0.24	0.00	Calculated
91	7-Sep	Pipe	STR-9	STR-7	6.00	265.99	265.50	8.1700	12.000	0.0110	0.61	12.03	0.05	8.03	0.15	0.15	0.00	Calculated
92	Culvert2	Pipe	Culvert2In	STR-13	25.00	270.70	269.63	4.2800	24.000	0.0130	4.91	46.80	0.10	9.66	0.44	0.22	0.00	Calculated
93	EX1-6	Pipe	STR-100	DMH6c	153.00	256.50	255.10	0.9200	12.000	0.0130	1.78	3.41	0.52	4.40	0.51	0.51	0.00	Calculated
94	EX3-4	Pipe	DMH3c	DMH4c	62.00	268.60	268.20	0.6500	18.000	0.0130	7.74	9.43	0.82	5.96	1.03	0.69	0.00	Calculated

Proposal No. 609035- 126590

Post-Development

10-yr

Boston Rd. 609035  
Westford, MA

March 22, 2023

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged (min)	Reported Condition
95	EX4-5	Pipe	DMH4c	DMH5c	22.00	268.10	266.00	9.5500	18.000	0.0130	7.74	32.45	0.24	15.06	0.50	0.33	0.00	Calculated
96	EX5-6	Pipe	DMH5c	STR-6	28.00	265.90	265.13	2.7500	18.000	0.0130	7.74	17.42	0.44	9.56	0.70	0.47	0.00	Calculated
97	EX9-3	Pipe	DMH9c	DMH3c	20.00	268.90	268.70	1.0000	18.000	0.0130	7.74	10.50	0.74	6.50	0.96	0.64	0.00	Calculated
98	FSP1-Out	Pipe	FSP1-Out	Culvert2In	20.00	273.00	272.60	2.0000	12.000	0.0110	3.01	5.95	0.51	7.60	0.50	0.50	0.00	Calculated
99	FSP2-Out	Pipe	FSP2-Out	DMH9c	178.00	272.00	269.00	1.6900	18.000	0.0130	6.36	13.64	0.47	7.59	0.72	0.48	0.00	Calculated
100	Out2_1	Pipe	DP_2_1	DP_2	297.73	249.00	249.00	0.0000	0.000	0.0150	36.84	0.00	0.47	0.00	0.72	0.48	0.00	Calculated
101	Out2_2	Pipe	DP_2_2	DP_2	345.60	250.00	250.00	0.0000	0.000	0.0150	3.19	0.00	0.47	0.00	0.72	0.48	0.00	Calculated
102	Pond_Outfall	Pipe	PondRiser	DP_2_1	50.00	249.50	249.00	1.0000	30.000	0.0130	36.84	41.02	0.90	9.45	1.85	0.74	0.00	Calculated
103	SD-16	Pipe	SD-16	STR-16	250.00	290.00	275.10	5.9600	10.000	0.0110	3.65	6.32	0.58	12.02	0.45	0.55	0.00	Calculated
104	SD-19	Pipe	SD-19	STR-19	224.00	302.75	290.00	5.6900	10.000	0.0110	4.27	6.18	0.69	12.23	0.51	0.61	0.00	Calculated
105	SD-23	Pipe	SD-23	STR-23	411.00	323.75	302.75	5.1100	15.000	0.0110	11.45	16.95	0.68	14.84	0.75	0.60	0.00	Calculated
106	SD-28	Pipe	SD-28	STR-28	357.00	331.94	323.75	2.2900	15.000	0.0110	8.59	11.56	0.74	10.33	0.80	0.64	0.00	Calculated
107	SD-33	Pipe	SD-33	STR-33	268.00	341.55	331.94	3.5900	12.000	0.0110	7.33	7.97	0.92	11.54	0.76	0.76	0.00	Calculated
108	SD-38	Pipe	SD-38	STR-38	284.00	355.60	341.55	4.9500	12.000	0.0110	6.92	9.37	0.74	13.06	0.64	0.64	0.00	Calculated
109	102_Bypass	Channel	STR-102	CBEX-33	233.14	263.07	256.90	2.6500	3.600	0.0130	0.07	11.66	0.01	1.56	0.04	0.15	0.00	
110	103_bypass	Channel	STR-103	CBEX-32	238.82	263.13	257.18	2.4900	3.840	0.0320	0.25	5.46	0.05	1.20	0.10	0.31	0.00	
111	105_Bypass	Channel	STR-105	STR-102	144.56	266.08	263.07	2.0800	3.600	0.0130	0.04	10.34	0.00	1.17	0.04	0.12	0.00	
112	106_Bypass	Channel	STR-106	STR-103	143.60	265.74	263.13	1.8200	3.840	0.0130	0.34	11.48	0.03	1.92	0.09	0.27	0.00	
113	11_Bypass	Channel	STR-11	STR-8	310.73	272.87	272.08	0.2500	3.840	0.0130	0.38	4.29	0.09	1.09	0.13	0.39	0.00	
114	12_Bypass	Channel	STR-12	STR-9	306.16	273.43	270.92	0.8200	1.200	0.0130	0.08	0.35	0.23	1.12	0.06	0.57	0.00	
115	15_Bypass	Channel	STR-15	STR-11	299.12	280.19	272.87	2.4500	3.840	0.0130	0.12	13.32	0.01	1.90	0.05	0.17	0.00	
116	16_Bypass	Channel	STR-16	STR-12	302.37	280.17	273.43	2.2300	1.200	0.0130	0.17	0.57	0.30	2.02	0.06	0.63	0.00	
117	19_Bypass	Channel	STR-19	STR-16	252.79	294.30	280.17	5.5900	3.840	0.0130	0.13	20.13	0.01	2.47	0.05	0.15	0.00	
118	22_Bypass	Channel	STR-22	STR-15	494.76	307.33	280.19	5.4900	1.200	0.0130	0.17	0.90	0.19	2.91	0.05	0.53	0.00	
119	23_Bypass	Channel	STR-23	STR-19	228.51	307.59	294.30	5.8200	3.840	0.0130	0.05	20.53	0.00	1.84	0.03	0.10	0.00	
120	25_Bypass	Channel	STR-25	STR-22	205.10	318.10	307.33	5.2500	3.840	0.0130	0.23	19.51	0.01	2.63	0.06	0.19	0.00	
121	27_Bypass	Channel	STR-27	STR-25	194.95	327.02	318.10	4.5800	3.840	0.0130	0.25	18.20	0.01	2.52	0.06	0.20	0.00	
122	28_Bypass	Channel	STR-28	STR-23	408.97	328.31	307.59	5.0700	1.200	0.0130	0.04	0.86	0.05	1.75	0.03	0.32	0.00	
123	30_Bypass	Channel	STR-30	STR-27	198.67	331.70	327.02	2.3600	3.840	0.0130	0.27	13.08	0.02	2.04	0.07	0.23	0.00	
124	33_Bypass	Channel	STR-33	STR-28	357.58	335.69	328.31	2.0600	1.200	0.0130	0.18	0.55	0.33	1.78	0.07	0.66	0.00	
125	35_Bypass	Channel	STR-35	STR-30	196.77	335.63	331.70	2.0000	3.840	0.0130	0.28	12.03	0.02	1.95	0.08	0.24	0.00	
126	37_Bypass	Channel	STR-37	STR-35	249.72	346.40	335.63	4.3100	3.840	0.0130	0.13	17.75	0.01	2.29	0.05	0.16	0.00	
127	38_Bypass	Channel	STR-38	STR-33	270.06	345.42	335.69	3.6000	1.200	0.0130	0.65	0.73	0.89	2.85	0.10	0.96	0.00	
128	4_Bypass	Channel	STR-4	STR-105	153.05	269.29	266.08	2.1000	1.200	0.0130	0.09	0.55	0.16	1.44	0.05	0.50	0.00	
129	40_bypass	Channel	STR-40	STR-37	261.30	359.60	346.40	5.0500	3.840	0.0130	0.14	19.08	0.01	2.44	0.05	0.16	0.00	
130	41_Bypass	Channel	STR-41	STR-38	286.28	359.61	345.42	4.9600	3.840	0.0130	2.30	18.96	0.12	4.38	0.15	0.45	0.00	
131	43_Bypass	Channel	STR-43	STR-41	214.88	370.25	359.61	4.9500	3.840	0.0130	1.85	18.95	0.10	4.14	0.13	0.42	0.00	
132	45_Bypass	Channel	STR-45	STR-40	287.18	372.97	359.60	4.6600	3.840	0.0130	0.13	18.37	0.01	2.35	0.05	0.15	0.00	
133	46_Bypass	Channel	STR-46	STR-43	69.33	373.15	370.25	4.1800	3.840	0.0130	3.52	17.41	0.20	4.56	0.18	0.55	0.00	
134	49_Bypass	Channel	STR-49	STR-46	115.00	376.30	373.15	2.7400	3.840	0.0320	0.14	5.72	0.02	0.90	0.08	0.25	0.00	
135	5_Bypass	Channel	STR-5	STR-106	149.01	268.12	265.74	1.6000	3.840	0.0130	0.43	10.76	0.04	1.96	0.10	0.30	0.00	
136	51-bypass	Channel	STR-51	STR-46	200.00	377.77	373.15	2.3100	3.840	0.0130	2.79	12.94	0.22	3.45	0.18	0.56	0.00	
137	53_Bypass	Channel	STR-53	STR-45	266.58	379.35	372.97	2.3900	3.840	0.0130	0.10	13.17	0.01	1.65	0.05	0.16	0.00	
138	54_Bypass	Channel	STR-54	STR-51	73.90	379.95	377.77	2.9500	3.840	0.0130	2.60	14.62	0.18	3.71	0.17	0.52	0.00	
139	56-bypass	Channel	STR-56	STR-54	94.37	381.80	379.95	1.9600	3.840	0.0130	2.40	10.77	0.22	2.89	0.18	0.57	0.00	
140	58_Bypass	Channel	STR-58	STR-56	86.78	383.51	381.80	1.9700	3.840	0.0130	2.43	12.93	0.19	3.33	0.17	0.53	0.00	
141	59_Bypass	Channel	STR-59	STR-53	188.00	383.54	379.35	2.2300	3.840	0.0130	0.16	12.71	0.01	1.81	0.06	0.19	0.00	

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged (min)	Condition
142	61-bypass	Channel	STR-61	STR-58	153.24	386.90	383.51	2.2100	3.840	0.0130	1.87	12.13	0.15	2.97	0.16	0.50	0.00	
143	63_Bypass	Channel	STR-63	STR-59	295.23	389.71	383.54	2.0900	3.840	0.0130	0.10	12.31	0.01	1.58	0.05	0.16	0.00	
144	64-Bypass	Channel	STR-64	STR-61	140.44	389.96	386.90	2.1800	3.840	0.0130	1.63	13.13	0.12	3.05	0.15	0.46	0.00	
145	66-bypass	Channel	STR-66	STR-64	100.35	392.10	389.96	2.1300	3.840	0.0130	1.46	12.23	0.12	2.81	0.14	0.45	0.00	
146	68_Bypass	Channel	STR-68	STR-63	193.86	394.22	389.71	2.3300	3.840	0.0130	0.13	12.99	0.01	1.76	0.06	0.18	0.00	
147	69_bypass	Channel	STR-69	STR-66	94.31	394.12	392.10	2.1400	3.840	0.0130	0.86	12.64	0.07	2.52	0.12	0.36	0.00	
148	71-Bypass	Channel	STR-71	STR-69	190.28	396.60	394.12	1.3000	3.840	0.0130	0.62	9.84	0.06	1.94	0.11	0.35	0.00	
149	73_Bypass	Channel	STR-73	STR-68	272.03	397.14	394.22	1.0700	3.840	0.0130	0.09	8.82	0.01	1.18	0.06	0.17	0.00	
150	74-Bypass	Channel	STR-74	STR-71	83.69	397.05	396.60	0.5400	3.840	0.0130	0.86	6.58	0.13	1.55	0.15	0.47	0.00	
151	76_Bypass	Channel	STR-76	STR-74	101.19	397.78	397.05	0.7200	3.840	0.0130	0.79	6.77	0.12	1.56	0.14	0.45	0.00	
152	77_Bypass	Channel	STR-77	STR-73	98.85	397.80	397.14	0.6700	3.840	0.0130	0.15	6.96	0.02	1.08	0.08	0.23	0.00	
153	79_Bypass	Channel	STR-79	STR-77	265.71	398.87	397.80	0.4000	3.840	0.0130	0.18	5.40	0.03	1.03	0.09	0.27	0.00	
154	8_Bypass	Channel	STR-8	STR-4	175.38	272.08	269.29	1.5900	1.200	0.0130	0.27	0.48	0.56	1.73	0.08	0.80	0.00	
155	81_Bypass	Channel	STR-81	STR-76	207.03	398.90	397.78	0.5400	3.840	0.0130	0.20	6.23	0.03	1.16	0.09	0.27	0.00	
156	83_bypass	Channel	STR-83	STR-81	139.00	399.62	398.90	0.5200	3.840	0.0130	0.06	6.04	0.01	0.81	0.06	0.18	0.00	
157	9_Bypass	Channel	STR-9	STR-5	169.63	270.92	268.12	1.6500	3.840	0.0130	0.25	10.94	0.02	1.75	0.08	0.24	0.00	
158	EX32-bypass	Channel	CBEX-32	EX32-bypass(out)	156.00	257.18	255.47	1.1000	3.600	0.0130	0.36	7.51	0.05	1.63	0.10	0.32	0.00	
159	EX33-bypass	Channel	CBEX-33	EX33-bypass(out)	70.00	256.90	255.70	1.7100	3.600	0.0130	0.06	9.39	0.01	1.36	0.04	0.15	0.00	
160	Outfall-1	Channel	DP-1	DP_1	333.49	327.00	286.00	12.2900	36.000	0.0320	23.09	439.39	0.05	10.22	0.85	0.28	0.00	
161	FSP1-1	Orifice	FSP-1	FSP1-Out		272.00	273.00		8.000		1.24							
162	FSP1-2	Orifice	FSP-1	FSP1-Out		272.00	273.00		12.000		1.77							
163	FSP2-1	Orifice	FSP-2	FSP2-Out		270.00	272.00		8.000		1.54							
164	FSP2-2	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		2.97							
165	FSP2-3	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		1.85							
166	Pond_LowFlow	Orifice	Pond_1	PondRiser		250.00	249.50		18.000		25.57							
167	primary	Orifice	Pond_1	PondRiser		250.00	249.50		17.000		11.27							
168	RiserTop	Orifice	Pond_1	PondRiser		250.00	249.50		48.000		0.00							
169	PondOverflow	Weir	Pond_1	DP_2_1		250.00	249.00				0.00							

**Inlet Summary**

SN Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft²)	Peak Flow (cfs)	Peak Flow Intercepted (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	
1	CBEX-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	0.00	N/A	1.10	0.74	0.36	67.46	10.50	6.28	257.31
2	CBEX-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	0.00	N/A	0.73	0.69	0.04	94.46	10.50	3.87	257.06
3	STR-102	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.57	263.07	0.00	N/A	0.38	0.32	0.06	84.67	10.50	4.21	263.15
4	STR-103	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.63	263.13	0.00	N/A	0.86	0.62	0.24	71.65	10.50	5.70	263.24
5	STR-105	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.58	266.08	0.00	N/A	0.19	0.18	0.01	93.59	10.50	3.26	266.15
6	STR-106	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.24	265.74	0.00	N/A	1.06	0.72	0.34	68.21	10.50	6.17	265.86
7	STR-11	FHWA HEC-22 GENERIC	N/A	On Grade	1	269.00	272.87	0.00	N/A	1.03	0.66	0.37	63.92	10.50	7.70	273.02
8	STR-12	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.70	273.43	0.00	N/A	0.32	0.27	0.06	81.89	10.50	5.00	273.53
9	STR-15	FHWA HEC-22 GENERIC	N/A	On Grade	1	276.00	280.19	0.00	N/A	0.68	0.57	0.11	83.58	10.50	4.15	280.27
10	STR-16	FHWA HEC-22 GENERIC	N/A	On Grade	1	275.00	280.17	0.00	N/A	0.82	0.65	0.16	80.29	10.50	4.49	280.26
11	STR-19	FHWA HEC-22 GENERIC	N/A	On Grade	1	289.75	294.30	0.00	N/A	0.71	0.58	0.12	82.47	10.50	4.27	294.39
12	STR-22	FHWA HEC-22 GENERIC	N/A	On Grade	1	304.00	307.33	0.00	N/A	0.81	0.65	0.16	80.35	10.50	4.49	307.42
13	STR-23	FHWA HEC-22 GENERIC	N/A	On Grade	1	303.50	307.59	0.00	N/A	0.38	0.35	0.03	91.51	10.50	3.38	307.66
14	STR-25	FHWA HEC-22 GENERIC	N/A	On Grade	1	314.00	318.10	0.00	N/A	1.00	0.77	0.23	76.85	10.50	4.86	318.20
15	STR-27	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	327.01	0.00	N/A	0.87	0.63	0.24	72.31	10.50	5.58	327.12
16	STR-28	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	328.31	0.00	N/A	0.23	0.21	0.02	92.12	10.50	3.40	328.38
17	STR-30	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.75	331.70	0.00	N/A	0.91	0.65	0.26	71.40	10.50	5.70	331.81
18	STR-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	331.69	335.69	0.00	N/A	0.71	0.53	0.17	75.56	10.50	5.19	335.79
19	STR-35	FHWA HEC-22 GENERIC	N/A	On Grade	1	332.50	335.63	0.00	N/A	0.94	0.67	0.28	70.74	10.50	5.79	335.75
20	STR-37	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.90	346.48	0.00	N/A	0.69	0.57	0.12	82.40	10.50	4.29	346.57
21	STR-38	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.30	345.42	0.00	N/A	2.47	1.31	1.15	53.25	10.50	5.37	345.53
22	STR-4	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.00	269.29	0.00	N/A	0.45	0.37	0.08	82.07	10.50	4.49	269.38
23	STR-40	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.35	359.60	0.00	N/A	0.70	0.58	0.13	81.87	10.50	4.34	359.69
24	STR-41	FHWA HEC-22 GENERIC	N/A	On Grade	2	355.36	359.61	0.00	N/A	5.59	3.29	2.30	58.90	10.50	8.35	359.83
25	STR-43	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.92	370.25	0.00	N/A	4.31	2.46	1.85	57.15	10.50	7.42	370.45
26	STR-45	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.70	372.97	0.00	N/A	0.68	0.56	0.12	82.50	10.50	4.28	373.06
27	STR-46	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.69	373.15	0.00	N/A	6.56	3.04	3.51	46.43	10.50	9.04	373.38
28	STR-49	FHWA HEC-22 GENERIC	N/A	N/A	1	372.80	376.30	0.00	N/A	3.16	3.02	0.14	96.00	10.50	2.53	376.56
29	STR-5	FHWA HEC-22 GENERIC	N/A	On Grade	1	264.50	268.12	0.00	N/A	1.24	0.81	0.43	65.55	10.50	6.55	268.25
30	STR-51	FHWA HEC-22 GENERIC	N/A	On Grade	2	373.77	377.77	0.00	N/A	6.04	3.25	2.79	53.81	10.50	10.47	378.03
31	STR-53	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.65	379.35	0.00	N/A	0.53	0.43	0.10	81.00	10.50	4.55	379.44
32	STR-54	FHWA HEC-22 GENERIC	N/A	On Grade	2	374.68	379.95	0.00	N/A	5.75	3.14	2.60	54.68	10.50	10.21	380.20
33	STR-56	FHWA HEC-22 GENERIC	N/A	On Grade	2	377.46	381.46	0.00	N/A	5.41	3.02	2.40	55.75	10.50	9.93	381.71
34	STR-58	FHWA HEC-22 GENERIC	N/A	On Grade	2	379.29	383.46	0.00	N/A	5.47	3.04	2.43	55.57	10.50	9.96	383.71
35	STR-59	FHWA HEC-22 GENERIC	N/A	On Grade	1	379.54	383.54	0.00	N/A	0.68	0.52	0.16	76.99	10.50	5.00	383.64
36	STR-61	FHWA HEC-22 GENERIC	N/A	On Grade	2	382.57	386.57	0.00	N/A	4.56	2.68	1.88	58.81	10.50	9.21	386.80
37	STR-63	FHWA HEC-22 GENERIC	N/A	On Grade	1	386.20	389.71	0.00	N/A	0.53	0.43	0.10	81.03	10.50	4.55	389.80
38	STR-64	FHWA HEC-22 GENERIC	N/A	On Grade	2	386.15	389.91	0.00	N/A	4.13	2.50	1.63	60.59	10.50	8.81	390.14
39	STR-66	FHWA HEC-22 GENERIC	N/A	On Grade	2	388.48	391.98	0.00	N/A	3.85	2.38	1.46	61.92	10.50	8.54	392.20
40	STR-68	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.70	394.22	0.00	N/A	0.61	0.48	0.13	78.88	10.50	4.78	394.32
41	STR-69	FHWA HEC-22 GENERIC	N/A	On Grade	2	390.70	394.06	0.00	N/A	2.74	1.88	0.86	68.64	10.50	7.24	394.25
42	STR-71	FHWA HEC-22 GENERIC	N/A	On Grade	2	392.55	396.60	0.00	N/A	2.16	1.54	0.62	71.31	10.50	8.67	396.82
43	STR-73	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.04	397.14	0.00	N/A	0.35	0.29	0.07	81.35	10.50	4.92	397.24
44	STR-74	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.10	397.10	0.00	N/A	2.67	1.81	0.86	67.87	10.50	9.51	397.34
45	STR-76	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.74	397.74	0.00	N/A	2.54	1.74	0.79	68.75	10.50	9.32	397.98
46	STR-77	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.30	397.80	0.00	N/A	0.56	0.42	0.14	74.29	10.50	5.84	397.92
47	STR-79	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.98	398.87	0.00	N/A	0.61	0.44	0.17	72.35	10.50	6.33	399.00

**Inlet Summary**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft²)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
48	STR-8	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.91	272.08	0.00	N/A	0.91	0.64	0.27	70.54	10.50	5.86	272.20
49	STR-81	FHWA HEC-22 GENERIC	N/A	On Grade	2	396.00	398.85	0.00	N/A	1.09	0.90	0.19	82.46	10.50	6.64	399.03
50	STR-83	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.55	399.55	0.00	N/A	0.38	0.33	0.05	87.21	10.50	4.11	399.67
51	STR-84	FHWA HEC-22 GENERIC	N/A	On Sag	2	395.80	399.80	0.00	0.00	2.65	N/A	N/A	N/A	10.50	10.40	400.03
52	STR-9	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.99	270.92	0.00	N/A	0.86	0.62	0.24	71.65	10.50	5.70	271.03

**Subbasin Hydrology**

**Subbasin : Blake1P**

**Input Data**

Area (ac) ..... 2.66  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 78.7  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.66	-	78.7
Composite Area & Weighted CN	2.66		78.7

**Time of Concentration**

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

- Tc = Time of Concentration (hr)
- n = Manning's roughness
- Lf = Flow Length (ft)
- P = 2 yr, 24 hr Rainfall (inches)
- Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

- V = 16.1345 \* (Sf<sup>0.5</sup>) (unpaved surface)
- V = 20.3282 \* (Sf<sup>0.5</sup>) (paved surface)
- V = 15.0 \* (Sf<sup>0.5</sup>) (grassed waterway surface)
- V = 10.0 \* (Sf<sup>0.5</sup>) (nearly bare & untilled surface)
- V = 9.0 \* (Sf<sup>0.5</sup>) (cultivated straight rows surface)
- V = 7.0 \* (Sf<sup>0.5</sup>) (short grass pasture surface)
- V = 5.0 \* (Sf<sup>0.5</sup>) (woodland surface)
- V = 2.5 \* (Sf<sup>0.5</sup>) (forest w/heavy litter surface)
- Tc = (Lf / V) / (3600 sec/hr)

Where:

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)

Channel Flow Equation :

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

$$R = A_q / W_p$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where :

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- R = Hydraulic Radius (ft)
- Aq = Flow Area (ft<sup>2</sup>)
- Wp = Wetted Perimeter (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)
- n = Manning's roughness



	Subarea A	Subarea B	Subarea C
<b>Sheet Flow Computations</b>			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0
<b>Shallow Concentrated Flow Computations</b>			
Flow Length (ft) :	346	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	7.64		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.69
Peak Runoff (cfs) .....	7.18
Weighted Curve Number .....	78.7
Time of Concentration (days hh:mm:ss) .....	0 00:07:38

**Subbasin : Blake2**

**Input Data**

Area (ac) ..... 0.57  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 82.1  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.57	-	82.1
Composite Area & Weighted CN	0.57		82.1

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 3  
Peak Runoff (cfs) ..... 1.77  
Weighted Curve Number ..... 82.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Culvert2L-DA**

**Input Data**

Area (ac) ..... 1.39  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 70.2  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	1.39	-	70.2
Composite Area & Weighted CN	1.39		70.2

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	426	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.33	0	0
Total TOC (min) .....	7.59		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 1.98  
 Peak Runoff (cfs) ..... 2.75  
 Weighted Curve Number ..... 70.2  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:35

**Subbasin : Culvert2P-DA**

**Input Data**

Area (ac) ..... 2.87  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 73.5  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.87	-	73.5
Composite Area & Weighted CN	2.87		73.5

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	317	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.04	0	0
Total TOC (min) .....	7.55		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.24  
 Peak Runoff (cfs) ..... 6.48  
 Weighted Curve Number ..... 73.5  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:33

**Subbasin : EX32-DA**

**Input Data**

Area (ac) ..... 0.21  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.21	-	98
Composite Area & Weighted CN	0.21		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.87  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : EX33-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	5	-	98
Composite Area & Weighted CN	5		98

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.66  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Hildreth-DA**

**Input Data**

Area (ac) ..... 2.35  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 87  
Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	2.35	-	87
Composite Area & Weighted CN	2.35		87

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	96	0	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	0.55	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.013	0	0
Flow Length (ft) :	553	0	0
Channel Slope (%) :	3	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.785	0	0
Wetted Perimeter (ft) :	3	0	0
Velocity (ft/sec) :	8.12	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	15.59		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 3.47  
Peak Runoff (cfs) ..... 6.9  
Weighted Curve Number ..... 87  
Time of Concentration (days hh:mm:ss) ..... 0 00:15:35

**Subbasin : Str102-DA**

**Input Data**

Area (ac) ..... 0.08  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.08	-	98
Composite Area & Weighted CN	0.08		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.34  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str103-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	98
Composite Area & Weighted CN	0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.53  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str105-DA**

**Input Data**

Area (ac) ..... 0.03  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.03	-	98
Composite Area & Weighted CN	0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.61  
Peak Runoff (cfs) ..... 0.11  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str106-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.63  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str11-DA**

**Input Data**

Area (ac) ..... 0.22  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.22	-	98
Composite Area & Weighted CN	0.22		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.92  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str12-DA**

**Input Data**

Area (ac) ..... 0.04  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.04	-	98
Composite Area & Weighted CN	0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.64  
Peak Runoff (cfs) ..... 0.16  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str15-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	98
Composite Area & Weighted CN	0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.53  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str16-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.68  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str16L-DA**

**Input Data**

Area (ac) ..... 1.77  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 71.3  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	1.77	-	71.3
Composite Area & Weighted CN	1.77		71.3

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	381	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.19	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	223	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.2	0	0
Total TOC (min) .....	7.65		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.07  
 Peak Runoff (cfs) ..... 3.66  
 Weighted Curve Number ..... 71.3  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:39



**Subbasin : Str19-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.66  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str19L-DA**

**Input Data**

Area (ac) ..... 1.85  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 74  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.85	-	74
Composite Area & Weighted CN	1.85		74

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	389	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.21	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	144	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.13	0	0
Total TOC (min) .....	7.61		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.29  
 Peak Runoff (cfs) ..... 4.27  
 Weighted Curve Number ..... 74  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:37

**Subbasin : Str22-DA**

**Input Data**

Area (ac) ..... 0.14  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.2  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.14	-	97.2
Composite Area & Weighted CN	0.14		97.2

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.57  
Peak Runoff (cfs) ..... 0.58  
Weighted Curve Number ..... 97.2  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str23-DA**

**Input Data**

Area (ac) ..... 0.08  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.08	-	98
Composite Area & Weighted CN	0.08		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.34  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str23L-DA**

**Input Data**

Area (ac) ..... 4.7  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 77.1  
Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	4.7	-	77.1
Composite Area & Weighted CN	4.7		77.1

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	8.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	463	0	0
Slope (%) :	9.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.05	0	0
Computed Flow Time (min) :	1.53	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	221	0	0
Channel Slope (%) :	5.9	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	19.49	0	0
Computed Flow Time (min) :	0.19	0	0
Total TOC (min) .....	10.31		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 2.55  
Peak Runoff (cfs) ..... 11.46  
Weighted Curve Number ..... 77.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:10:19

**Subbasin : Str25-DA**

**Input Data**

Area (ac) ..... 0.19  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 94  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.19	-	94
Composite Area & Weighted CN	0.19		94

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.21  
Peak Runoff (cfs) ..... 0.76  
Weighted Curve Number ..... 94  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str27-DA**

**Input Data**

Area (ac) ..... 0.15  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.8  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.15	-	97.8
Composite Area & Weighted CN	0.15		97.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.64  
Peak Runoff (cfs) ..... 0.61  
Weighted Curve Number ..... 97.8  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str28-DA**

**Input Data**

Area (ac) ..... 0.05  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.05	-	98
Composite Area & Weighted CN	0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.65  
Peak Runoff (cfs) ..... 0.18  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str28L-DA**

**Input Data**

Area (ac) ..... 4.17  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 75.4  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	4.17	-	75.4
Composite Area & Weighted CN	4.17		75.4

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	367	0	0
Slope (%) :	10.3	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.18	0	0
Computed Flow Time (min) :	1.18	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	294	0	0
Channel Slope (%) :	2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.35	0	0
Computed Flow Time (min) :	0.43	0	0
Total TOC (min) .....	15.52		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
 Total Runoff (in) ..... 2.4  
 Peak Runoff (cfs) ..... 8.6  
 Weighted Curve Number ..... 75.4  
 Time of Concentration (days hh:mm:ss) ..... 0 00:15:31

**Subbasin : Str30-DA**

**Input Data**

Area (ac) ..... 0.15  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.15	-	98
Composite Area & Weighted CN	0.15		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.63  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str32-DA**

**Input Data**

Area (ac) ..... 0.2  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.2	-	98
Composite Area & Weighted CN	0.2		98

**Time of Concentration**

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.82  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:00:00

**Subbasin : Str33-DA**

**Input Data**

Area (ac) ..... 0.04  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.65  
Peak Runoff (cfs) ..... 0.18  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str33L-DA**

**Input Data**

Area (ac) .....	3.18
Peak Rate Factor .....	484
Weighted Curve Number .....	75.4
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		3.18	-	75.4
Composite Area & Weighted CN		3.18		75.4

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	6	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	7.99	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	497	0	0
Slope (%) :	7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.27	0	0
Computed Flow Time (min) :	1.94	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	39	0	0
Channel Slope (%) :	3.6	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	15.23	0	0
Computed Flow Time (min) :	0.04	0	0
Total TOC (min) .....	9.97		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.4
Peak Runoff (cfs) .....	7.34
Weighted Curve Number .....	75.4
Time of Concentration (days hh:mm:ss) .....	0 00:09:58

**Subbasin : Str37-DA**

**Input Data**

Area (ac) .....	0.13
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.13	-	98
Composite Area & Weighted CN		0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.66
Peak Runoff (cfs) .....	0.55
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str38-DA**

**Input Data**

Area (ac) .....	0.13
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.13	-	98
Composite Area & Weighted CN		0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.66
Peak Runoff (cfs) .....	0.53
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str38L-DA**

**Input Data**

Area (ac) .....	3.72
Peak Rate Factor .....	484
Weighted Curve Number .....	73.3
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		3.72	-	73.3
Composite Area & Weighted CN		3.72		73.3

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	12.93	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	623	0	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	3.59	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	23	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	16.54		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.23
Peak Runoff (cfs) .....	6.92
Weighted Curve Number .....	73.3
Time of Concentration (days hh:mm:ss) .....	0 00:16:32



**Subbasin : Str40-DA**

**Input Data**

Area (ac) .....	0.14
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.66
Peak Runoff (cfs) .....	0.58
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str41-DA**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	98
Composite Area & Weighted CN		0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.34  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str41L-DA**

**Input Data**

Area (ac) .....	2.56
Peak Rate Factor .....	484
Weighted Curve Number .....	72.1
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		2.56	-	72.1
Composite Area & Weighted CN		2.56		72.1

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	20.77	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	498	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	8.38	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	59	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.05	0	0
Total TOC (min) .....	29.21		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.13
Peak Runoff (cfs) .....	3.67
Weighted Curve Number .....	72.1
Time of Concentration (days hh:mm:ss) .....	0 00:29:13

**Subbasin : Str43-DA**

**Input Data**

Area (ac) .....	0.03
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.61
Peak Runoff (cfs) .....	0.11
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str43L-DA**

**Input Data**

Area (ac) .....	0.5
Peak Rate Factor .....	484
Weighted Curve Number .....	73.7
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		0.5	-	73.7
Composite Area & Weighted CN		0.5		73.7

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	406	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	6.84	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	20	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	28.88		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.26
Peak Runoff (cfs) .....	0.78
Weighted Curve Number .....	73.7
Time of Concentration (days hh:mm:ss) .....	0 00:28:53

**Subbasin : Str45-DA**

**Input Data**

Area (ac) .....	0.14
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.66
Peak Runoff (cfs) .....	0.58
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str46-DA**

**Input Data**

Area (ac) .....	0.09
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.05	-	98
Composite Area & Weighted CN		0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.66
Peak Runoff (cfs) .....	0.37
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str46L-DA**

**Input Data**

Area (ac) .....	2.2
Peak Rate Factor .....	484
Weighted Curve Number .....	76.4
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area (acres)	Soil Group	Curve Number
Soil/Surface Description		2.01	-	76.4
Composite Area & Weighted CN		2.01		76.4

**Time of Concentration**

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	659	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.09	0	0

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	104	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.1	0	0
Total TOC (min) .....	32.77		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.49
Peak Runoff (cfs) .....	3.54
Weighted Curve Number .....	76.4
Time of Concentration (days hh:mm:ss) .....	0 00:32:46



**Subbasin : Str49-DA**

**Input Data**

Area (ac) .....	2.2
Peak Rate Factor .....	484
Weighted Curve Number .....	74.2
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.2	-	74.2
Composite Area & Weighted CN		2.2		74.2

**Time of Concentration**

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.8	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.5	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
	Flow Length (ft) :	706	0
Slope (%) :	1.8	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.94	0	0
Computed Flow Time (min) :	12.52	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
	Manning's Roughness :	0.016	0
Flow Length (ft) :	35	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	35.05		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.3
Peak Runoff (cfs) .....	3.16
Weighted Curve Number .....	74.2
Time of Concentration (days hh:mm:ss) .....	0 00:35:03

**Subbasin : Str4-DA**

**Input Data**

Area (ac) ..... 0.04  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.65  
Peak Runoff (cfs) ..... 0.18  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str51-DA**

**Input Data**

Area (ac) .....	0.03
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.63
Peak Runoff (cfs) .....	0.13
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str51L-DA**

**Input Data**

Area (ac) .....	2.4
Peak Rate Factor .....	484
Weighted Curve Number .....	73.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.4	-	73.3
Composite Area & Weighted CN		2.4		73.3

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	706	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.89	0	0
Total TOC (min) .....	33.46		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.23
Peak Runoff (cfs) .....	3.39
Weighted Curve Number .....	73.3
Time of Concentration (days hh:mm:ss) .....	0 00:33:28

**Subbasin : Str53-AD**

**Input Data**

Area (ac) ..... 0.09  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	98
Composite Area & Weighted CN		0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.66  
Peak Runoff (cfs) ..... 0.37  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str54-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	4.63
Peak Runoff (cfs) .....	0.13
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str54L-DA**

**Input Data**

Area (ac) .....	2.11
Peak Rate Factor .....	484
Weighted Curve Number .....	77
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area (acres)	Soil Group	Curve Number
Soil/Surface Description				
-		2.11	-	77
Composite Area & Weighted CN		2.11		77

**Time of Concentration**

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	23.02	0	0

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	714	0	0
Slope (%) :	1.8	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.94	0	0
Computed Flow Time (min) :	12.66	0	0

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	219	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.31	0	0
Total TOC (min) .....	35.99		

**Subbasin Runoff Results**

Total Rainfall (in) .....	4.9
Total Runoff (in) .....	2.54
Peak Runoff (cfs) .....	3.31
Weighted Curve Number .....	77
Time of Concentration (days hh:mm:ss) .....	0 00:35:59

**Subbasin : Str56-DA**

**Input Data**

Area (ac) ..... 0.04  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 4.9  
Total Runoff (in) ..... 4.63  
Peak Runoff (cfs) ..... 0.13  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str56L-DA**

**Input Data**

Area (ac) .....	2.12
Peak Rate Factor .....	484
Weighted Curve Number .....	75.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.12	-	75.3
Composite Area & Weighted CN		2.12		75.3

**Time of Concentration**

**Junction Input**

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft <sup>2</sup> )	Minimum Pipe Cover (in)
1	Culvert2In	270.70	274.50	3.80	270.70	0.00	274.50	0.00	0.00	0.00
2	DMH3c	268.70	271.83	3.13	268.70	0.00	271.83	0.00	0.00	0.00
3	DMH4c	268.10	271.22	3.12	268.10	0.00	271.22	0.00	0.00	0.00
4	DMH5c	265.90	269.46	3.56	265.90	0.00	269.46	0.00	0.00	0.00
5	DMH6c	253.60	258.48	4.88	253.60	0.00	258.48	0.00	0.00	0.00
6	DMH9c	268.90	271.70	2.80	268.90	0.00	271.70	0.00	0.00	0.00
7	DP_2_1	249.00	255.00	6.00	249.00	0.00	255.00	0.00	0.00	0.00
8	DP_2_2	250.00	256.00	6.00	250.00	0.00	256.00	0.00	0.00	0.00
9	DP-1	327.00	336.00	9.00	327.00	0.00	336.00	0.00	0.00	0.00
10	FSP1-Out	273.00	276.00	3.00	273.00	0.00	276.00	0.00	7794.00	0.00
11	FSP2-Out	272.00	276.00	4.00	272.00	0.00	276.00	0.00	3746.00	0.00
12	PondRiser	249.50	255.90	6.40	249.50	0.00	257.50	1.60	0.00	0.00
13	SD-16	290.00	294.30	4.30	290.00	0.00	294.30	0.00	0.00	0.00
14	SD-19	302.75	307.59	4.84	302.75	0.00	307.59	0.00	0.00	0.00
15	SD-23	323.75	328.31	4.56	323.75	0.00	328.31	0.00	0.00	0.00
16	SD-28	331.94	335.69	3.75	331.94	0.00	335.69	0.00	0.00	0.00
17	SD-33	341.55	345.42	3.87	341.55	0.00	345.42	0.00	0.00	0.00
18	SD-38	355.60	359.61	4.01	355.60	0.00	359.61	0.00	0.00	0.00
19	STR-10	267.50	273.38	5.88	267.50	0.00	273.38	0.00	0.00	0.00
20	STR-100	256.50	261.94	5.44	256.50	0.00	261.94	0.00	0.00	0.00
21	STR-101	258.50	262.54	4.04	258.50	0.00	262.54	0.00	0.00	0.00
22	STR-104	262.08	265.84	3.76	262.08	0.00	265.84	0.00	0.00	0.00
23	STR-13	269.10	274.10	5.00	269.10	0.00	274.10	0.00	0.00	0.00
24	STR-14	274.00	280.22	6.22	274.00	0.00	280.22	0.00	0.00	0.00
25	STR-17	282.30	287.81	5.51	282.30	0.00	287.81	0.00	0.00	0.00
26	STR-18	289.30	294.76	5.46	289.30	0.00	294.76	0.00	0.00	0.00
27	STR-2	253.60	261.00	7.40	253.60	0.00	261.00	0.00	0.00	0.00
28	STR-20	296.30	301.69	5.39	296.30	0.00	301.69	0.00	0.00	0.00
29	STR-21	302.10	307.72	5.62	302.10	0.00	307.72	0.00	0.00	0.00
30	STR-24	313.50	318.70	5.20	313.50	0.00	318.70	0.00	0.00	0.00
31	STR-26	322.80	328.00	5.20	322.80	0.00	328.00	0.00	0.00	0.00
32	STR-29	326.75	332.13	5.38	326.75	0.00	332.13	0.00	0.00	0.00
33	STR-3	259.30	269.66	10.36	259.30	0.00	269.66	0.00	0.00	0.00
34	STR-34	330.32	336.12	5.80	330.32	0.00	336.12	0.00	0.00	0.00
35	STR-36	341.00	346.20	5.20	341.00	0.00	346.20	0.00	0.00	0.00
36	STR-39	354.40	359.65	5.25	354.40	0.00	359.65	0.00	0.00	0.00
37	STR-42	365.50	370.42	4.92	365.50	0.00	370.42	0.00	0.00	0.00
38	STR-44	367.50	372.84	5.34	367.50	0.00	372.84	0.00	0.00	0.00
39	STR-47	370.40	376.35	5.95	370.40	0.00	376.35	0.00	0.00	0.00
40	STR-50	372.50	378.03	5.53	372.50	0.00	378.03	0.00	0.00	0.00
41	STR-52	374.40	379.58	5.18	374.40	0.00	379.58	0.00	0.00	0.00
42	STR-55	376.70	381.70	5.00	376.70	0.00	381.70	0.00	0.00	0.00
43	STR-57	379.05	383.70	4.65	379.05	0.00	383.70	0.00	0.00	0.00
44	STR-6	260.10	270.06	9.96	260.10	0.00	270.06	0.00	0.00	0.00
45	STR-60	382.35	386.80	4.45	382.35	0.00	386.80	0.00	0.00	0.00
46	STR-62	386.00	390.16	4.16	386.00	0.00	390.16	0.00	0.00	0.00
47	STR-65	388.10	392.29	4.19	388.10	0.00	392.29	0.00	0.00	0.00
48	STR-67	390.10	394.40	4.30	390.10	0.00	394.40	0.00	0.00	0.00
49	STR-7	262.00	271.28	9.28	262.00	0.00	271.28	0.00	0.00	0.00
50	STR-70	391.20	396.78	5.58	391.20	0.00	396.78	0.00	0.00	0.00
51	STR-72	391.70	397.36	5.66	391.70	0.00	397.36	0.00	0.00	0.00
52	STR-75	392.70	397.98	5.28	392.70	0.00	397.98	0.00	0.00	0.00
53	STR-78	393.90	398.98	5.08	393.90	0.00	398.98	0.00	0.00	0.00
54	STR-80	394.90	398.92	4.02	394.90	0.00	398.92	0.00	0.00	0.00
55	STR-82	395.15	399.57	4.42	395.15	0.00	399.57	0.00	0.00	0.00

**Junction Results**

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert2In	4.91	2.75	273.10	2.40	0.00	1.40	272.66	1.96	0 12:21	0 00:00	0.00	0.00
2	DMH3c	7.74	0.00	269.73	1.03	0.00	2.10	268.82	0.12	0 12:08	0 00:00	0.00	0.00
3	DMH4c	7.74	0.00	269.23	1.13	0.00	1.99	268.32	0.22	0 12:08	0 00:00	0.00	0.00
4	DMH5c	7.74	0.00	266.60	0.70	0.00	2.86	266.07	0.17	0 12:08	0 00:00	0.00	0.00
5	DMH6c	2.52	0.00	255.61	2.01	0.00	2.87	255.18	1.58	0 12:07	0 00:00	0.00	0.00
6	DMH9c	7.74	1.76	269.86	0.96	0.00	1.84	269.08	0.18	0 12:08	0 00:00	0.00	0.00
7	DP_2_1	36.84	0.00	250.85	1.85	0.00	5.55	249.37	0.37	0 12:36	0 00:00	0.00	0.00
8	DP_2_2	3.19	0.00	250.49	0.49	0.00	5.51	250.08	0.08	0 12:07	0 00:00	0.00	0.00
9	DP-1	23.27	0.00	329.22	2.22	0.00	6.78	327.82	0.82	0 12:31	0 00:00	0.00	0.00
10	FSP1-Out	3.01	0.00	273.50	0.50	0.00	2.62	273.06	0.06	0 12:21	0 00:00	0.00	0.00
11	FSP2-Out	6.37	0.00	272.72	0.72	0.00	4.03	272.08	0.08	0 12:10	0 00:00	0.00	0.00
12	PondRiser	36.84	0.00	251.35	1.85	0.00	4.55	249.87	0.37	0 12:36	0 00:00	0.00	0.00
13	SD-16	3.66	3.66	290.45	0.45	0.00	3.85	290.06	0.06	0 12:07	0 00:00	0.00	0.00
14	SD-19	4.27	4.27	303.26	0.51	0.00	4.33	302.81	0.06	0 12:07	0 00:00	0.00	0.00
15	SD-23	11.46	11.46	324.50	0.75	0.00	3.81	323.85	0.10	0 12:08	0 00:00	0.00	0.00
16	SD-28	8.60	8.60	332.74	0.80	0.00	2.95	332.05	0.11	0 12:11	0 00:00	0.00	0.00
17	SD-33	7.34	7.34	342.31	0.76	0.00	3.11	341.64	0.09	0 12:08	0 00:00	0.00	0.00
18	SD-38	6.92	6.92	356.24	0.64	0.00	3.37	355.69	0.09	0 12:12	0 00:00	0.00	0.00
19	STR-10	73.87	0.00	269.51	2.01	0.00	3.87	268.56	1.06	0 12:10	0 00:00	0.00	0.00
20	STR-100	1.78	0.00	257.35	0.85	0.00	4.59	257.06	0.56	0 12:06	0 00:00	0.00	0.00
21	STR-101	1.78	0.00	258.97	0.47	0.00	3.57	258.75	0.25	0 12:07	0 00:00	0.00	0.00
22	STR-104	0.87	0.00	262.46	0.38	0.00	3.38	262.23	0.15	0 12:06	0 00:00	0.00	0.00
23	STR-13	73.22	0.00	271.05	1.95	0.00	3.05	269.72	0.62	0 12:10	0 00:00	0.00	0.00
24	STR-14	68.34	0.00	276.15	2.15	0.00	4.07	275.95	1.95	0 12:06	0 00:00	0.00	0.00
25	STR-17	64.22	0.00	283.71	1.41	0.00	4.10	282.58	0.28	0 12:10	0 00:00	0.00	0.00
26	STR-18	64.22	0.00	290.67	1.37	0.00	4.09	289.57	0.27	0 12:11	0 00:00	0.00	0.00
27	STR-2	83.25	0.00	255.76	2.16	0.00	5.24	253.96	0.36	0 12:11	0 00:00	0.00	0.00
28	STR-20	60.19	0.00	297.70	1.40	0.00	3.99	296.58	0.28	0 12:11	0 00:00	0.00	0.00
29	STR-21	60.19	0.00	304.09	1.99	0.00	3.63	303.46	1.36	0 12:08	0 00:00	0.00	0.00
30	STR-24	49.17	0.00	314.81	1.31	0.00	3.89	313.76	0.26	0 12:14	0 00:00	0.00	0.00
31	STR-26	48.76	0.00	324.26	1.46	0.00	3.74	323.13	0.33	0 12:15	0 00:00	0.00	0.00
32	STR-29	40.01	0.00	328.89	2.14	0.00	3.24	327.47	0.72	0 12:15	0 00:00	0.00	0.00
33	STR-3	83.26	0.00	263.73	4.43	0.00	5.93	263.54	4.24	0 12:06	0 00:00	0.00	0.00
34	STR-34	56.00	0.00	332.68	2.36	0.00	3.44	332.45	2.13	0 12:06	0 00:00	0.00	0.00
35	STR-36	55.67	0.00	342.45	1.45	0.00	3.75	341.34	0.34	0 12:16	0 00:00	0.00	0.00
36	STR-39	47.47	0.00	355.77	1.37	0.00	3.88	355.09	0.69	0 12:16	0 00:00	0.00	0.00
37	STR-42	44.22	0.00	367.12	1.62	0.00	3.30	365.92	0.42	0 12:15	0 00:00	0.00	0.00
38	STR-44	42.03	0.00	369.16	1.66	0.00	3.68	368.60	1.10	0 12:15	0 00:00	0.00	0.00
39	STR-47	39.01	0.00	373.16	2.76	0.00	3.19	372.69	2.29	0 12:26	0 00:00	0.00	0.00
40	STR-50	36.53	0.00	374.10	1.60	0.00	3.93	373.58	1.08	0 12:14	0 00:00	0.00	0.00
41	STR-52	33.82	0.00	375.81	1.41	0.00	3.77	374.73	0.33	0 12:13	0 00:00	0.00	0.00
42	STR-55	31.01	0.00	378.03	1.33	0.00	3.67	377.51	0.81	0 12:23	0 00:00	0.00	0.00
43	STR-57	28.46	0.00	380.30	1.25	0.00	3.40	379.35	0.30	0 12:11	0 00:00	0.00	0.00
44	STR-6	82.39	0.00	265.83	5.73	0.00	4.23	265.22	5.12	0 12:08	0 00:00	0.00	0.00
45	STR-60	25.38	0.00	383.50	1.15	0.00	3.30	382.62	0.27	0 12:11	0 00:00	0.00	0.00
46	STR-62	23.15	0.00	387.13	1.13	0.00	3.03	386.28	0.28	0 12:10	0 00:00	0.00	0.00
47	STR-65	20.63	0.00	389.13	1.03	0.00	3.16	388.48	0.38	0 12:10	0 00:00	0.00	0.00
48	STR-67	18.50	0.00	391.59	1.49	0.00	2.81	390.70	0.60	0 12:09	0 00:00	0.00	0.00
49	STR-7	74.85	0.00	265.73	3.73	0.00	5.55	265.54	3.54	0 12:07	0 00:00	0.00	0.00
50	STR-70	16.36	0.00	392.66	1.46	0.00	4.12	392.40	1.20	0 12:12	0 00:00	0.00	0.00
51	STR-72	14.86	0.00	393.24	1.54	0.00	4.12	392.96	1.26	0 12:09	0 00:00	0.00	0.00
52	STR-75	12.82	0.00	394.20	1.50	0.00	3.78	393.79	1.09	0 12:08	0 00:00	0.00	0.00
53	STR-78	10.77	0.00	395.17	1.27	0.00	3.81	394.94	1.04	0 12:09	0 00:00	0.00	0.00
54	STR-80	7.55	6.90	396.13	1.23	0.00	2.79	395.94	1.04	0 12:06	0 00:00	0.00	0.00
55	STR-82	2.87	0.00	395.84	0.69	0.00	3.73	395.33	0.18	0 12:09	0 00:00	0.00	0.00

**Channel Input**

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 102_Bypass	233.14	263.07	3.50	256.90	3.80	6.17	2.6500	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
2 103_bypass	238.82	263.13	3.50	257.18	2.18	5.95	2.4900	Trapezoidal	0.320	16.000	0.0320	0.5000	0.5000	0.0000	0.00	No
3 105_Bypass	144.56	266.08	3.50	263.07	3.50	3.01	2.0800	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
4 106_Bypass	143.60	265.74	3.50	263.13	3.50	2.61	1.8200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
5 11_Bypass	310.73	272.87	3.87	272.08	6.17	0.79	0.2500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
6 12_Bypass	306.16	273.43	4.73	270.92	4.93	2.51	0.8200	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
7 15_Bypass	299.12	280.19	4.19	272.87	3.87	7.32	2.4500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
8 16_Bypass	302.37	280.17	5.17	273.43	4.73	6.74	2.2300	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
9 19_Bypass	252.79	294.30	4.55	280.17	5.17	14.13	5.5900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
10 22_Bypass	494.76	307.33	3.33	280.19	4.19	27.14	5.4900	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
11 23_Bypass	228.51	307.59	4.09	294.30	4.55	13.29	5.8200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
12 25_Bypass	205.10	318.10	4.10	307.33	3.33	10.77	5.2500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
13 27-Bypass	194.95	327.02	3.52	318.10	4.10	8.92	4.5800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
14 28_Bypass	408.97	328.31	4.81	307.59	4.09	20.72	5.0700	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
15 30_Bypass	198.67	331.70	3.95	327.02	3.52	4.68	2.3600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
16 33_Bypass	357.58	335.69	4.00	328.31	4.81	7.38	2.0600	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
17 35_Bypass	196.77	335.63	3.13	331.70	3.95	3.93	2.0000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
18 37_Bypass	249.72	346.40	4.50	335.63	3.13	10.77	4.3100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
19 38_Bypass	270.06	345.42	4.12	335.69	4.00	9.73	3.6000	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
20 4_Bypass	153.05	269.29	4.29	266.08	3.50	3.21	2.1000	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
21 40_bypass	261.30	359.60	4.25	346.40	4.50	13.20	5.0500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
22 41_Bypass	286.28	359.61	4.25	345.42	4.12	14.19	4.9600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
23 43_Bypass	214.88	370.25	4.33	359.61	4.25	10.64	4.9500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
24 45_Bypass	287.18	372.97	4.27	359.60	4.25	13.37	4.6600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
25 46_Bypass	69.33	373.15	4.46	370.25	4.33	2.90	4.1800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
26 49_Bypass	115.00	376.30	3.50	373.15	4.46	3.15	2.7400	Trapezoidal	0.320	16.000	0.0320	0.5000	0.5000	0.0000	0.00	No
27 5_Bypass	149.01	268.12	3.62	265.74	3.50	2.38	1.6000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
28 51-bypass	200.00	377.77	4.00	373.15	4.46	4.62	2.3100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
29 53_Bypass	266.58	379.35	4.70	372.97	4.27	6.38	2.3900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
30 54_Bypass	73.90	379.95	5.27	377.77	4.00	2.18	2.9500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
31 56-bypass	94.37	381.80	4.34	379.95	5.27	1.85	1.9600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
32 58_Bypass	86.78	383.51	4.22	381.80	4.34	1.71	1.9700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
33 59_Bypass	188.00	383.54	4.00	379.35	4.70	4.19	2.2300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
34 61-bypass	153.24	386.90	4.33	383.51	4.22	3.39	2.2100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
35 63_Bypass	295.23	389.71	3.51	383.54	4.00	6.17	2.0900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
36 64-Bypass	140.44	389.96	3.81	386.90	4.33	3.06	2.1800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
37 66-bypass	100.35	392.10	3.62	389.96	3.81	2.14	2.1300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
38 68_Bypass	193.86	394.22	3.52	389.71	3.51	4.51	2.3300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
39 69_bypass	94.31	394.12	3.42	392.10	3.62	2.02	2.1400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
40 71-Bypass	190.28	396.60	4.05	394.12	3.42	2.48	1.3000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
41 73_Bypass	272.03	397.14	4.10	394.22	3.52	2.92	1.0700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
42 74-Bypass	83.69	397.05	3.95	396.60	4.05	0.45	0.5400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
43 76_Bypass	101.19	397.78	4.04	397.05	3.95	0.73	0.7200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
44 77_Bypass	98.85	397.80	4.50	397.14	4.10	0.66	0.6700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
45 79_Bypass	265.71	398.87	3.89	397.80	4.50	1.07	0.4000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
46 8_Bypass	175.38	272.08	6.17	269.29	4.29	2.79	1.5900	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
47 81_Bypass	207.03	398.90	2.90	397.78	4.04	1.12	0.5400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
48 83_bypass	139.00	399.62	4.07	398.90	2.90	0.72	0.5200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
49 9_Bypass	169.63	270.92	4.93	268.12	3.62	2.80	1.6500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
50 EX32-bypass	156.00	257.18	2.18	255.47	0.00	1.71	1.1000	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
51 EX33-bypass	70.00	256.90	3.80	255.70	0.00	1.20	1.7100	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
52 Outfall-1	333.49	327.00	0.00	286.00	0.00	41.00	12.2900	Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No

**Channel Results**

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 102_Bypass	0.07	0 12:08	11.66	0.01	1.56	2.49	0.04	0.15	0.00		
2 103_bypass	0.25	0 12:08	5.46	0.05	1.20	3.32	0.10	0.31	0.00		
3 105_Bypass	0.04	0 12:08	10.34	0.00	1.17	2.06	0.04	0.12	0.00		
4 106_Bypass	0.34	0 12:07	11.48	0.03	1.92	1.25	0.09	0.27	0.00		
5 11_Bypass	0.38	0 12:09	4.29	0.09	1.09	4.75	0.13	0.39	0.00		
6 12_Bypass	0.08	0 12:09	0.35	0.23	1.12	4.56	0.06	0.57	0.00		
7 15_Bypass	0.12	0 12:08	13.32	0.01	1.90	2.62	0.05	0.17	0.00		
8 16_Bypass	0.17	0 12:08	0.57	0.30	2.02	2.49	0.06	0.63	0.00		
9 19_Bypass	0.13	0 12:07	20.13	0.01	2.47	1.71	0.05	0.15	0.00		
10 22_Bypass	0.17	0 12:08	0.90	0.19	2.91	2.83	0.05	0.53	0.00		
11 23_Bypass	0.05	0 12:07	20.53	0.00	1.84	2.07	0.03	0.10	0.00		
12 25_Bypass	0.23	0 12:07	19.51	0.01	2.63	1.30	0.06	0.19	0.00		
13 27-Bypass	0.25	0 12:07	18.20	0.01	2.52	1.29	0.06	0.20	0.00		
14 28_Bypass	0.04	0 12:08	0.86	0.05	1.75	3.89	0.03	0.32	0.00		
15 30_Bypass	0.27	0 12:07	13.08	0.02	2.04	1.62	0.07	0.23	0.00		
16 33_Bypass	0.18	0 12:27	0.55	0.33	1.78	3.35	0.07	0.66	0.00		
17 35_Bypass	0.28	0 12:07	12.03	0.02	1.95	1.68	0.08	0.24	0.00		
18 37_Bypass	0.13	0 12:07	17.75	0.01	2.29	1.82	0.05	0.16	0.00		
19 38_Bypass	0.65	0 12:24	0.73	0.89	2.85	1.58	0.10	0.96	0.00		
20 4_Bypass	0.09	0 12:08	0.55	0.16	1.44	1.77	0.05	0.50	0.00		
21 40_bypass	0.14	0 12:07	19.08	0.01	2.44	1.78	0.05	0.16	0.00		
22 41_Bypass	2.30	0 12:23	18.96	0.12	4.38	1.09	0.15	0.45	0.00		
23 43_Bypass	1.85	0 12:24	18.95	0.10	4.14	0.87	0.13	0.42	0.00		
24 45_Bypass	0.13	0 12:07	18.37	0.01	2.35	2.04	0.05	0.15	0.00		
25 46_Bypass	3.52	0 12:24	17.41	0.20	4.56	0.25	0.18	0.55	0.00		
26 49_Bypass	0.14	0 12:27	5.72	0.02	0.90	2.13	0.08	0.25	0.00		
27 5_Bypass	0.43	0 12:07	10.76	0.04	1.96	1.27	0.10	0.30	0.00		
28 51-bypass	2.79	0 12:25	12.94	0.22	3.45	0.97	0.18	0.56	0.00		
29 53_Bypass	0.10	0 12:08	13.17	0.01	1.65	2.69	0.05	0.16	0.00		
30 54_Bypass	2.60	0 12:25	14.62	0.18	3.71	0.33	0.17	0.52	0.00		
31 56-bypass	2.40	0 12:24	10.77	0.22	2.89	0.54	0.18	0.57	0.00		
32 58_Bypass	2.43	0 12:20	12.93	0.19	3.33	0.43	0.17	0.53	0.00		
33 59_Bypass	0.16	0 12:07	12.71	0.01	1.81	1.73	0.06	0.19	0.00		
34 61-bypass	1.87	0 12:20	12.13	0.15	2.97	0.86	0.16	0.50	0.00		
35 63_Bypass	0.10	0 12:07	12.31	0.01	1.58	3.11	0.05	0.16	0.00		
36 64-Bypass	1.63	0 12:17	13.13	0.12	3.05	0.77	0.15	0.46	0.00		
37 66-bypass	1.46	0 12:17	12.23	0.12	2.81	0.60	0.14	0.45	0.00		
38 68_Bypass	0.13	0 12:07	12.99	0.01	1.76	1.84	0.06	0.18	0.00		
39 69_bypass	0.86	0 12:15	12.64	0.07	2.52	0.62	0.12	0.36	0.00		
40 71-Bypass	0.62	0 12:13	9.84	0.06	1.94	1.63	0.11	0.35	0.00		
41 73_Bypass	0.09	0 12:09	8.82	0.01	1.18	3.84	0.06	0.17	0.00		
42 74-Bypass	0.86	0 12:09	6.58	0.13	1.55	0.90	0.15	0.47	0.00		
43 76_Bypass	0.79	0 12:08	6.77	0.12	1.56	1.08	0.14	0.45	0.00		
44 77_Bypass	0.15	0 12:07	6.96	0.02	1.08	1.53	0.08	0.23	0.00		
45 79_Bypass	0.18	0 12:08	5.40	0.03	1.03	4.30	0.09	0.27	0.00		
46 8_Bypass	0.27	0 12:07	0.48	0.56	1.73	1.69	0.08	0.80	0.00		
47 81_Bypass	0.20	0 12:08	6.23	0.03	1.16	2.97	0.09	0.27	0.00		
48 83_bypass	0.06	0 12:08	6.04	0.01	0.81	2.86	0.06	0.18	0.00		
49 9_Bypass	0.25	0 12:07	10.94	0.02	1.75	1.62	0.08	0.24	0.00		
50 EX32-bypass	0.36	0 12:07	7.51	0.05	1.63	1.60	0.10	0.32	0.00		
51 EX33-bypass	0.06	0 12:06	9.39	0.01	1.36	0.86	0.04	0.15	0.00		
52 Outfall-1	23.09	0 12:07	439.39	0.05	10.22	0.54	0.85	0.28	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet		Outlet		Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
		Invert Elevation (ft)	Invert Offset (ft)	Invert Elevation (ft)	Invert Offset (ft)												
1 101-100	30.00	258.50	0.00	257.00	0.50	1.50	5.0000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2 102-101	60.00	259.57	0.00	258.70	0.20	0.87	1.4500	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
3 103-101	30.00	259.63	0.00	258.70	0.20	0.93	3.1000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
4 104-101	190.00	262.08	0.00	258.70	0.20	3.38	1.7800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
5 105-104	29.00	262.58	0.00	262.18	0.10	0.40	1.3800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
6 106-104	6.00	262.24	0.00	262.18	0.10	0.06	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
7 7-Oct	303.00	267.50	0.00	262.10	0.10	5.40	1.7800	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
8 10-Nov	17.00	269.00	0.00	268.50	1.00	0.50	2.9400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
9 10-Dec	5.00	268.70	0.00	268.50	1.00	0.20	4.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
10 13-10	93.00	269.10	0.00	267.60	0.10	1.50	1.6100	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
11 14-13	195.00	274.00	0.00	269.20	0.10	4.80	2.4600	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
12 15-14	15.00	276.00	0.00	275.90	1.90	0.10	0.6700	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
13 16-14	7.00	275.00	0.00	274.60	0.60	0.40	5.7100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
14 17-14	133.00	282.30	0.00	274.50	0.50	7.80	5.8600	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
15 18-17	115.00	289.30	0.00	282.40	0.10	6.90	6.0000	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
16 19-18	7.00	289.75	0.00	289.30	0.00	0.45	6.4300	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
17 20-18	118.00	296.30	0.00	289.40	0.10	6.90	5.8500	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
18 1-Feb	27.00	253.60	0.00	253.20	3.20	0.40	1.4800	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
19 21-20	106.00	302.10	0.00	296.40	0.10	5.70	5.3800	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
20 22-21	19.00	304.00	0.00	302.10	0.00	1.90	10.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
21 23-21	4.00	303.50	0.00	303.35	1.25	0.15	3.7500	CIRCULAR	18.000	18.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
22 24-21	192.00	313.50	0.00	302.20	0.10	11.30	5.8900	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
23 25-24	17.00	314.00	0.00	313.50	0.00	0.50	2.9400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
24 26-24	206.00	322.80	0.00	313.60	0.10	9.20	4.4700	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
25 27-26	16.00	323.50	0.00	323.00	0.20	0.50	3.1300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
26 28-26	8.00	323.50	0.00	323.00	0.20	0.50	6.2500	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
27 29-26	188.00	326.75	0.00	322.90	0.10	3.85	2.0500	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
28 30-29	8.00	327.75	0.00	327.40	0.65	0.35	4.3800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
29 31-29	156.00	327.90	0.25	326.85	0.10	1.05	0.6700	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
30 31-Out	37.00	327.70	0.05	327.45	0.45	0.25	0.6800	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
31 2-Mar	260.00	259.30	0.00	253.70	0.10	5.60	2.1500	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
32 32-6	18.00	255.00	0.00	254.20	0.60	0.80	4.4400	CIRCULAR	6.000	6.000	0.0110	0.5000	0.5000	0.0000	0.00	No	2
33 33-31	10.00	331.69	0.00	330.89	3.24	0.80	8.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
34 33-out	40.00	253.10	0.00	250.00	0.00	3.10	7.7500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
35 34-31	34.00	330.72	0.40	329.70	2.05	1.02	3.0000	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
36 35-34	11.00	332.50	0.00	332.40	2.08	0.10	0.9100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
37 36-34	240.00	340.60	-0.40	330.82	0.50	9.78	4.0800	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
38 37-36	18.00	341.90	0.00	341.10	0.10	0.80	4.4400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
39 38-36	16.00	341.30	0.00	341.10	0.10	0.20	1.2500	CIRCULAR	18.000	18.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
40 39-36	266.00	354.40	0.00	341.10	0.10	13.30	5.0000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
41 40-39	17.00	355.35	0.00	355.00	0.60	0.35	2.0600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
42 41-39	6.00	355.36	0.00	355.00	0.60	0.36	6.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
43 42-39	217.00	365.50	0.00	354.50	0.10	11.00	5.0700	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
44 3-Apr	19.00	265.00	0.00	263.50	4.20	1.50	7.8900	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
45 43-42	5.00	365.92	0.00	365.80	0.30	0.12	2.4000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
46 44-42	66.00	367.50	0.00	365.60	0.10	1.90	2.8800	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
47 45-44	18.00	368.70	0.00	368.50	1.00	0.20	1.1100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
48 46-44	7.00	368.69	0.00	368.50	1.00	0.19	2.7100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
49 47-44	119.00	370.40	0.00	367.60	0.10	2.80	2.3500	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
50 49-47	14.00	372.80	0.00	372.60	2.20	0.20	1.4300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
51 50-47	74.00	372.62	0.12	370.90	0.50	1.72	2.3200	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
52 51-50	8.00	373.77	0.00	373.50	1.00	0.27	3.3700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
53 52-50	67.00	374.40	0.00	372.72	0.22	1.68	2.5100	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
54 3-May	38.00	264.50	0.00	263.50	4.20	1.00	2.6300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
55 53-52	15.00	374.65	0.00	374.40	0.00	0.25	1.6700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
56 54-52	11.00	374.68	0.00	374.40	0.00	0.28	2.5500	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
57 55-52	95.00	376.70	0.00	374.50	0.10	2.20	2.3200	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
58 56-55	6.00	377.46	0.00	377.40	0.70	0.06	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
59 57-55	95.00	379.05	0.00	376.77	0.07	2.28	2.4000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
60 58-57	6.00	379.29	0.00	379.17	0.12	0.12	2.0000	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
61 59-57	18.00	379.54	0.00	379.17	0.12	0.37	2.0600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
62 60-57	140.00	382.35	0.00	379.15	0.10	3.20	2.2900	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
63 61-60	6.00	382.57	0.00	382.50	0.15	0.07	1.1700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
64 62-60	150.00	386.00	0.00	382.40	0.05	3.60	2.4000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
65 3-Jun	38.00	260.10	0.00	259.40	0.10	0.70	1.8400	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
66 63-62	17.00	386.20	0.00	386.10	0.10	0.10	0.5										

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
76 71-70	8.00	392.55	0.00	392.34	1.14	0.21	2.6300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
77 72-70	78.00	391.90	0.20	391.30	0.10	0.60	0.7700	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
78 73-72	18.00	393.04	0.00	392.68	0.98	0.36	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
79 74-72	7.00	393.10	0.00	392.90	1.20	0.20	2.8600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
80 75-72	99.00	392.70	0.00	392.00	0.30	0.70	0.7100	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
81 76-75	6.00	393.74	0.00	393.70	1.00	0.04	0.6700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
82 77-75	17.00	393.30	0.00	393.13	0.43	0.17	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
83 78-75	201.00	393.90	0.00	392.80	0.10	1.10	0.5500	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
84 79-78	4.00	394.98	0.00	394.90	1.00	0.08	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
85 80-78	25.00	394.90	0.00	394.40	0.50	0.50	2.0000	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
86 81-80	3.00	396.00	0.00	395.90	1.00	0.10	3.3300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
87 82-78	107.00	395.15	0.00	394.40	0.50	0.75	0.7000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
88 83-82	50.00	395.55	0.00	395.25	0.10	0.30	0.6000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
89 84-82	42.00	395.80	0.00	395.25	0.10	0.55	1.3100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
90 7-Aug	26.00	265.91	0.00	265.50	3.50	0.41	1.5800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
91 7-Sep	6.00	265.99	0.00	265.50	3.50	0.49	8.1700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
92 Culvert2	25.00	270.70	0.00	269.63	0.53	1.07	4.2800	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
93 EX1-6	153.00	256.50	0.00	255.10	1.50	1.40	0.9200	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
94 EX3-4	62.00	268.60	-0.10	268.20	0.10	0.40	0.6500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
95 EX4-5	22.00	268.10	0.00	266.00	0.10	2.10	9.5500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
96 EX5-6	28.00	265.90	0.00	265.13	5.03	0.77	2.7500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
97 EX9-3	20.00	268.90	0.00	268.70	0.00	0.20	1.0000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
98 FSP1-Out	20.00	273.00	0.00	272.60	1.90	0.40	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
99 FSP2-Out	178.00	272.00	0.00	269.00	0.10	3.00	1.6900	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
100 Out2_1	297.73	249.00	0.00	249.00	0.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
101 Out2_2	345.60	250.00	0.00	250.00	1.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
102 Pond_Outfall	50.00	249.50	0.00	249.00	0.00	0.50	1.0000	CIRCULAR	30.000	30.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
103 SD-16	250.00	290.00	0.00	275.10	0.10	14.90	5.9600	CIRCULAR	9.960	9.960	0.0110	0.5000	0.5000	0.0000	0.00	No	1
104 SD-19	224.00	302.75	0.00	290.00	0.25	12.75	5.6900	CIRCULAR	9.960	9.960	0.0110	0.5000	0.5000	0.0000	0.00	No	1
105 SD-23	411.00	323.75	0.00	302.75	-0.75	21.00	5.1100	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
106 SD-28	357.00	331.94	0.00	323.75	0.25	8.19	2.2900	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
107 SD-33	268.00	341.55	0.00	331.94	0.25	9.61	3.5900	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
108 SD-38	284.00	355.60	0.00	341.55	0.25	14.05	4.9500	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 101-100	1.78	0 12:06	6.90	0.26	7.37	0.07	0.35	0.35	0.00		Calculated
2 102-101	0.30	0 12:06	5.07	0.06	3.55	0.28	0.17	0.17	0.00		Calculated
3 103-101	0.61	0 12:06	7.41	0.08	5.71	0.09	0.19	0.19	0.00		Calculated
4 104-101	0.87	0 12:07	5.62	0.16	5.20	0.61	0.27	0.27	0.00		Calculated
5 105-104	0.15	0 12:06	4.95	0.03	2.86	0.17	0.12	0.12	0.00		Calculated
6 106-104	0.72	0 12:06	4.21	0.17	4.00	0.03	0.28	0.28	0.00		Calculated
7 7-Oct	73.86	0 12:10	105.23	0.70	16.12	0.31	1.85	0.62	0.00		Calculated
8 10-Nov	0.66	0 12:06	7.22	0.09	5.73	0.05	0.20	0.20	0.00		Calculated
9 10-Dec	0.24	0 12:06	8.42	0.03	4.77	0.02	0.12	0.12	0.00		Calculated
10 13-10	73.21	0 12:10	100.11	0.73	15.46	0.10	1.91	0.64	0.00		Calculated
11 14-13	68.33	0 12:10	76.05	0.90	17.52	0.19	1.85	0.74	0.00		Calculated
12 15-14	0.56	0 12:06	6.23	0.09	3.16	0.08	0.25	0.20	0.00		Calculated
13 16-14	4.28	0 12:07	10.07	0.42	12.29	0.01	0.46	0.46	0.00		Calculated
14 17-14	64.22	0 12:11	117.39	0.55	24.44	0.09	1.32	0.53	0.00		Calculated
15 18-17	64.22	0 12:10	118.74	0.54	24.66	0.08	1.31	0.52	0.00		Calculated
16 19-18	4.82	0 12:07	19.36	0.25	13.09	0.01	0.43	0.34	0.00		Calculated
17 20-18	60.19	0 12:11	117.22	0.51	24.03	0.08	1.27	0.51	0.00		Calculated
18 1-Feb	83.25	0 12:11	95.94	0.87	15.27	0.03	2.16	0.72	0.00		Calculated
19 21-20	60.19	0 12:11	112.41	0.54	23.28	0.08	1.30	0.52	0.00		Calculated
20 22-21	0.64	0 12:06	13.32	0.05	8.76	0.04	0.15	0.15	0.00		Calculated
21 23-21	11.74	0 12:08	24.04	0.49	13.52	0.00	0.74	0.49	0.00		Calculated
22 24-21	49.17	0 12:14	117.60	0.42	22.89	0.14	1.13	0.45	0.00		Calculated
23 25-24	0.77	0 12:06	7.22	0.11	5.99	0.05	0.22	0.22	0.00		Calculated
24 26-24	48.76	0 12:14	102.44	0.48	20.61	0.17	1.21	0.49	0.00		Calculated
25 27-26	0.62	0 12:06	7.44	0.08	5.75	0.05	0.20	0.20	0.00		Calculated
26 28-26	8.73	0 12:11	19.09	0.46	15.20	0.01	0.59	0.47	0.00		Calculated
27 29-26	40.01	0 12:15	69.37	0.58	14.63	0.21	1.36	0.54	0.00		Calculated
28 30-29	0.64	0 12:06	8.81	0.07	6.55	0.02	0.18	0.18	0.00		Calculated
29 31-29	39.68	0 12:15	39.77	1.00	9.24	0.28	2.04	0.82	0.00		Calculated
30 31-Out	23.27	0 12:31	21.98	1.06	8.16	0.08	1.87	0.94	0.00		> CAPACITY
31 2-Mar	83.25	0 12:11	115.68	0.72	17.81	0.24	1.88	0.63	0.00		Calculated
32 32-6	0.74	0 12:06	2.80	0.26	6.01	0.05	0.18	0.35	0.00		Calculated
33 33-31	7.59	0 12:08	11.91	0.64	16.06	0.01	0.58	0.58	0.00		Calculated
34 33-out	0.68	0 12:06	9.92	0.07	7.17	0.09	0.18	0.18	0.00		Calculated
35 34-31	56.00	0 12:16	83.96	0.67	18.30	0.03	1.49	0.60	0.00		Calculated
36 35-34	0.66	0 12:06	4.01	0.17	3.78	0.05	0.28	0.28	0.00		Calculated
37 36-34	55.67	0 12:16	99.84	0.56	20.88	0.19	1.33	0.53	0.00		Calculated
38 37-36	0.56	0 12:06	8.88	0.06	6.28	0.05	0.17	0.17	0.00		Calculated
39 38-36	8.14	0 12:13	13.88	0.59	8.16	0.03	0.83	0.55	0.00		Calculated
40 39-36	47.47	0 12:16	59.78	0.79	21.11	0.21	1.35	0.67	0.00		Calculated
41 40-39	0.57	0 12:06	6.04	0.09	4.83	0.06	0.21	0.21	0.00		Calculated
42 41-39	3.29	0 12:23	10.31	0.32	11.66	0.01	0.39	0.39	0.00		Calculated
43 42-39	44.22	0 12:16	60.19	0.73	20.94	0.17	1.27	0.64	0.00		Calculated
44 3-Apr	0.36	0 12:07	11.83	0.03	6.81	0.05	0.12	0.12	0.00		Calculated
45 43-42	2.46	0 12:24	6.52	0.38	7.72	0.01	0.43	0.43	0.00		Calculated
46 44-42	42.03	0 12:15	45.36	0.93	16.39	0.07	1.52	0.76	0.00		Calculated
47 45-44	0.55	0 12:06	4.44	0.12	3.85	0.08	0.24	0.24	0.00		Calculated
48 46-44	3.04	0 12:24	6.94	0.44	8.54	0.01	0.46	0.46	0.00		Calculated
49 47-44	39.01	0 12:15	41.01	0.95	14.85	0.13	1.56	0.78	0.00		Calculated
50 49-47	3.01	0 12:26	5.03	0.60	6.69	0.03	0.56	0.56	0.00		Calculated
51 50-47	36.53	0 12:14	40.76	0.90	14.66	0.08	1.48	0.74	0.00		Calculated
52 51-50	3.25	0 12:25	7.74	0.42	9.42	0.01	0.45	0.45	0.00		Calculated
53 52-50	33.82	0 12:14	42.34	0.80	14.97	0.07	1.35	0.68	0.00		Calculated
54 3-May	0.81	0 12:06	6.83	0.12	5.83	0.11	0.23	0.23	0.00		Calculated
55 53-52	0.43	0 12:06	5.44	0.08	4.13	0.06	0.19	0.19	0.00		Calculated
56 54-52	3.14	0 12:24	12.18	0.26	8.32	0.02	0.43	0.35	0.00		Calculated
57 55-52	31.01	0 12:13	40.69	0.76	14.26	0.11	1.31	0.65	0.00		Calculated
58 56-55	3.02	0 12:23	4.21	0.72	5.83	0.02	0.63	0.63	0.00		Calculated
59 57-55	28.46	0 12:12	41.42	0.69	14.20	0.11	1.22	0.61	0.00		Calculated
60 58-57	3.04	0 12:20	10.80	0.28	7.56	0.01	0.45	0.36	0.00		Calculated
61 59-57	0.51	0 12:06	6.04	0.09	4.69	0.06	0.20	0.20	0.00		Calculated
62 60-57	25.38	0 12:11	40.42	0.63	13.58	0.17	1.15	0.57	0.00		Calculated
63 61-60	2.68	0 12:19	4.55	0.59	6.02	0.02	0.55	0.55	0.00		Calculated
64 62-60	23.15	0 12:10	41.42	0.56	13.54	0.18	1.07	0.53	0.00		Calculated
65 3-Jun	82.39	0 12:10	106.99	0.77	16.70	0.04	1.97	0.66	0.00		Calculated
66 63-62	0.42	0 12:06	3.23	0.13	2.85	0.10	0.24	0.24	0.00		Calculated
67 64-62	2.50	0 12:17	11.33	0.22	5.15	0.02	0.48	0.32	0.00		Calculated
68 65-62	20.63	0 12:10	39.21	0.53	12.63	0.12	1.03	0.52	0.00		Calculated
69 66-65	2.38	0 12:17	4.21	0.57	5.52	0.03	0.54	0.54	0.00		Calculated
70 7-Jun	74.85	0 12:11	103.21	0.73	15.91	0.11	1.89	0.63	0.00		Calculated
71 67-65	18.50	0 12:09	38.81	0.48	12.20	0.13	0.97	0.49	0.00		Calculated
72 68-67	0.47	0 12:06	3.23	0.15	2.93	0.10	0.26	0.26	0.00		Calculated
73 69-67	1.87	0 12:15	4.01	0.47	5.02	0.04	0.48	0.48	0.00		Calculated
74 6-out	2.52	0 12:07	5.26	0.48	6.64	0.41	0.49	0.49	0.00		Calculated



**Pipe Results**

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
75 70-67	16.36	0 12:09	19.66	0.83	7.00	0.44	1.39	0.70	0.00		Calculated
76 71-70	1.54	0 12:12	6.82	0.23	7.02	0.02	0.32	0.32	0.00		Calculated
77 72-70	14.86	0 12:09	23.45	0.63	7.90	0.16	1.16	0.58	0.00		Calculated
78 73-72	0.27	0 12:06	5.95	0.05	3.85	0.08	0.14	0.14	0.00		Calculated
79 74-72	1.81	0 12:09	7.12	0.25	7.57	0.02	0.34	0.34	0.00		Calculated
80 75-72	12.82	0 12:09	22.48	0.57	7.39	0.22	1.08	0.54	0.00		Calculated
81 76-75	1.74	0 12:08	3.44	0.51	4.39	0.02	0.50	0.50	0.00		Calculated
82 77-75	0.41	0 12:06	4.21	0.10	3.41	0.08	0.21	0.21	0.00		Calculated
83 78-75	10.77	0 12:09	19.78	0.54	6.43	0.52	1.05	0.53	0.00		Calculated
84 79-78	0.43	0 12:05	5.95	0.07	4.42	0.02	0.18	0.18	0.00		Calculated
85 80-78	7.55	0 12:09	10.80	0.70	9.51	0.04	0.77	0.62	0.00		Calculated
86 81-80	0.90	0 12:06	7.69	0.12	6.53	0.01	0.23	0.23	0.00		Calculated
87 82-78	2.87	0 12:10	3.53	0.82	5.01	0.36	0.69	0.69	0.00		Calculated
88 83-82	0.32	0 12:06	3.26	0.10	2.64	0.32	0.21	0.21	0.00		Calculated
89 84-82	2.65	0 12:11	4.82	0.55	6.28	0.11	0.53	0.53	0.00		Calculated
90 7-Aug	0.64	0 12:07	5.29	0.12	4.54	0.10	0.24	0.24	0.00		Calculated
91 7-Sep	0.61	0 12:06	12.03	0.05	8.03	0.01	0.15	0.15	0.00		Calculated
92 Culvert2	4.91	0 12:09	46.80	0.10	9.66	0.04	0.44	0.22	0.00		Calculated
93 EX1-6	1.78	0 12:07	3.41	0.52	4.40	0.58	0.51	0.51	0.00		Calculated
94 EX3-4	7.74	0 12:08	9.43	0.82	5.96	0.17	1.03	0.69	0.00		Calculated
95 EX4-5	7.74	0 12:08	32.45	0.24	15.06	0.02	0.50	0.33	0.00		Calculated
96 EX5-6	7.74	0 12:08	17.42	0.44	9.56	0.05	0.70	0.47	0.00		Calculated
97 EX9-3	7.74	0 12:08	10.50	0.74	6.50	0.05	0.96	0.64	0.00		Calculated
98 FSP1-Out	3.01	0 12:21	5.95	0.51	7.60	0.04	0.50	0.50	0.00		Calculated
99 FSP2-Out	6.36	0 12:10	13.64	0.47	7.59	0.39	0.72	0.48	0.00		Calculated
100 Out2_1	36.84	0 12:36	0.00	0.47	0.00		0.72	0.48	0.00		Calculated
101 Out2_2	3.19	0 12:06	0.00	0.47	0.00		0.72	0.48	0.00		Calculated
102 Pond_Outfall	36.84	0 12:36	41.02	0.90	9.45	0.09	1.85	0.74	0.00		Calculated
103 SD-16	3.65	0 12:07	6.32	0.58	12.02	0.35	0.45	0.55	0.00		Calculated
104 SD-19	4.27	0 12:07	6.18	0.69	12.23	0.31	0.51	0.61	0.00		Calculated
105 SD-23	11.45	0 12:09	16.95	0.68	14.84	0.46	0.75	0.60	0.00		Calculated
106 SD-28	8.59	0 12:11	11.56	0.74	10.33	0.58	0.80	0.64	0.00		Calculated
107 SD-33	7.33	0 12:08	7.97	0.92	11.54	0.39	0.76	0.76	0.00		Calculated
108 SD-38	6.92	0 12:12	9.37	0.74	13.06	0.36	0.64	0.64	0.00		Calculated

**Inlet Input**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft <sup>2</sup> )	Grate Clogging Factor (%)
1	CBEX-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	2.18	0.00	0.00	N/A	0.00
2	CBEX-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	3.80	0.00	0.00	N/A	0.00
3	STR-102	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.57	263.07	3.50	0.00	0.00	N/A	0.00
4	STR-103	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.63	263.13	3.50	0.00	0.00	N/A	0.00
5	STR-105	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.58	266.08	3.50	0.00	0.00	N/A	0.00
6	STR-106	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.24	265.74	3.50	0.00	0.00	N/A	0.00
7	STR-11	FHWA HEC-22 GENERIC	N/A	On Grade	1	269.00	272.87	3.87	0.00	0.00	N/A	0.00
8	STR-12	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.70	273.43	4.73	0.00	0.00	N/A	0.00
9	STR-15	FHWA HEC-22 GENERIC	N/A	On Grade	1	276.00	280.19	4.19	0.00	0.00	N/A	0.00
10	STR-16	FHWA HEC-22 GENERIC	N/A	On Grade	1	275.00	280.17	5.17	0.00	0.00	N/A	0.00
11	STR-19	FHWA HEC-22 GENERIC	N/A	On Grade	1	289.75	294.30	4.55	0.00	0.00	N/A	0.00
12	STR-22	FHWA HEC-22 GENERIC	N/A	On Grade	1	304.00	307.33	3.33	0.00	0.00	N/A	0.00
13	STR-23	FHWA HEC-22 GENERIC	N/A	On Grade	1	303.50	307.59	4.09	0.00	0.00	N/A	0.00
14	STR-25	FHWA HEC-22 GENERIC	N/A	On Grade	1	314.00	318.10	4.10	0.00	0.00	N/A	0.00
15	STR-27	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	327.01	3.51	0.00	0.00	N/A	0.00
16	STR-28	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	328.31	4.81	0.00	0.00	N/A	0.00
17	STR-30	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.75	331.70	3.95	0.00	0.00	N/A	0.00
18	STR-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	331.69	335.69	4.00	0.00	0.00	N/A	0.00
19	STR-35	FHWA HEC-22 GENERIC	N/A	On Grade	1	332.50	335.63	3.13	0.00	0.00	N/A	0.00
20	STR-37	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.90	346.48	4.58	0.00	0.00	N/A	0.00
21	STR-38	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.30	345.42	4.12	0.00	0.00	N/A	0.00
22	STR-4	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.00	269.29	4.29	0.00	0.00	N/A	0.00
23	STR-40	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.35	359.60	4.25	0.00	0.00	N/A	0.00
24	STR-41	FHWA HEC-22 GENERIC	N/A	On Grade	2	355.36	359.61	4.25	0.00	0.00	N/A	0.00
25	STR-43	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.92	370.25	4.33	0.00	0.00	N/A	0.00
26	STR-45	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.70	372.97	4.27	0.00	0.00	N/A	0.00
27	STR-46	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.69	373.15	4.46	0.00	0.00	N/A	0.00
28	STR-49	FHWA HEC-22 GENERIC	N/A	N/A	1	372.80	376.30	3.50	0.00	0.00	N/A	0.00
29	STR-5	FHWA HEC-22 GENERIC	N/A	On Grade	1	264.50	268.12	3.62	0.00	0.00	N/A	0.00
30	STR-51	FHWA HEC-22 GENERIC	N/A	On Grade	2	373.77	377.77	4.00	0.00	0.00	N/A	0.00
31	STR-53	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.65	379.35	4.70	0.00	0.00	N/A	0.00
32	STR-54	FHWA HEC-22 GENERIC	N/A	On Grade	2	374.68	379.95	5.27	0.00	0.00	N/A	0.00
33	STR-56	FHWA HEC-22 GENERIC	N/A	On Grade	2	377.46	381.46	4.00	0.00	0.00	N/A	0.00
34	STR-58	FHWA HEC-22 GENERIC	N/A	On Grade	2	379.29	383.46	4.17	0.00	0.00	N/A	0.00
35	STR-59	FHWA HEC-22 GENERIC	N/A	On Grade	1	379.54	383.54	4.00	0.00	0.00	N/A	0.00
36	STR-61	FHWA HEC-22 GENERIC	N/A	On Grade	2	382.57	386.57	4.00	0.00	0.00	N/A	0.00
37	STR-63	FHWA HEC-22 GENERIC	N/A	On Grade	1	386.20	389.71	3.51	0.00	0.00	N/A	0.00
38	STR-64	FHWA HEC-22 GENERIC	N/A	On Grade	2	386.15	389.91	3.76	0.00	0.00	N/A	0.00
39	STR-66	FHWA HEC-22 GENERIC	N/A	On Grade	2	388.48	391.98	3.50	0.00	0.00	N/A	0.00
40	STR-68	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.70	394.22	3.52	0.00	0.00	N/A	0.00
41	STR-69	FHWA HEC-22 GENERIC	N/A	On Grade	2	390.70	394.06	3.36	0.00	0.00	N/A	0.00
42	STR-71	FHWA HEC-22 GENERIC	N/A	On Grade	2	392.55	396.60	4.05	0.00	0.00	N/A	0.00
43	STR-73	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.04	397.14	4.10	0.00	0.00	N/A	0.00
44	STR-74	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.10	397.10	4.00	0.00	0.00	N/A	0.00
45	STR-76	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.74	397.74	4.00	0.00	0.00	N/A	0.00
46	STR-77	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.30	397.80	4.50	0.00	0.00	N/A	0.00
47	STR-79	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.98	398.87	3.89	0.00	0.00	N/A	0.00
48	STR-8	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.91	272.08	6.17	0.00	0.00	N/A	0.00
49	STR-81	FHWA HEC-22 GENERIC	N/A	On Grade	2	396.00	398.85	2.85	0.00	0.00	N/A	0.00
50	STR-83	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.55	399.55	4.00	0.00	0.00	N/A	0.00
51	STR-84	FHWA HEC-22 GENERIC	N/A	On Sag	2	395.80	399.80	4.00	0.00	0.00	0.00	0.00
52	STR-9	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.99	270.92	4.93	0.00	0.00	N/A	0.00

**Roadway & Gutter Input**

SN Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1 CBEX-32	0.0170	0.0200	0.0130	0.0200	3.00	0.0328	10.50
2 CBEX-33	0.0170	0.0200	0.0130	0.0620	2.00	0.0000	10.50
3 STR-102	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
4 STR-103	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
5 STR-105	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
6 STR-106	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
7 STR-11	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
8 STR-12	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
9 STR-15	0.0590	0.0200	0.0130	0.0200	5.00	0.0000	10.50
10 STR-16	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
11 STR-19	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
12 STR-22	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
13 STR-23	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
14 STR-25	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
15 STR-27	0.0200	0.0200	0.0130	0.0200	5.00	0.0000	10.50
16 STR-28	0.0200	0.0200	0.0130	0.0200	5.00	0.0000	10.50
17 STR-30	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
18 STR-33	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
19 STR-35	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
20 STR-37	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
21 STR-38	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
22 STR-4	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
23 STR-40	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
24 STR-41	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
25 STR-43	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
26 STR-45	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
27 STR-46	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
28 STR-5	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
29 STR-51	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
30 STR-53	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
31 STR-54	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
32 STR-56	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
33 STR-58	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
34 STR-59	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
35 STR-61	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
36 STR-63	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
37 STR-64	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
38 STR-66	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
39 STR-68	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
40 STR-69	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
41 STR-71	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
42 STR-73	0.0065	0.0200	0.0130	0.0200	5.00	0.0000	10.50
43 STR-74	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
44 STR-76	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
45 STR-77	0.0065	0.0200	0.0130	0.0200	5.00	0.0000	10.50
46 STR-79	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
47 STR-8	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
48 STR-81	0.0050	0.0200	0.0130	0.0300	5.00	0.0000	10.50
49 STR-83	0.0050	0.0200	0.0130	0.0300	5.00	0.0000	10.50
50 STR-84	N/A	0.0200	0.0130	0.0620	2.00	0.0000	10.50
51 STR-9	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50

### Median & Ditch Input

SN Element ID	Median Ditch Longitudinal Slope (ft/ft)	Median Ditch Bottom Width (ft)	Median Ditch Left Side Slope	Median Ditch Right Side Slope	Median Ditch Manning's Roughness
1 STR-49	0.0250	2.0000	1:01	1:01	0.0160

**Inlet Results**

SN Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Time of Max Depth Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1 CBEX-32	1.10	0.87	0.74	0.36	67.46	6.28	257.31	0.13	0 12:06	0.00	0.00
2 CBEX-33	0.73	0.66	0.69	0.04	94.46	3.87	257.06	0.16	0 12:06	0.00	0.00
3 STR-102	0.38	0.34	0.32	0.06	84.67	4.21	263.15	0.08	0 12:06	0.00	0.00
4 STR-103	0.86	0.53	0.62	0.24	71.65	5.70	263.24	0.11	0 12:06	0.00	0.00
5 STR-105	0.19	0.10	0.18	0.01	93.59	3.26	266.15	0.07	0 12:06	0.00	0.00
6 STR-106	1.06	0.63	0.72	0.34	68.21	6.17	265.86	0.12	0 12:06	0.00	0.00
7 STR-11	1.03	0.92	0.66	0.37	63.92	7.70	273.02	0.15	0 12:06	0.00	0.00
8 STR-12	0.32	0.16	0.27	0.06	81.89	5.00	273.53	0.10	0 12:06	0.00	0.00
9 STR-15	0.68	0.53	0.57	0.11	83.58	4.15	280.27	0.08	0 12:06	0.00	0.00
10 STR-16	0.82	0.69	0.65	0.16	80.29	4.49	280.26	0.09	0 12:07	0.00	0.00
11 STR-19	0.71	0.66	0.58	0.12	82.47	4.27	294.39	0.09	0 12:07	0.00	0.00
12 STR-22	0.81	0.58	0.65	0.16	80.35	4.49	307.42	0.09	0 12:06	0.00	0.00
13 STR-23	0.38	0.34	0.35	0.03	91.51	3.38	307.66	0.07	0 12:09	0.00	0.00
14 STR-25	1.00	0.76	0.77	0.23	76.85	4.86	318.20	0.10	0 12:06	0.00	0.00
15 STR-27	0.87	0.60	0.63	0.24	72.31	5.58	327.12	0.11	0 12:06	0.00	0.00
16 STR-28	0.23	0.18	0.21	0.02	92.12	3.40	328.38	0.07	0 12:11	0.00	0.00
17 STR-30	0.91	0.63	0.65	0.26	71.40	5.70	331.81	0.11	0 12:06	0.00	0.00
18 STR-33	0.71	0.18	0.53	0.17	75.56	5.19	335.79	0.10	0 12:08	0.00	0.00
19 STR-35	0.94	0.82	0.67	0.28	70.74	5.79	335.75	0.12	0 12:06	0.00	0.00
20 STR-37	0.69	0.55	0.57	0.12	82.40	4.29	346.57	0.09	0 12:06	0.00	0.00
21 STR-38	2.47	0.53	1.31	1.15	53.25	5.37	345.53	0.11	0 12:12	0.00	0.00
22 STR-4	0.45	0.18	0.37	0.08	82.07	4.49	269.38	0.09	0 12:07	0.00	0.00
23 STR-40	0.70	0.58	0.58	0.13	81.87	4.34	359.69	0.09	0 12:06	0.00	0.00
24 STR-41	5.59	3.80	3.29	2.30	58.90	8.35	359.83	0.22	0 12:23	0.00	0.00
25 STR-43	4.31	0.82	2.46	1.85	57.15	7.42	370.45	0.20	0 12:24	0.00	0.00
26 STR-45	0.68	0.58	0.56	0.12	82.50	4.28	373.06	0.09	0 12:06	0.00	0.00
27 STR-46	6.56	3.66	3.04	3.51	46.43	9.04	373.38	0.23	0 12:24	0.00	0.00
28 STR-49	3.16	3.16	3.02	0.14	96.00	2.53	376.56	0.26	0 12:26	0.00	0.00
29 STR-5	1.24	0.99	0.81	0.43	65.55	6.55	268.25	0.13	0 12:06	0.00	0.00
30 STR-51	6.04	3.44	3.25	2.79	53.81	10.47	378.03	0.26	0 12:25	0.00	0.00
31 STR-53	0.53	0.37	0.43	0.10	81.00	4.55	379.44	0.09	0 12:06	0.00	0.00
32 STR-54	5.75	3.35	3.14	2.60	54.68	10.21	380.20	0.25	0 12:24	0.00	0.00
33 STR-56	5.41	3.09	3.02	2.40	55.75	9.93	381.71	0.25	0 12:23	0.00	0.00
34 STR-58	5.47	3.99	3.04	2.43	55.57	9.96	383.71	0.25	0 12:20	0.00	0.00
35 STR-59	0.68	0.58	0.52	0.16	76.99	5.00	383.64	0.10	0 12:06	0.00	0.00
36 STR-61	4.56	3.03	2.68	1.88	58.81	9.21	386.80	0.23	0 12:19	0.00	0.00
37 STR-63	0.53	0.40	0.43	0.10	81.03	4.55	389.80	0.09	0 12:06	0.00	0.00
38 STR-64	4.13	2.67	2.50	1.63	60.59	8.81	390.14	0.23	0 12:17	0.00	0.00
39 STR-66	3.85	3.00	2.38	1.46	61.92	8.54	392.20	0.22	0 12:17	0.00	0.00
40 STR-68	0.61	0.53	0.48	0.13	78.88	4.78	394.32	0.10	0 12:06	0.00	0.00
41 STR-69	2.74	2.12	1.88	0.86	68.64	7.24	394.25	0.19	0 12:15	0.00	0.00
42 STR-71	2.16	1.43	1.54	0.62	71.31	8.67	396.82	0.22	0 12:12	0.00	0.00
43 STR-73	0.35	0.21	0.29	0.07	81.35	4.92	397.24	0.10	0 12:06	0.00	0.00
44 STR-74	2.67	1.89	1.81	0.86	67.87	9.51	397.34	0.24	0 12:09	0.00	0.00
45 STR-76	2.54	2.34	1.74	0.79	68.75	9.32	397.98	0.24	0 12:08	0.00	0.00
46 STR-77	0.56	0.40	0.42	0.14	74.29	5.84	397.92	0.12	0 12:06	0.00	0.00
47 STR-79	0.61	0.61	0.44	0.17	72.35	6.33	399.00	0.13	0 12:05	0.00	0.00
48 STR-8	0.91	0.58	0.64	0.27	70.54	5.86	272.20	0.12	0 12:07	0.00	0.00
49 STR-81	1.09	1.03	0.90	0.19	82.46	6.64	399.03	0.18	0 12:06	0.00	0.00
50 STR-83	0.38	0.38	0.33	0.05	87.21	4.11	399.67	0.12	0 12:05	0.00	0.00
51 STR-84	2.65	2.65	N/A	N/A	N/A	10.40	400.03	0.23	0 12:11	0.00	0.00
52 STR-9	0.86	0.79	0.62	0.24	71.65	5.70	271.03	0.11	0 12:06	0.00	0.00

### Storage Nodes

#### Storage Node : FSP-1

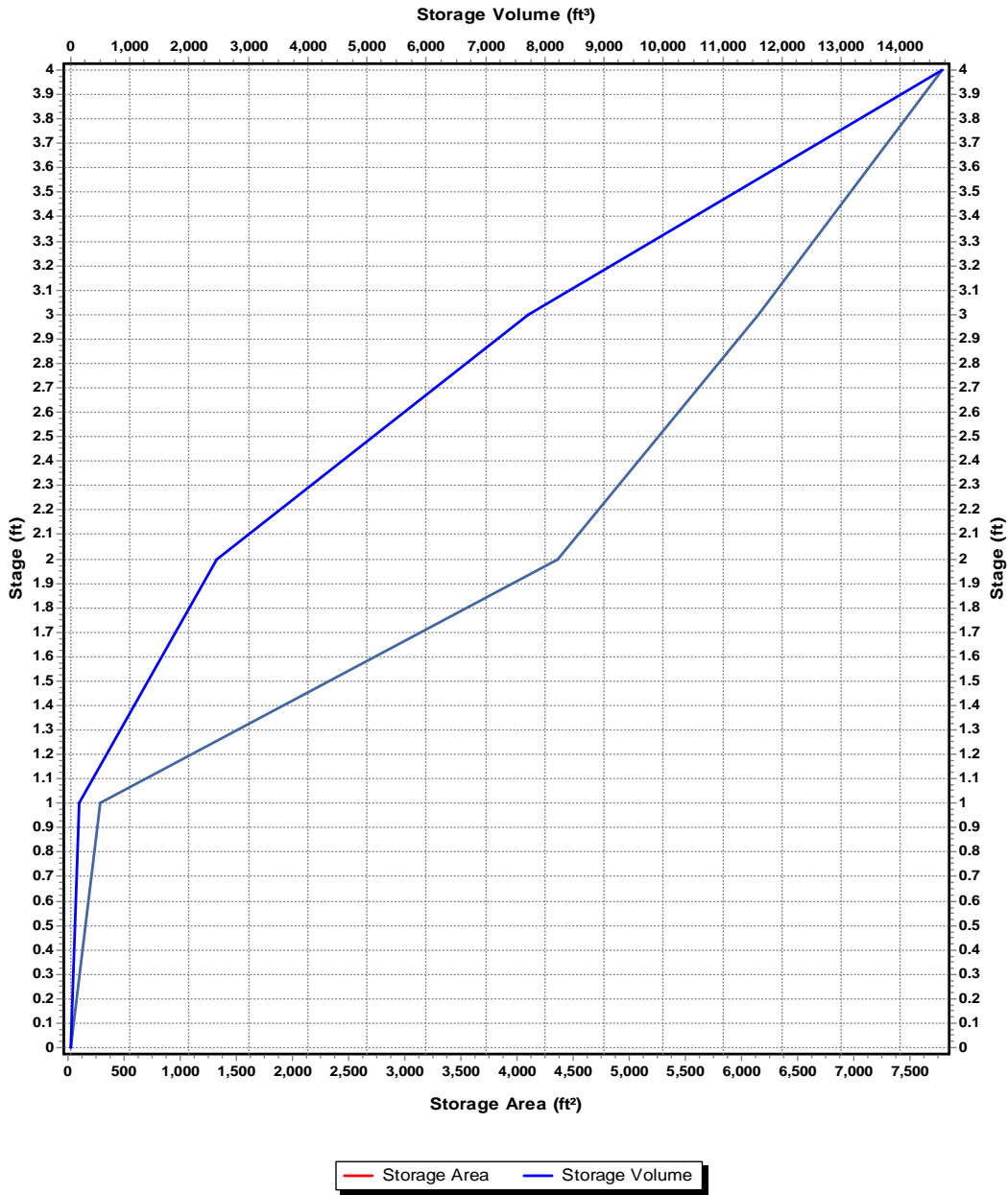
##### Input Data

Invert Elevation (ft) .....	272
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	4
Initial Water Elevation (ft) .....	272
Initial Water Depth (ft) .....	0
Ponded Area (ft²) .....	7794
Evaporation Loss .....	0

##### Storage Area Volume Curves Storage Curve : FH-Pond1

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	20	0
1	277	148.5
2	4361	2467.5
3	6157	7726.5
4	7794	14702

### Storage Area Volume Curves



**Storage Node : FSP-1 (continued)**

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 FSP1-1	Side	CIRCULAR	No	8.00			274.00	0.60
2 FSP1-2	Side	CIRCULAR	No	12.00			274.12	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	6.48
Peak Lateral Inflow (cfs) .....	6.48
Peak Outflow (cfs) .....	3.01
Peak Exfiltration Flow Rate (cfm) .....	8.42
Max HGL Elevation Attained (ft) .....	274.88
Max HGL Depth Attained (ft) .....	2.88
Average HGL Elevation Attained (ft) .....	273.22
Average HGL Depth Attained (ft) .....	1.22
Time of Max HGL Occurrence (days hh:mm) .....	0 12:21
Total Exfiltration Volume (1000-ft <sup>3</sup> ) .....	6.369
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0



**Storage Node : FSP-2**

**Input Data**

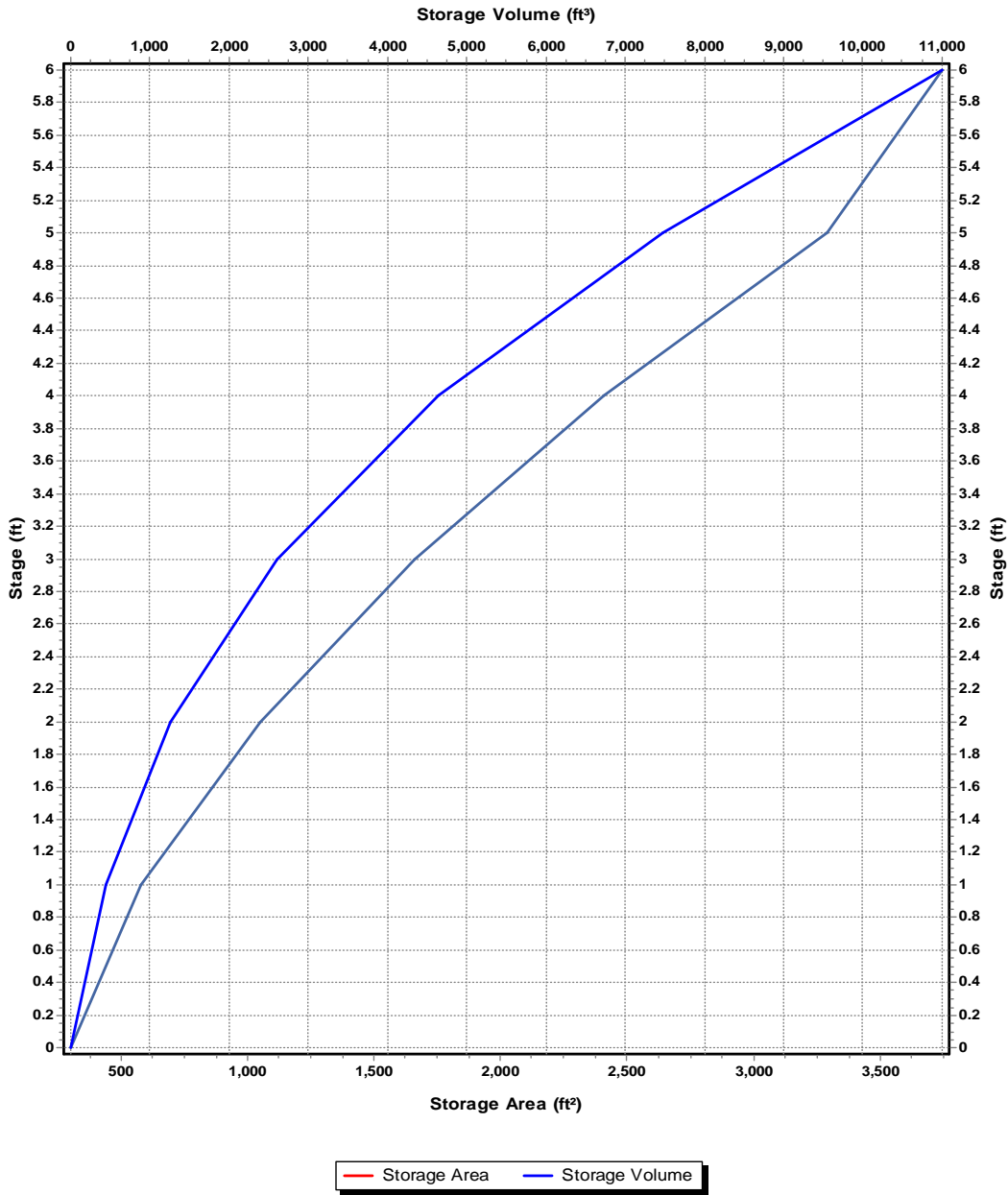
Invert Elevation (ft) .....	270
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	6
Initial Water Elevation (ft) .....	270
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	3746
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : FH-Pond2

Stage (ft)	Storage Area (ft <sup>2</sup> )	Storage Volume (ft <sup>3</sup> )
0	300	0
1	578	439
2	1048	1252
3	1659	2605.5
4	2406	4638
5	3289	7485.5
6	3746	11003

### Storage Area Volume Curves



**Storage Node : FSP-2 (continued)**

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 FSP2-1	Side	CIRCULAR	No	8.00			273.00	0.60
2 FSP2-2	Side	CIRCULAR	No	15.00			273.25	0.60
3 FSP2-3	Side	CIRCULAR	No	15.00			273.50	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	7.18
Peak Lateral Inflow (cfs) .....	7.18
Peak Outflow (cfs) .....	6.37
Peak Exfiltration Flow Rate (cfm) .....	3.63
Max HGL Elevation Attained (ft) .....	274.17
Max HGL Depth Attained (ft) .....	4.17
Average HGL Elevation Attained (ft) .....	271.81
Average HGL Depth Attained (ft) .....	1.81
Time of Max HGL Occurrence (days hh:mm) .....	0 12:10
Total Exfiltration Volume (1000-ft³) .....	2.853
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : Pond\_1**

**Input Data**

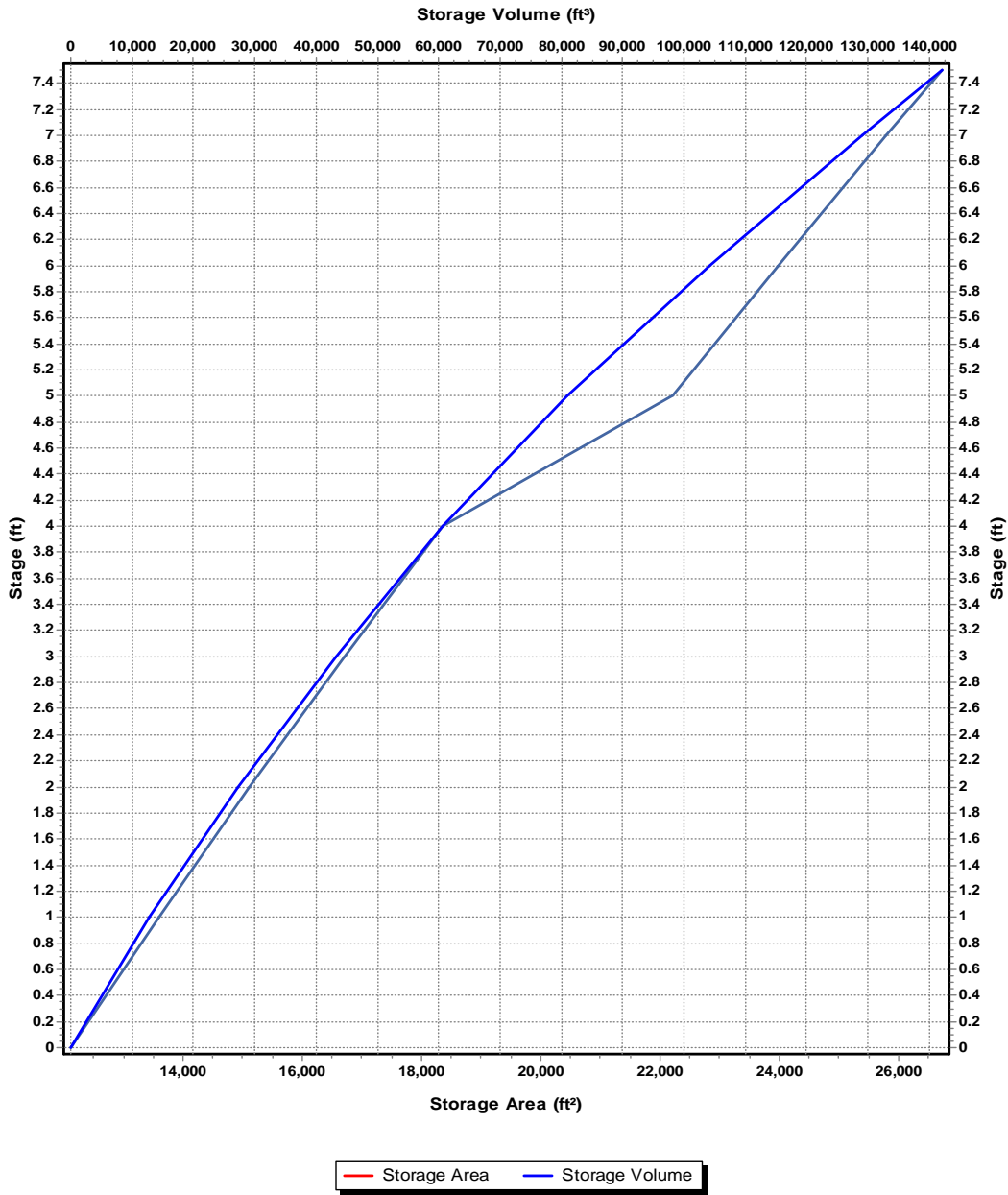
Invert Elevation (ft) .....	250
Max (Rim) Elevation (ft) .....	257.5
Max (Rim) Offset (ft) .....	7.5
Initial Water Elevation (ft) .....	250
Initial Water Depth (ft) .....	0
Ponded Area (ft²) .....	25046
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : Pond 1

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	12130	0
1	13618	12874
2	15124	27245
3	16705	43159.5
4	18355	60689.5
5	22210	80972
6	23978	104066
7	25802	128956
7.5	26736	142090.5

### Storage Area Volume Curves



**Storage Node : Pond\_1 (continued)**

**Outflow Weirs**

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 PondOverflow	Trapezoidal	No	255.90	5.90	20.00	1.50	3.33

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Pond_LowFlow	Side	Rectangular	No		18.00	18.00	250.00	0.63
2 primary	Side	Rectangular	No		17.00	12.00	252.65	0.63
3 RiserTop	Bottom	Rectangular	No		48.00	48.00	255.90	0.63

**Output Summary Results**

Peak Inflow (cfs) .....	83.25
Peak Lateral Inflow (cfs) .....	0
Peak Outflow (cfs) .....	36.84
Peak Exfiltration Flow Rate (cfm) .....	0
Max HGL Elevation Attained (ft) .....	255.87
Max HGL Depth Attained (ft) .....	5.87
Average HGL Elevation Attained (ft) .....	250.72
Average HGL Depth Attained (ft) .....	0.72
Time of Max HGL Occurrence (days hh:mm) .....	0 12:36
Total Exfiltration Volume (1000-ft³) .....	0
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : STR-31**

**Input Data**

Invert Elevation (ft) .....	327.65
Max (Rim) Elevation (ft) .....	335.28
Max (Rim) Offset (ft) .....	7.63
Initial Water Elevation (ft) .....	327.65
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	0
Evaporation Loss .....	0

**Output Summary Results**

Peak Inflow (cfs) .....	61.66
Peak Lateral Inflow (cfs) .....	0
Peak Outflow (cfs) .....	61.66
Peak Exfiltration Flow Rate (cfm) .....	0
Max HGL Elevation Attained (ft) .....	329.94
Max HGL Depth Attained (ft) .....	2.29
Average HGL Elevation Attained (ft) .....	328.07
Average HGL Depth Attained (ft) .....	0.42
Time of Max HGL Occurrence (days hh:mm) .....	0 12:15
Total Exfiltration Volume (1000-ft <sup>3</sup> ) .....	0
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

### Project Description

File Name ..... Boston Rd - Post Dev - 20230227.SPF

### Project Options

Flow Units ..... CFS  
 Elevation Type ..... Elevation  
 Hydrology Method ..... SCS TR-55  
 Time of Concentration (TOC) Method ..... SCS TR-55  
 Link Routing Method ..... Kinematic Wave  
 Enable Overflow Ponding at Nodes ..... YES  
 Skip Steady State Analysis Time Periods ... YES

### Analysis Options

Start Analysis On ..... 00:00:00      0:00:00  
 End Analysis On ..... 00:00:00      0:00:00  
 Start Reporting On ..... 00:00:00      0:00:00  
 Antecedent Dry Days ..... 0      days  
 Runoff (Dry Weather) Time Step ..... 0 01:00:00      days hh:mm:ss  
 Runoff (Wet Weather) Time Step ..... 0 00:05:00      days hh:mm:ss  
 Reporting Time Step ..... 0 00:00:02      days hh:mm:ss  
 Routing Time Step ..... 2      seconds

### Number of Elements

	Qty
Rain Gages .....	1
Subbasins .....	77
Nodes.....	115
<i>Junctions</i> .....	55
<i>Outfalls</i> .....	4
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	52
<i>Storage Nodes</i> .....	4
Links.....	169
<i>Channels</i> .....	52
<i>Pipes</i> .....	108
<i>Pumps</i> .....	0
<i>Orifices</i> .....	8
<i>Weirs</i> .....	1
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

### Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	100-yr	Cumulative	inches	Massachusetts	Middlesex	100.00	7.65	SCS Type III 24-hr



**Subbasin Summary**

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Blake1P	2.66	484.00	78.70	7.65	5.15	13.68	13.48	0 00:07:38
2	Blake2	0.57	484.00	82.10	7.65	5.54	3.16	3.16	0 00:05:00
3	Culvert2L-DA	1.39	484.00	70.20	7.65	4.19	5.82	5.85	0 00:07:35
4	Culvert2P-DA	2.87	484.00	73.50	7.65	4.56	13.07	13.08	0 00:07:33
5	EX32-DA	0.21	484.00	98.00	7.65	7.41	1.56	1.36	0 00:05:00
6	EX33-DA	0.16	484.00	98.00	7.65	7.41	1.19	1.03	0 00:05:00
7	Hildreth-DA	2.35	484.00	87.00	7.65	6.11	14.35	11.82	0 00:15:35
8	Str102-DA	0.08	484.00	98.00	7.65	7.41	0.60	0.54	0 00:05:00
9	Str103-DA	0.13	484.00	98.00	7.65	7.41	0.93	0.83	0 00:05:00
10	Str105-DA	0.03	484.00	98.00	7.65	7.38	0.21	0.17	0 00:05:00
11	Str106-DA	0.16	484.00	98.00	7.65	7.41	1.16	0.99	0 00:05:00
12	Str11-DA	0.22	484.00	98.00	7.65	7.41	1.64	1.44	0 00:05:00
13	Str12-DA	0.04	484.00	98.00	7.65	7.40	0.28	0.25	0 00:05:00
14	Str15-DA	0.13	484.00	98.00	7.65	7.41	0.94	0.83	0 00:05:00
15	Str16-DA	0.16	484.00	98.00	7.65	7.41	1.22	1.07	0 00:05:00
16	Str16L-DA	1.77	484.00	71.30	7.65	4.31	7.61	7.64	0 00:07:39
17	Str19-DA	0.16	484.00	98.00	7.65	7.41	1.20	1.03	0 00:05:00
18	Str19L-DA	1.85	484.00	74.00	7.65	4.61	8.55	8.55	0 00:07:36
19	Str22-DA	0.14	484.00	97.20	7.65	7.31	1.04	0.91	0 00:05:00
20	Str23-DA	0.08	484.00	98.00	7.65	7.41	0.62	0.54	0 00:05:00
21	Str23L-DA	4.70	484.00	77.10	7.65	4.97	23.36	22.10	0 00:10:18
22	Str25-DA	0.19	484.00	94.00	7.65	6.93	1.31	1.22	0 00:05:00
23	Str27-DA	0.15	484.00	97.80	7.65	7.39	1.11	0.95	0 00:05:00
24	Str28-DA	0.05	484.00	98.00	7.65	7.40	0.35	0.29	0 00:05:00
25	Str28L-DA	4.17	484.00	75.40	7.65	4.77	19.91	17.09	0 00:15:31
26	Str30-DA	0.15	484.00	98.00	7.65	7.41	1.12	0.99	0 00:05:00
27	Str32-DA	0.20	484.00	98.00	7.65	7.41	1.46	1.28	0 00:05:00
28	Str33-DA	0.04	484.00	98.00	7.65	7.40	0.31	0.29	0 00:05:00
29	Str33L-DA	3.18	484.00	75.40	7.65	4.77	15.16	14.48	0 00:09:58
30	Str37-DA	0.13	484.00	98.00	7.65	7.41	0.99	0.87	0 00:05:00
31	Str38-DA	0.13	484.00	98.00	7.65	7.41	0.93	0.83	0 00:05:00
32	Str38L-DA	3.72	484.00	73.30	7.65	4.54	16.87	14.22	0 00:16:32
33	Str40-DA	0.14	484.00	98.00	7.65	7.41	1.05	0.91	0 00:05:00
34	Str41-DA	0.09	484.00	98.00	7.65	7.41	0.64	0.54	0 00:05:00
35	Str41L-DA	2.56	484.00	72.10	7.65	4.40	11.28	7.69	0 00:29:12
36	Str43-DA	0.03	484.00	98.00	7.65	7.38	0.19	0.17	0 00:05:00
37	Str43L-DA	0.50	484.00	73.70	7.65	4.58	2.30	1.58	0 00:28:52
38	Str45-DA	0.14	484.00	98.00	7.65	7.41	1.04	0.91	0 00:05:00
39	Str46-DA	0.09	484.00	98.00	7.65	7.41	0.64	0.58	0 00:05:00
40	Str46L-DA	2.20	484.00	76.40	7.65	4.89	10.75	6.95	0 00:32:46
41	Str49-DA	2.20	484.00	74.20	7.65	4.64	10.20	6.41	0 00:35:03
42	Str4-DA	0.04	484.00	98.00	7.65	7.40	0.31	0.29	0 00:05:00
43	Str51-DA	0.03	484.00	98.00	7.65	7.40	0.24	0.21	0 00:05:00
44	Str51L-DA	2.40	484.00	73.30	7.65	4.54	10.88	6.98	0 00:33:27
45	Str53-AD	0.09	484.00	98.00	7.65	7.41	0.67	0.58	0 00:05:00
46	Str54-DA	0.04	484.00	98.00	7.65	7.40	0.26	0.21	0 00:05:00
47	Str54L-DA	2.11	484.00	77.00	7.65	4.95	10.44	6.45	0 00:35:59
48	Str56-DA	0.04	484.00	98.00	7.65	7.40	0.26	0.21	0 00:05:00
49	Str56L-DA	2.12	484.00	75.30	7.65	4.76	10.11	6.10	0 00:38:02
50	Str58-DA	0.64	484.00	98.00	7.65	7.41	4.74	4.13	0 00:05:00
51	Str58L-DA	1.70	484.00	77.60	7.65	5.02	8.53	5.23	0 00:36:25
52	Str59-DA	0.14	484.00	98.00	7.65	7.41	1.05	0.91	0 00:05:00
53	Str5-DA	0.26	484.00	92.40	7.65	6.74	1.74	1.60	0 00:05:00
54	Str61-DA	0.06	484.00	98.00	7.65	7.41	0.41	0.37	0 00:05:00
55	Str61L-DA	1.75	484.00	78.20	7.65	5.09	8.89	5.65	0 00:33:46
56	Str63-DA	0.10	484.00	98.00	7.65	7.41	0.70	0.62	0 00:05:00
57	Str64-DA	0.05	484.00	98.00	7.65	7.41	0.37	0.33	0 00:05:00
58	Str64L-DA	1.30	484.00	79.10	7.65	5.19	6.75	4.88	0 00:24:45
59	Str66-DA	0.05	484.00	98.00	7.65	7.40	0.34	0.29	0 00:05:00
60	Str66L-DA	1.47	484.00	78.90	7.65	5.17	7.61	5.53	0 00:24:34
61	Str68-DA	0.13	484.00	98.00	7.65	7.41	0.97	0.83	0 00:05:00
62	Str69-DA	0.09	484.00	98.00	7.65	7.41	0.65	0.58	0 00:05:00
63	Str69L-Da	0.93	484.00	80.20	7.65	5.32	4.96	3.64	0 00:23:42
64	Str71-DA	0.03	484.00	98.00	7.65	7.40	0.24	0.21	0 00:05:00
65	Str71L-DA	0.58	484.00	84.90	7.65	5.86	3.38	2.41	0 00:24:16
66	Str73-DA	0.05	484.00	98.00	7.65	7.41	0.38	0.33	0 00:05:00
67	Str74-DA	0.04	484.00	98.00	7.65	7.40	0.29	0.25	0 00:05:00
68	Str74L-DA	0.64	484.00	83.60	7.65	5.71	3.68	3.17	0 00:14:21
69	Str76-DA	0.18	484.00	98.00	7.65	7.41	1.33	1.16	0 00:05:00
70	Str76L-DA	0.63	484.00	83.00	7.65	5.64	3.56	3.08	0 00:14:12
71	Str77-DA	0.10	484.00	98.00	7.65	7.41	0.70	0.62	0 00:05:00
72	Str79-DA	0.15	484.00	98.00	7.65	7.41	1.10	0.95	0 00:05:00
73	Str81-DA	0.28	484.00	89.00	7.65	6.34	1.80	1.71	0 00:05:00
74	Str83-DA	0.10	484.00	89.90	7.65	6.45	0.67	0.63	0 00:05:00
75	Str84-DA	1.00	484.00	82.60	7.65	5.60	5.59	4.78	0 00:14:42

**Subbasin Summary**

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
76 Str8-DA	0.14	484.00	98.00	7.65	7.41	1.06	0.91	0 00:05:00
77 Str9-DA	0.23	484.00	86.30	7.65	6.03	1.37	1.36	0 00:05:00

**Node Summary**

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft <sup>2</sup> )	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert2In	Junction	270.70	274.50	270.70	274.50	0.00	11.19	273.60	0.00	0.90	0 00:00	0.00	0.00
2	DMH3c	Junction	268.70	271.83	268.70	271.83	0.00	11.28	271.83	0.00	0.00	0 12:02	0.34	20.00
3	DMH4c	Junction	268.10	271.22	268.10	271.22	0.00	10.21	269.70	0.00	1.52	0 00:00	0.00	0.00
4	DMH5c	Junction	265.90	269.46	265.90	269.46	0.00	10.20	266.73	0.00	2.73	0 00:00	0.00	0.00
5	DMH6c	Junction	253.60	258.48	253.60	258.48	0.00	4.02	255.81	0.00	2.67	0 00:00	0.00	0.00
6	DMH9c	Junction	268.90	271.70	268.90	271.70	0.00	14.58	271.70	0.00	0.00	0 12:08	0.69	17.00
7	DP_2_1	Junction	249.00	255.00	249.00	255.00	0.00	71.79	251.50	0.00	4.90	0 00:00	0.00	0.00
8	DP_2_2	Junction	250.00	256.00	250.00	256.00	0.00	5.01	250.65	0.00	5.35	0 00:00	0.00	0.00
9	DP-1	Junction	327.00	336.00	327.00	336.00	0.00	23.27	329.22	0.00	6.78	0 00:00	0.00	0.00
10	FSP1-Out	Junction	273.00	276.00	273.00	276.00	7794.00	6.11	276.13	0.01	0.00	0 12:20	0.03	22.00
11	FSP2-Out	Junction	272.00	276.00	272.00	276.00	3746.00	12.03	273.09	0.00	3.66	0 00:00	0.00	0.00
12	PondRiser	Junction	249.50	255.90	249.50	257.50	0.00	63.82	255.90	0.00	0.00	0 12:21	9.27	43.00
13	SD-16	Junction	290.00	294.30	290.00	294.30	0.00	7.64	294.30	0.00	0.00	0 12:07	0.13	10.00
14	SD-19	Junction	302.75	307.59	302.75	307.59	0.00	8.55	307.59	0.00	0.00	0 12:07	0.32	13.00
15	SD-23	Junction	323.75	328.31	323.75	328.31	0.00	22.10	328.31	0.00	0.00	0 12:08	0.66	13.00
16	SD-28	Junction	331.94	335.69	331.94	335.69	0.00	17.09	335.69	0.00	0.00	0 12:11	1.05	20.00
17	SD-33	Junction	341.55	345.42	341.55	345.42	0.00	14.48	345.42	0.00	0.00	0 12:08	1.28	21.00
18	SD-38	Junction	355.60	359.61	355.60	359.61	0.00	14.22	359.61	0.00	0.00	0 12:11	1.00	21.00
19	STR-10	Junction	267.50	273.38	267.50	273.38	0.00	93.27	269.87	0.00	3.51	0 00:00	0.00	0.00
20	STR-100	Junction	256.50	261.94	256.50	261.94	0.00	2.88	257.45	0.00	4.49	0 00:00	0.00	0.00
21	STR-101	Junction	258.50	262.54	258.50	262.54	0.00	2.88	259.04	0.00	3.50	0 00:00	0.00	0.00
22	STR-104	Junction	262.08	265.84	262.08	265.84	0.00	1.43	262.53	0.00	3.31	0 00:00	0.00	0.00
23	STR-13	Junction	269.10	274.10	269.10	274.10	0.00	91.51	271.70	0.00	2.40	0 00:00	0.00	0.00
24	STR-14	Junction	274.00	280.22	274.00	280.22	0.00	90.91	280.22	0.00	0.00	0 12:04	2.88	20.00
25	STR-17	Junction	282.30	287.81	282.30	287.81	0.00	82.20	283.93	0.00	3.88	0 00:00	0.00	0.00
26	STR-18	Junction	289.30	294.76	289.30	294.76	0.00	82.20	290.86	0.00	3.90	0 00:00	0.00	0.00
27	STR-2	Junction	253.60	261.00	253.60	261.00	0.00	106.18	261.00	0.00	0.00	0 12:03	1.34	20.00
28	STR-20	Junction	296.30	301.69	296.30	301.69	0.00	75.19	297.90	0.00	3.79	0 00:00	0.00	0.00
29	STR-21	Junction	302.10	307.72	302.10	307.72	0.00	75.19	304.35	0.00	3.37	0 00:00	0.00	0.00
30	STR-24	Junction	313.50	318.70	313.50	318.70	0.00	55.87	314.90	0.00	3.80	0 00:00	0.00	0.00
31	STR-26	Junction	322.80	328.00	322.80	328.00	0.00	54.66	324.30	0.00	3.70	0 00:00	0.00	0.00
32	STR-29	Junction	326.75	332.13	326.75	332.13	0.00	42.99	329.28	0.00	2.85	0 00:00	0.00	0.00
33	STR-3	Junction	259.30	269.66	259.30	269.66	0.00	106.50	263.79	0.00	5.87	0 00:00	0.00	0.00
34	STR-34	Junction	330.32	336.12	330.32	336.12	0.00	73.41	332.74	0.00	3.38	0 00:00	0.00	0.00
35	STR-36	Junction	341.00	346.20	341.00	346.20	0.00	73.57	342.71	0.00	3.49	0 00:00	0.00	0.00
36	STR-39	Junction	354.40	359.65	354.40	359.65	0.00	58.89	356.01	0.00	3.64	0 00:00	0.00	0.00
37	STR-42	Junction	365.50	370.42	365.50	370.42	0.00	51.89	367.37	0.00	3.05	0 00:00	0.00	0.00
38	STR-44	Junction	367.50	372.84	367.50	372.84	0.00	49.03	372.84	0.00	0.00	0 12:22	1.69	37.00
39	STR-47	Junction	370.40	376.35	370.40	376.35	0.00	48.81	376.35	0.00	0.00	0 12:34	2.57	38.00
40	STR-50	Junction	372.50	378.03	372.50	378.03	0.00	51.32	378.03	0.00	0.00	0 12:28	3.65	34.00
41	STR-52	Junction	374.40	379.58	374.40	379.58	0.00	49.89	379.58	0.00	0.00	0 12:20	2.14	26.00
42	STR-55	Junction	376.70	381.70	376.70	381.70	0.00	48.33	381.70	0.00	0.00	0 12:21	1.35	22.00
43	STR-57	Junction	379.05	383.70	379.05	383.70	0.00	42.13	383.70	0.00	0.00	0 12:21	0.04	8.00
44	STR-6	Junction	260.10	270.06	260.10	270.06	0.00	104.86	265.96	0.00	4.10	0 00:00	0.00	0.00
45	STR-60	Junction	382.35	386.80	382.35	386.80	0.00	36.68	383.84	0.00	2.96	0 00:00	0.00	0.00
46	STR-62	Junction	386.00	390.16	386.00	390.16	0.00	32.23	387.35	0.00	2.81	0 00:00	0.00	0.00
47	STR-65	Junction	388.10	392.29	388.10	392.29	0.00	27.99	389.35	0.00	2.94	0 00:00	0.00	0.00
48	STR-67	Junction	390.10	394.40	390.10	394.40	0.00	24.42	392.20	0.00	2.20	0 00:00	0.00	0.00
49	STR-7	Junction	262.00	271.28	262.00	271.28	0.00	95.88	265.79	0.00	5.49	0 00:00	0.00	0.00
50	STR-70	Junction	391.20	396.78	391.20	396.78	0.00	24.79	396.78	0.00	0.00	0 12:06	0.95	19.00
51	STR-72	Junction	391.70	397.36	391.70	397.36	0.00	22.39	393.46	0.00	3.90	0 00:00	0.00	0.00
52	STR-75	Junction	392.70	397.98	392.70	397.98	0.00	19.28	394.37	0.00	3.61	0 00:00	0.00	0.00
53	STR-78	Junction	393.90	398.98	393.90	398.98	0.00	15.70	395.65	0.00	3.33	0 00:00	0.00	0.00
54	STR-80	Junction	394.90	398.92	394.90	398.92	0.00	12.83	398.92	0.00	0.00	0 12:09	0.26	12.00
55	STR-82	Junction	395.15	399.57	395.15	399.57	0.00	5.17	399.57	0.00	0.00	0 12:09	0.31	19.00
56	DP_1	Outfall	286.00					23.11	286.85					
57	DP_2	Outfall	249.00					73.85	250.00					
58	EX32-bypass(out)	Outfall	255.47					0.83	255.60					
59	EX33-bypass(out)	Outfall	255.70					0.18	255.77					
60	FSP-1	Storage Node	272.00	276.00	272.00		7794.00	13.08	275.79				0.00	0.00
61	FSP-2	Storage Node	270.00	276.00	270.00		3746.00	13.48	274.73				0.00	0.00
62	Pond_1	Storage Node	250.00	257.50	250.00		25046.00	102.89	256.49				0.00	0.00
63	STR-31	Storage Node	327.65	335.28	327.65		0.00	82.01	335.28				9.27	40.00

**Link Summary**

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged (min)	Condition
1	101-100	Pipe	STR-101	STR-100	30.00	258.50	257.00	5.0000	12.000	0.0150	2.88	6.90	0.42	8.39	0.45	0.45	0.00	Calculated
2	102-101	Pipe	STR-102	STR-101	60.00	259.57	258.70	1.4500	12.000	0.0110	0.46	5.07	0.09	4.03	0.20	0.20	0.00	Calculated
3	103-101	Pipe	STR-103	STR-101	30.00	259.63	258.70	3.1000	12.000	0.0110	0.99	7.41	0.13	6.57	0.25	0.25	0.00	Calculated
4	104-101	Pipe	STR-104	STR-101	190.00	262.08	258.70	1.7800	12.000	0.0110	1.43	5.62	0.25	5.98	0.34	0.34	0.00	Calculated
5	105-104	Pipe	STR-105	STR-104	29.00	262.58	262.18	1.3800	12.000	0.0110	0.30	4.95	0.06	3.48	0.17	0.17	0.00	Calculated
6	106-104	Pipe	STR-106	STR-104	6.00	262.24	262.18	1.0000	12.000	0.0110	1.12	4.21	0.27	4.54	0.35	0.35	0.00	Calculated
7	7-Oct	Pipe	STR-10	STR-7	303.00	267.50	262.10	1.7800	36.000	0.0110	94.07	105.23	0.89	17.25	2.19	0.73	0.00	Calculated
8	10-Nov	Pipe	STR-11	STR-10	17.00	269.00	268.50	2.9400	12.000	0.0110	0.98	7.22	0.14	6.42	0.25	0.25	0.00	Calculated
9	10-Dec	Pipe	STR-12	STR-10	5.00	268.70	268.50	4.0000	12.000	0.0110	0.45	8.42	0.05	5.69	0.16	0.16	0.00	Calculated
10	13-10	Pipe	STR-13	STR-10	93.00	269.10	267.60	1.6100	36.000	0.0110	91.91	100.11	0.92	16.41	2.25	0.75	0.00	Calculated
11	14-13	Pipe	STR-14	STR-13	195.00	274.00	269.20	2.4600	30.000	0.0110	82.29	76.05	1.08	18.21	2.50	1.00	17.00	SURCHARGED
12	15-14	Pipe	STR-15	STR-14	15.00	276.00	275.90	0.6700	15.000	0.0110	0.92	6.23	0.15	3.64	0.32	0.26	0.00	Calculated
13	16-14	Pipe	STR-16	STR-14	7.00	275.00	274.60	5.7100	12.000	0.0110	7.80	10.07	0.78	14.16	0.66	0.66	0.00	Calculated
14	17-14	Pipe	STR-17	STR-14	133.00	282.30	274.50	5.8600	30.000	0.0110	82.21	117.39	0.70	25.91	1.54	0.62	0.00	Calculated
15	18-17	Pipe	STR-18	STR-17	115.00	289.30	282.40	6.0000	30.000	0.0110	82.20	118.74	0.69	26.14	1.53	0.61	0.00	Calculated
16	19-18	Pipe	STR-19	STR-18	7.00	289.75	289.30	6.4300	15.000	0.0110	7.49	19.36	0.39	14.76	0.54	0.43	0.00	Calculated
17	20-18	Pipe	STR-20	STR-18	118.00	296.30	289.40	5.8500	30.000	0.0110	75.19	117.22	0.64	25.39	1.46	0.58	0.00	Calculated
18	1-Feb	Pipe	STR-2	Pond_1	27.00	253.60	253.20	1.4800	36.000	0.0110	102.89	95.94	1.07	15.76	3.00	1.00	1.00	SURCHARGED
19	21-20	Pipe	STR-21	STR-20	106.00	302.10	296.40	5.3800	30.000	0.0110	75.19	112.41	0.67	24.57	1.50	0.60	0.00	Calculated
20	22-21	Pipe	STR-22	STR-21	19.00	304.00	302.10	10.0000	12.000	0.0110	1.05	13.32	0.08	10.12	0.19	0.19	0.00	Calculated
21	23-21	Pipe	STR-23	STR-21	4.00	303.50	303.35	3.7500	18.000	0.0110	18.84	24.04	0.78	15.06	1.00	0.67	0.00	Calculated
22	24-21	Pipe	STR-24	STR-21	192.00	313.50	302.20	5.8900	30.000	0.0110	55.89	117.60	0.48	23.72	1.21	0.49	0.00	Calculated
23	25-24	Pipe	STR-25	STR-24	17.00	314.00	313.50	2.9400	12.000	0.0110	1.20	7.22	0.17	6.80	0.28	0.28	0.00	Calculated
24	26-24	Pipe	STR-26	STR-24	206.00	322.80	313.60	4.4700	30.000	0.0110	54.68	102.44	0.53	21.30	1.30	0.52	0.00	Calculated
25	27-26	Pipe	STR-27	STR-26	16.00	323.50	323.00	3.1300	12.000	0.0110	0.97	7.44	0.13	6.55	0.24	0.24	0.00	Calculated
26	28-26	Pipe	STR-28	STR-26	8.00	323.50	323.00	6.2500	15.000	0.0110	12.95	19.09	0.68	16.70	0.76	0.60	0.00	Calculated
27	29-26	Pipe	STR-29	STR-26	188.00	326.75	322.90	2.0500	30.000	0.0110	41.97	69.37	0.61	15.17	1.40	0.56	0.00	Calculated
28	30-29	Pipe	STR-30	STR-29	8.00	327.75	327.40	4.3800	12.000	0.0110	0.99	8.81	0.11	7.41	0.23	0.23	0.00	Calculated
29	31-29	Pipe	STR-31	STR-29	156.00	327.90	326.85	0.6700	30.000	0.0110	42.86	39.77	1.08	9.82	2.30	0.92	0.00	> CAPACITY
30	31-Out	Pipe	STR-31	DP-1	37.00	327.70	327.45	0.6800	24.000	0.0110	23.27	21.98	1.06	8.16	1.87	0.94	0.00	> CAPACITY
31	2-Mar	Pipe	STR-3	STR-2	260.00	259.30	253.70	2.1500	36.000	0.0110	106.18	115.68	0.92	18.77	2.26	0.75	0.00	Calculated
32	32-6	Pipe	CBEX-32	DMH6c	18.00	255.00	254.20	4.4400	6.000	0.0110	1.14	2.80	0.41	6.76	0.22	0.44	0.00	Calculated
33	33-31	Pipe	STR-33	STR-31	10.00	331.69	330.89	8.0000	12.000	0.0110	9.23	11.91	0.78	16.75	0.66	0.66	0.00	Calculated
34	33-out	Pipe	CBEX-33	DP_2_2	40.00	253.10	250.00	7.7500	12.000	0.0130	1.00	9.92	0.10	8.09	0.21	0.21	0.00	Calculated
35	34-31	Pipe	STR-34	STR-31	34.00	330.72	329.70	3.0000	30.000	0.0110	73.40	83.96	0.87	19.27	1.81	0.72	0.00	Calculated
36	35-34	Pipe	STR-35	STR-34	11.00	332.50	332.40	0.9100	12.000	0.0110	0.99	4.01	0.25	4.23	0.34	0.34	0.00	Calculated
37	36-34	Pipe	STR-36	STR-34	240.00	340.60	330.82	4.0800	30.000	0.0110	73.05	99.84	0.73	22.24	1.59	0.64	0.00	Calculated
38	37-36	Pipe	STR-37	STR-36	18.00	341.90	341.10	4.4400	12.000	0.0110	0.87	8.88	0.10	7.19	0.21	0.21	0.00	Calculated
39	38-36	Pipe	STR-38	STR-36	16.00	341.30	341.10	1.2500	18.000	0.0110	14.47	13.88	1.04	9.12	1.37	0.91	0.00	> CAPACITY
40	39-36	Pipe	STR-39	STR-36	266.00	354.40	341.10	5.0000	24.000	0.0110	58.89	59.78	0.99	21.92	1.61	0.81	0.00	Calculated
41	40-39	Pipe	STR-40	STR-39	17.00	355.35	355.00	2.0600	12.000	0.0110	0.88	6.04	0.15	5.49	0.26	0.26	0.00	Calculated
42	41-39	Pipe	STR-41	STR-39	6.00	355.36	355.00	6.0000	12.000	0.0110	6.69	10.31	0.65	13.96	0.59	0.59	0.00	Calculated
43	42-39	Pipe	STR-42	STR-39	217.00	365.50	354.50	5.0700	24.000	0.0110	51.89	60.19	0.86	22.03	1.43	0.72	0.00	Calculated
44	3-Apr	Pipe	STR-4	STR-3	19.00	265.00	263.50	7.8900	12.000	0.0110	0.56	11.83	0.05	7.74	0.15	0.15	0.00	Calculated
45	43-42	Pipe	STR-43	STR-42	5.00	365.92	365.80	2.4000	12.000	0.0110	4.33	6.52	0.66	8.88	0.60	0.60	0.00	Calculated
46	44-42	Pipe	STR-44	STR-42	66.00	367.50	365.60	2.8800	24.000	0.0110	48.01	45.36	1.06	17.07	1.87	0.94	0.00	> CAPACITY
47	45-44	Pipe	STR-45	STR-44	18.00	368.70	368.50	1.1100	12.000	0.0110	0.86	4.44	0.19	4.37	0.30	0.30	0.00	Calculated

Proposal No. 609035- 126590

Post-Development

100-yr

Boston Rd. 609035  
Westford, MA

March 22, 2023

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged Condition (min)
48 46-44	Pipe	STR-46	STR-44	7.00	368.69	368.50	2.7100	12.000	0.0110	4.70	6.94	0.68	9.49	0.60	0.60	0.00 Calculated
49 47-44	Pipe	STR-47	STR-44	119.00	370.40	367.60	2.3500	24.000	0.0110	44.38	41.01	1.08	15.39	1.94	0.97	0.00 > CAPACITY
50 49-47	Pipe	STR-49	STR-47	14.00	372.80	372.60	1.4300	12.000	0.0110	5.26	5.03	1.05	7.44	0.93	0.93	0.00 > CAPACITY
51 50-47	Pipe	STR-50	STR-47	74.00	372.62	370.90	2.3200	24.000	0.0110	44.10	40.76	1.08	15.14	2.00	1.00	31.00 SURCHARGED
52 51-50	Pipe	STR-51	STR-50	8.00	373.77	373.50	3.3700	12.000	0.0110	6.08	7.74	0.79	10.91	0.67	0.67	0.00 Calculated
53 52-50	Pipe	STR-52	STR-50	67.00	374.40	372.72	2.5100	24.000	0.0110	45.81	42.34	1.08	15.92	2.00	1.00	18.00 SURCHARGED
54 3-May	Pipe	STR-5	STR-3	38.00	264.50	263.50	2.6300	12.000	0.0110	1.22	6.83	0.18	6.57	0.29	0.29	0.00 Calculated
55 53-52	Pipe	STR-53	STR-52	15.00	374.65	374.40	1.6700	12.000	0.0110	0.67	5.44	0.12	4.71	0.24	0.24	0.00 Calculated
56 54-52	Pipe	STR-54	STR-52	11.00	374.68	374.40	2.5500	15.000	0.0110	5.73	12.18	0.47	9.77	0.60	0.48	0.00 Calculated
57 55-52	Pipe	STR-55	STR-52	95.00	376.70	374.50	2.3200	24.000	0.0110	43.96	40.69	1.08	15.15	2.00	1.00	5.00 SURCHARGED
58 56-55	Pipe	STR-56	STR-55	6.00	377.46	377.40	1.0000	12.000	0.0110	4.54	4.21	1.08	6.20	1.00	1.00	25.00 SURCHARGED
59 57-55	Pipe	STR-57	STR-55	95.00	379.05	376.77	2.4000	24.000	0.0110	44.12	41.42	1.07	15.41	1.83	0.91	0.00 > CAPACITY
60 58-57	Pipe	STR-58	STR-57	6.00	379.29	379.17	2.0000	15.000	0.0110	5.27	10.80	0.49	8.74	0.62	0.49	0.00 Calculated
61 59-57	Pipe	STR-59	STR-57	18.00	379.54	379.17	2.0600	12.000	0.0110	0.78	6.04	0.13	5.31	0.24	0.24	0.00 Calculated
62 60-57	Pipe	STR-60	STR-57	140.00	382.35	379.15	2.2900	24.000	0.0110	36.58	40.42	0.90	14.62	1.49	0.75	0.00 Calculated
63 61-60	Pipe	STR-61	STR-60	6.00	382.57	382.50	1.1700	12.000	0.0110	4.68	4.55	1.03	6.69	0.92	0.92	0.00 > CAPACITY
64 62-60	Pipe	STR-62	STR-60	150.00	386.00	382.40	2.4000	24.000	0.0110	32.07	41.42	0.77	14.61	1.32	0.66	0.00 Calculated
65 3-Jun	Pipe	STR-6	STR-3	38.00	260.10	259.40	1.8400	36.000	0.0110	104.76	106.99	0.98	17.29	2.41	0.80	0.00 Calculated
66 63-62	Pipe	STR-63	STR-62	17.00	386.20	386.10	0.5900	12.000	0.0110	0.65	3.23	0.20	3.22	0.30	0.30	0.00 Calculated
67 64-62	Pipe	STR-64	STR-62	6.00	386.15	386.10	0.8300	18.000	0.0110	4.32	11.33	0.38	5.98	0.64	0.43	0.00 Calculated
68 65-62	Pipe	STR-65	STR-62	93.00	388.10	386.10	2.1500	24.000	0.0110	27.85	39.21	0.71	13.64	1.24	0.62	0.00 Calculated
69 66-65	Pipe	STR-66	STR-65	10.00	388.48	388.38	1.0000	12.000	0.0110	3.99	4.21	0.95	6.09	0.78	0.78	0.00 Calculated
70 7-Jun	Pipe	STR-7	STR-6	105.00	262.00	260.20	1.7100	36.000	0.0110	95.42	103.21	0.92	16.70	2.28	0.76	0.00 Calculated
71 67-65	Pipe	STR-67	STR-65	93.00	390.10	388.14	2.1100	24.000	0.0110	24.36	38.81	0.63	13.26	1.15	0.57	0.00 Calculated
72 68-67	Pipe	STR-68	STR-67	17.00	390.70	390.60	0.5900	12.000	0.0110	0.70	3.23	0.22	3.29	0.32	0.32	0.00 Calculated
73 69-67	Pipe	STR-69	STR-67	11.00	390.70	390.60	0.9100	12.000	0.0110	3.10	4.01	0.77	5.64	0.66	0.66	0.00 Calculated
74 6-out	Pipe	DMH6c	DP_2_2	165.00	253.60	250.00	2.1800	12.000	0.0130	4.02	5.26	0.76	7.39	0.65	0.65	0.00 Calculated
75 70-67	Pipe	STR-70	STR-67	185.00	391.20	390.20	0.5400	24.000	0.0110	21.27	19.66	1.08	7.39	2.00	1.00	16.00 SURCHARGED
76 71-70	Pipe	STR-71	STR-70	8.00	392.55	392.34	2.6300	12.000	0.0110	2.66	6.82	0.39	8.14	0.43	0.43	0.00 Calculated
77 72-70	Pipe	STR-72	STR-70	78.00	391.90	391.30	0.7700	24.000	0.0110	22.32	23.45	0.95	8.52	1.56	0.78	0.00 Calculated
78 73-72	Pipe	STR-73	STR-72	18.00	393.04	392.68	2.0000	12.000	0.0110	0.46	5.95	0.08	4.50	0.19	0.19	0.00 Calculated
79 74-72	Pipe	STR-74	STR-72	7.00	393.10	392.90	2.8600	12.000	0.0110	2.97	7.12	0.42	8.65	0.45	0.45	0.00 Calculated
80 75-72	Pipe	STR-75	STR-72	99.00	392.70	392.00	0.7100	24.000	0.0110	19.05	22.48	0.85	8.07	1.41	0.71	0.00 Calculated
81 76-75	Pipe	STR-76	STR-75	6.00	393.74	393.70	0.6700	12.000	0.0110	2.70	3.44	0.79	4.85	0.67	0.67	0.00 Calculated
82 77-75	Pipe	STR-77	STR-75	17.00	393.30	393.13	1.0000	12.000	0.0110	0.62	4.21	0.15	3.83	0.26	0.26	0.00 Calculated
83 78-75	Pipe	STR-78	STR-75	201.00	393.90	392.80	0.5500	24.000	0.0110	15.99	19.78	0.81	7.20	1.34	0.67	0.00 Calculated
84 79-78	Pipe	STR-79	STR-78	4.00	394.98	394.90	2.0000	12.000	0.0110	0.62	5.95	0.10	4.90	0.22	0.22	0.00 Calculated
85 80-78	Pipe	STR-80	STR-78	25.00	394.90	394.40	2.0000	15.000	0.0110	11.56	10.80	1.07	10.24	1.25	1.00	9.00 SURCHARGED
86 81-80	Pipe	STR-81	STR-80	3.00	396.00	395.90	3.3300	12.000	0.0110	1.37	7.69	0.18	7.38	0.29	0.29	0.00 Calculated
87 82-78	Pipe	STR-82	STR-78	107.00	395.15	394.40	0.7000	12.000	0.0110	3.81	3.53	1.08	5.31	1.00	1.00	17.00 SURCHARGED
88 83-82	Pipe	STR-83	STR-82	50.00	395.55	395.25	0.6000	12.000	0.0110	0.50	3.26	0.15	3.00	0.26	0.26	0.00 Calculated
89 84-82	Pipe	STR-84	STR-82	42.00	395.80	395.25	1.3100	12.000	0.0110	4.78	4.82	0.99	7.00	0.81	0.81	0.00 Calculated
90 7-Aug	Pipe	STR-8	STR-7	26.00	265.91	265.50	1.5800	12.000	0.0110	0.99	5.29	0.19	5.16	0.29	0.29	0.00 Calculated
91 7-Sep	Pipe	STR-9	STR-7	6.00	265.99	265.50	8.1700	12.000	0.0110	0.94	12.03	0.08	9.13	0.19	0.19	0.00 Calculated
92 Culvert2	Pipe	Culvert2In	STR-13	25.00	270.70	269.63	4.2800	24.000	0.0130	11.19	46.80	0.24	12.22	0.67	0.33	0.00 Calculated
93 EX1-6	Pipe	STR-100	DMH6c	153.00	256.50	255.10	0.9200	12.000	0.0130	2.88	3.41	0.84	4.90	0.71	0.71	0.00 Calculated
94 EX3-4	Pipe	DMH3c	DMH4c	62.00	268.60	268.20	0.6500	18.000	0.0130	10.21	9.43	1.08	6.27	1.50	1.00	18.00 SURCHARGED

Proposal No. 609035- 126590

Post-Development

100-yr

Boston Rd. 609035  
Westford, MA

March 22, 2023

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged Condition (min)
95 EX4-5	Pipe	DMH4c	DMH5c	22.00	268.10	266.00	9.5500	18.000	0.0130	10.20	32.45	0.31	16.25	0.58	0.39	0.00 Calculated
96 EX5-6	Pipe	DMH5c	STR-6	28.00	265.90	265.13	2.7500	18.000	0.0130	10.20	17.42	0.59	10.32	0.83	0.55	0.00 Calculated
97 EX9-3	Pipe	DMH9c	DMH3c	20.00	268.90	268.70	1.0000	18.000	0.0130	11.28	10.50	1.07	6.92	1.50	1.00	15.00 SURCHARGED
98 FSP1-Out	Pipe	FSP1-Out	Culvert2In	20.00	273.00	272.60	2.0000	12.000	0.0110	6.35	5.95	1.07	9.12	1.00	1.00	21.00 SURCHARGED
99 FSP2-Out	Pipe	FSP2-Out	DMH9c	178.00	272.00	269.00	1.6900	18.000	0.0130	12.03	13.64	0.88	8.71	1.09	0.73	0.00 Calculated
100 Out2_1	Pipe	DP_2_1	DP_2	297.73	249.00	249.00	0.0000	0.000	0.0150	71.79	0.00	0.88	0.00	1.09	0.73	0.00 Calculated
101 Out2_2	Pipe	DP_2_2	DP_2	345.60	250.00	250.00	0.0000	0.000	0.0150	5.01	0.00	0.88	0.00	1.09	0.73	0.00 Calculated
102 Pond_Outfall	Pipe	PondRiser	DP_2_1	50.00	249.50	249.00	1.0000	30.000	0.0130	44.38	41.02	1.08	9.75	2.50	1.00	41.00 SURCHARGED
103 SD-16	Pipe	SD-16	STR-16	250.00	290.00	275.10	5.9600	10.000	0.0110	6.84	6.32	1.08	13.74	0.83	1.00	6.00 SURCHARGED
104 SD-19	Pipe	SD-19	STR-19	224.00	302.75	290.00	5.6900	10.000	0.0110	6.68	6.18	1.08	13.40	0.83	1.00	11.00 SURCHARGED
105 SD-23	Pipe	SD-23	STR-23	411.00	323.75	302.75	5.1100	15.000	0.0110	18.33	16.95	1.08	16.39	1.25	1.00	10.00 SURCHARGED
106 SD-28	Pipe	SD-28	STR-28	357.00	331.94	323.75	2.2900	15.000	0.0110	12.51	11.56	1.08	11.17	1.25	1.00	17.00 SURCHARGED
107 SD-33	Pipe	SD-33	STR-33	268.00	341.55	331.94	3.5900	12.000	0.0110	8.63	7.97	1.08	11.99	1.00	1.00	20.00 SURCHARGED
108 SD-38	Pipe	SD-38	STR-38	284.00	355.60	341.55	4.9500	12.000	0.0110	10.13	9.37	1.08	14.08	1.00	1.00	19.00 SURCHARGED
109 102_Bypass	Channel	STR-102	CBEX-33	233.14	263.07	256.90	2.6500	3.600	0.0130	0.15	11.66	0.01	1.90	0.06	0.19	0.00
110 103_bypass	Channel	STR-103	CBEX-32	238.82	263.13	257.18	2.4900	3.840	0.0320	0.64	5.46	0.12	1.42	0.14	0.44	0.00
111 105_Bypass	Channel	STR-105	STR-102	144.56	266.08	263.07	2.0800	3.600	0.0130	0.07	10.34	0.01	1.37	0.05	0.16	0.00
112 106_Bypass	Channel	STR-106	STR-103	143.60	265.74	263.13	1.8200	3.840	0.0130	0.80	11.48	0.07	2.36	0.12	0.37	0.00
113 11_Bypass	Channel	STR-11	STR-8	310.73	272.87	272.08	0.2500	3.840	0.0130	0.79	4.29	0.18	1.27	0.17	0.52	0.00
114 12_Bypass	Channel	STR-12	STR-9	306.16	273.43	270.92	0.8200	1.200	0.0130	0.19	0.35	0.54	1.38	0.08	0.78	0.00
115 15_Bypass	Channel	STR-15	STR-11	299.12	280.19	272.87	2.4500	3.840	0.0130	0.34	13.32	0.03	2.26	0.08	0.25	0.00
116 16_Bypass	Channel	STR-16	STR-12	302.37	280.17	273.43	2.2300	1.200	0.0130	0.39	0.57	0.68	2.31	0.09	0.86	0.00
117 19_Bypass	Channel	STR-19	STR-16	252.79	294.30	280.17	5.5900	3.840	0.0130	0.29	20.13	0.01	2.87	0.07	0.20	0.00
118 22_Bypass	Channel	STR-22	STR-15	494.76	307.33	280.19	5.4900	1.200	0.0130	0.45	0.90	0.50	3.44	0.08	0.77	0.00
119 23_Bypass	Channel	STR-23	STR-19	228.51	307.59	294.30	5.8200	3.840	0.0130	0.11	20.53	0.01	2.36	0.04	0.14	0.00
120 25_Bypass	Channel	STR-25	STR-22	205.10	318.10	307.33	5.2500	3.840	0.0130	0.59	19.51	0.03	3.27	0.09	0.27	0.00
121 27_Bypass	Channel	STR-27	STR-25	194.95	327.02	318.10	4.5800	3.840	0.0130	0.58	18.20	0.03	3.07	0.09	0.27	0.00
122 28_Bypass	Channel	STR-28	STR-23	408.97	328.31	307.59	5.0700	1.200	0.0130	0.13	0.86	0.15	2.33	0.05	0.48	0.00
123 30_Bypass	Channel	STR-30	STR-27	198.67	331.70	327.02	2.3600	3.840	0.0130	0.61	13.08	0.05	2.46	0.10	0.32	0.00
124 33_Bypass	Channel	STR-33	STR-28	357.58	335.69	328.31	2.0600	1.200	0.0130	0.31	0.55	0.56	1.99	0.08	0.80	0.00
125 35_Bypass	Channel	STR-35	STR-30	196.77	335.63	331.70	2.0000	3.840	0.0130	0.61	12.03	0.05	2.33	0.10	0.33	0.00
126 37_Bypass	Channel	STR-37	STR-35	249.72	346.40	335.63	4.3100	3.840	0.0130	0.33	17.75	0.02	2.71	0.07	0.22	0.00
127 38_Bypass	Channel	STR-38	STR-33	270.06	345.42	335.69	3.6000	1.200	0.0130	0.73	0.73	1.00	3.01	0.10	1.00	45.00
128 4_Bypass	Channel	STR-4	STR-105	153.05	269.29	266.08	2.1000	1.200	0.0130	0.21	0.55	0.38	1.77	0.07	0.70	0.00
129 40_bypass	Channel	STR-40	STR-37	261.30	359.60	346.40	5.0500	3.840	0.0130	0.34	19.08	0.02	2.87	0.07	0.22	0.00
130 41_Bypass	Channel	STR-41	STR-38	286.28	359.61	345.42	4.9600	3.840	0.0130	10.94	18.96	0.58	6.46	0.26	0.81	0.00
131 43_Bypass	Channel	STR-43	STR-41	214.88	370.25	359.61	4.9500	3.840	0.0130	9.86	18.95	0.52	6.29	0.25	0.78	0.00
132 45_Bypass	Channel	STR-45	STR-40	287.18	372.97	359.60	4.6600	3.840	0.0130	0.32	18.37	0.02	2.75	0.07	0.22	0.00
133 46_Bypass	Channel	STR-46	STR-43	69.33	373.15	370.25	4.1800	3.840	0.0130	12.60	17.41	0.72	6.27	0.28	0.89	0.00
134 49_Bypass	Channel	STR-49	STR-46	115.00	376.30	373.15	2.7400	3.840	0.0320	0.99	5.72	0.17	1.45	0.17	0.52	0.00
135 5_Bypass	Channel	STR-5	STR-106	149.01	268.12	265.74	1.6000	3.840	0.0130	0.94	10.76	0.09	2.34	0.13	0.40	0.00
136 51-bypass	Channel	STR-51	STR-46	200.00	377.77	373.15	2.3100	3.840	0.0130	9.23	12.94	0.71	4.65	0.28	0.88	0.00
137 53_Bypass	Channel	STR-53	STR-45	266.58	379.35	372.97	2.3900	3.840	0.0130	0.27	13.17	0.02	2.12	0.07	0.23	0.00
138 54_Bypass	Channel	STR-54	STR-51	73.90	379.95	377.77	2.9500	3.840	0.0130	8.27	14.62	0.57	4.95	0.26	0.81	0.00
139 56-bypass	Channel	STR-56	STR-54	94.37	381.80	379.95	1.9600	3.840	0.0130	7.52	10.77	0.70	3.85	0.28	0.87	0.00
140 58_Bypass	Channel	STR-58	STR-56	86.78	383.51	381.80	1.9700	3.840	0.0130	7.07	12.93	0.55	4.34	0.26	0.80	0.00
141 59_Bypass	Channel	STR-59	STR-53	188.00	383.54	379.35	2.2300	3.840	0.0130	0.37	12.71	0.03	2.14	0.08	0.27	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged Condition (min)
142	61-bypass	Channel	STR-61	STR-58	153.24	386.90	383.51	2.2100	3.840	0.0130	5.69	12.13	0.47	3.92	0.24	0.75	0.00
143	63_Bypass	Channel	STR-63	STR-59	295.23	389.71	383.54	2.0900	3.840	0.0130	0.26	12.31	0.02	2.03	0.07	0.23	0.00
144	64-Bypass	Channel	STR-64	STR-61	140.44	389.96	386.90	2.1800	3.840	0.0130	4.86	13.13	0.37	4.00	0.22	0.69	0.00
145	66-bypass	Channel	STR-66	STR-64	100.35	392.10	389.96	2.1300	3.840	0.0130	4.16	12.23	0.34	3.65	0.21	0.67	0.00
146	68_Bypass	Channel	STR-68	STR-63	193.86	394.22	389.71	2.3300	3.840	0.0130	0.29	12.99	0.02	2.06	0.08	0.24	0.00
147	69_bypass	Channel	STR-69	STR-66	94.31	394.12	392.10	2.1400	3.840	0.0130	2.54	12.64	0.20	3.31	0.18	0.55	0.00
148	71-Bypass	Channel	STR-71	STR-69	190.28	396.60	394.12	1.3000	3.840	0.0130	1.78	9.84	0.18	2.51	0.17	0.53	0.00
149	73_Bypass	Channel	STR-73	STR-68	272.03	397.14	394.22	1.0700	3.840	0.0130	0.19	8.82	0.02	1.50	0.07	0.23	0.00
150	74-Bypass	Channel	STR-74	STR-71	83.69	397.05	396.60	0.5400	3.840	0.0130	2.19	6.58	0.33	1.96	0.21	0.66	0.00
151	76_Bypass	Channel	STR-76	STR-74	101.19	397.78	397.05	0.7200	3.840	0.0130	1.83	6.77	0.27	1.92	0.20	0.61	0.00
152	77_Bypass	Channel	STR-77	STR-73	98.85	397.80	397.14	0.6700	3.840	0.0130	0.32	6.96	0.05	1.29	0.10	0.32	0.00
153	79_Bypass	Channel	STR-79	STR-77	265.71	398.87	397.80	0.4000	3.840	0.0130	0.34	5.40	0.06	1.23	0.11	0.35	0.00
154	8_Bypass	Channel	STR-8	STR-4	175.38	272.08	269.29	1.5900	1.200	0.0130	0.48	0.48	1.00	2.00	0.10	1.00	8.00
155	81_Bypass	Channel	STR-81	STR-76	207.03	398.90	397.78	0.5400	3.840	0.0130	0.48	6.23	0.08	1.42	0.12	0.38	0.00
156	83_bypass	Channel	STR-83	STR-81	139.00	399.62	398.90	0.5200	3.840	0.0130	0.13	6.04	0.02	1.03	0.08	0.24	0.00
157	9_Bypass	Channel	STR-9	STR-5	169.63	270.92	268.12	1.6500	3.840	0.0130	0.57	10.94	0.05	2.12	0.11	0.33	0.00
158	EX32-bypass	Channel	CBEX-32	EX32-bypass(out)	156.00	257.18	255.47	1.1000	3.600	0.0130	0.83	7.51	0.11	1.97	0.13	0.44	0.00
159	EX33-bypass	Channel	CBEX-33	EX33-bypass(out)	70.00	256.90	255.70	1.7100	3.600	0.0130	0.18	9.39	0.02	1.58	0.07	0.23	0.00
160	Outfall-1	Channel	DP-1	DP_1	333.49	327.00	286.00	12.2900	36.000	0.0320	23.11	439.39	0.05	10.24	0.85	0.28	0.00
161	FSP1-1	Orifice	FSP-1	FSP1-Out		272.00	273.00		8.000		2.03						
162	FSP1-2	Orifice	FSP-1	FSP1-Out		272.00	273.00		12.000		4.09						
163	FSP2-1	Orifice	FSP-2	FSP2-Out		270.00	272.00		8.000		1.99						
164	FSP2-2	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		5.47						
165	FSP2-3	Orifice	FSP-2	FSP2-Out		270.00	272.00		15.000		4.57						
166	Pond_LowFlow	Orifice	Pond_1	PondRiser		250.00	249.50		18.000		27.08						
167	primary	Orifice	Pond_1	PondRiser		250.00	249.50		17.000		12.60						
168	RiserTop	Orifice	Pond_1	PondRiser		250.00	249.50		48.000		24.15						
169	PondOverflow	Weir	Pond_1	DP_2_1		250.00	249.00				30.77						

**Inlet Summary**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft²)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
1	CBEX-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	0.00	N/A	1.97	1.14	0.82	58.09	10.50	7.77	257.34
2	CBEX-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	0.00	N/A	1.17	1.00	0.17	85.44	10.50	5.21	257.09
3	STR-102	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.57	263.07	0.00	N/A	0.61	0.47	0.14	77.30	10.50	5.02	263.17
4	STR-103	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.63	263.13	0.00	N/A	1.62	0.99	0.63	61.16	10.50	7.24	263.27
5	STR-105	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.58	266.08	0.00	N/A	0.38	0.32	0.06	84.68	10.50	4.21	266.16
6	STR-106	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.24	265.74	0.00	N/A	1.93	1.13	0.80	58.38	10.50	7.73	265.89
7	STR-11	FHWA HEC-22 GENERIC	N/A	On Grade	1	269.00	272.87	0.00	N/A	1.77	0.98	0.78	55.57	10.50	9.42	273.06
8	STR-12	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.70	273.43	0.00	N/A	0.63	0.45	0.18	71.67	10.50	6.43	273.56
9	STR-15	FHWA HEC-22 GENERIC	N/A	On Grade	1	276.00	280.19	0.00	N/A	1.26	0.92	0.33	73.44	10.50	5.24	280.29
10	STR-16	FHWA HEC-22 GENERIC	N/A	On Grade	1	275.00	280.17	0.00	N/A	1.36	0.98	0.38	71.81	10.50	5.44	280.28
11	STR-19	FHWA HEC-22 GENERIC	N/A	On Grade	1	289.75	294.30	0.00	N/A	1.13	0.85	0.29	74.80	10.50	5.09	294.40
12	STR-22	FHWA HEC-22 GENERIC	N/A	On Grade	1	304.00	307.33	0.00	N/A	1.50	1.05	0.45	69.98	10.50	5.66	307.44
13	STR-23	FHWA HEC-22 GENERIC	N/A	On Grade	1	303.50	307.59	0.00	N/A	0.64	0.54	0.10	84.05	10.50	4.11	307.67
14	STR-25	FHWA HEC-22 GENERIC	N/A	On Grade	1	314.00	318.10	0.00	N/A	1.79	1.20	0.59	67.02	10.50	6.05	318.22
15	STR-27	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	327.01	0.00	N/A	1.55	0.97	0.58	62.82	10.50	6.90	327.15
16	STR-28	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	328.31	0.00	N/A	0.59	0.46	0.12	78.91	10.50	4.79	328.41
17	STR-30	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.75	331.70	0.00	N/A	1.60	0.99	0.61	61.91	10.50	7.08	331.84
18	STR-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	331.69	335.69	0.00	N/A	1.02	0.71	0.31	69.46	10.50	5.96	335.81
19	STR-35	FHWA HEC-22 GENERIC	N/A	On Grade	1	332.50	335.63	0.00	N/A	1.60	0.99	0.61	61.88	10.50	7.08	335.77
20	STR-37	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.90	346.48	0.00	N/A	1.20	0.88	0.32	73.29	10.50	5.27	346.59
21	STR-38	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.30	345.42	0.00	N/A	11.21	3.91	7.31	34.85	10.50	11.40	345.70
22	STR-4	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.00	269.29	0.00	N/A	0.77	0.57	0.21	73.33	10.50	5.50	269.40
23	STR-40	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.35	359.60	0.00	N/A	1.22	0.89	0.33	72.83	10.50	5.33	359.71
24	STR-41	FHWA HEC-22 GENERIC	N/A	On Grade	2	355.36	359.61	0.00	N/A	17.64	6.66	10.97	37.77	10.50	13.74	359.93
25	STR-43	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.92	370.25	0.00	N/A	14.20	4.35	9.85	30.64	10.50	12.65	370.55
26	STR-45	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.70	372.97	0.00	N/A	1.17	0.86	0.31	73.50	10.50	5.25	373.07
27	STR-46	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.69	373.15	0.00	N/A	17.30	4.70	12.61	27.13	10.50	13.66	373.47
28	STR-49	FHWA HEC-22 GENERIC	N/A	N/A	1	372.80	376.30	0.00	N/A	6.41	5.42	0.99	85.00	10.50	2.80	376.70
29	STR-5	FHWA HEC-22 GENERIC	N/A	On Grade	1	264.50	268.12	0.00	N/A	2.16	1.22	0.94	56.48	10.50	8.09	268.28
30	STR-51	FHWA HEC-22 GENERIC	N/A	On Grade	2	373.77	377.77	0.00	N/A	15.31	6.08	9.23	39.73	10.50	15.40	378.13
31	STR-53	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.65	379.35	0.00	N/A	0.94	0.67	0.27	71.45	10.50	5.66	379.46
32	STR-54	FHWA HEC-22 GENERIC	N/A	On Grade	2	374.68	379.95	0.00	N/A	14.00	5.73	8.27	40.94	10.50	14.85	380.30
33	STR-56	FHWA HEC-22 GENERIC	N/A	On Grade	2	377.46	381.46	0.00	N/A	12.97	5.45	7.52	42.01	10.50	14.37	381.80
34	STR-58	FHWA HEC-22 GENERIC	N/A	On Grade	2	379.29	383.46	0.00	N/A	12.34	5.27	7.07	42.70	10.50	14.10	383.79
35	STR-59	FHWA HEC-22 GENERIC	N/A	On Grade	1	379.54	383.54	0.00	N/A	1.15	0.79	0.37	68.27	10.50	6.07	383.66
36	STR-61	FHWA HEC-22 GENERIC	N/A	On Grade	2	382.57	386.57	0.00	N/A	10.39	4.70	5.70	45.18	10.50	13.15	386.88
37	STR-63	FHWA HEC-22 GENERIC	N/A	On Grade	1	386.20	389.71	0.00	N/A	0.91	0.65	0.25	72.11	10.50	5.58	389.82
38	STR-64	FHWA HEC-22 GENERIC	N/A	On Grade	2	386.15	389.91	0.00	N/A	9.18	4.32	4.86	47.09	10.50	12.42	390.21
39	STR-66	FHWA HEC-22 GENERIC	N/A	On Grade	2	388.48	391.98	0.00	N/A	8.15	3.99	4.17	48.90	10.50	11.89	392.27
40	STR-68	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.70	394.22	0.00	N/A	1.00	0.70	0.29	70.59	10.50	5.77	394.34
41	STR-69	FHWA HEC-22 GENERIC	N/A	On Grade	2	390.70	394.06	0.00	N/A	5.64	3.10	2.54	54.98	10.50	10.16	394.31
42	STR-71	FHWA HEC-22 GENERIC	N/A	On Grade	2	392.55	396.60	0.00	N/A	4.44	2.66	1.78	59.94	10.50	11.89	396.89
43	STR-73	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.04	397.14	0.00	N/A	0.65	0.47	0.18	71.96	10.50	6.16	397.26
44	STR-74	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.10	397.10	0.00	N/A	5.16	2.97	2.18	57.66	10.50	12.68	397.40
45	STR-76	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.74	397.74	0.00	N/A	4.54	2.70	1.84	59.54	10.50	11.96	398.03
46	STR-77	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.30	397.80	0.00	N/A	0.94	0.62	0.32	65.96	10.50	7.09	397.94
47	STR-79	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.98	398.87	0.00	N/A	0.95	0.62	0.33	65.27	10.50	7.46	399.02



**Inlet Summary**

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Initial Water Elevation (ft)	Ponded Area (ft²)	Peak Flow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Allowable Spread (ft)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)
48	STR-8	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.91	272.08	0.00	N/A	1.63	0.99	0.64	60.90	10.50	7.30	272.23
49	STR-81	FHWA HEC-22 GENERIC	N/A	On Grade	2	396.00	398.85	0.00	N/A	1.84	1.37	0.47	74.48	10.50	8.55	399.07
50	STR-83	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.55	399.55	0.00	N/A	0.63	0.50	0.13	79.93	10.50	4.95	399.70
51	STR-84	FHWA HEC-22 GENERIC	N/A	On Sag	2	395.80	399.80	0.00	0.00	4.78	N/A	N/A	N/A	10.50	15.95	400.14
52	STR-9	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.99	270.92	0.00	N/A	1.52	0.94	0.57	62.15	10.50	7.09	271.06

**Subbasin Hydrology**

**Subbasin : Blake1P**

**Input Data**

Area (ac) ..... 2.66  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 78.7  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.66	-	78.7
Composite Area & Weighted CN	2.66		78.7

**Time of Concentration**

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

- Tc = Time of Concentration (hr)
- n = Manning's roughness
- Lf = Flow Length (ft)
- P = 2 yr, 24 hr Rainfall (inches)
- Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

- V = 16.1345 \* (Sf<sup>0.5</sup>) (unpaved surface)
- V = 20.3282 \* (Sf<sup>0.5</sup>) (paved surface)
- V = 15.0 \* (Sf<sup>0.5</sup>) (grassed waterway surface)
- V = 10.0 \* (Sf<sup>0.5</sup>) (nearly bare & untilled surface)
- V = 9.0 \* (Sf<sup>0.5</sup>) (cultivated straight rows surface)
- V = 7.0 \* (Sf<sup>0.5</sup>) (short grass pasture surface)
- V = 5.0 \* (Sf<sup>0.5</sup>) (woodland surface)
- V = 2.5 \* (Sf<sup>0.5</sup>) (forest w/heavy litter surface)
- Tc = (Lf / V) / (3600 sec/hr)

Where:

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)

Channel Flow Equation :

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

$$R = A_q / W_p$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where :

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- R = Hydraulic Radius (ft)
- Aq = Flow Area (ft<sup>2</sup>)
- Wp = Wetted Perimeter (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)
- n = Manning's roughness

	Subarea A	Subarea B	Subarea C
<b>Sheet Flow Computations</b>			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0
<b>Shallow Concentrated Flow Computations</b>			
Flow Length (ft) :	346	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	7.64		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	5.15
Peak Runoff (cfs) .....	13.48
Weighted Curve Number .....	78.7
Time of Concentration (days hh:mm:ss) .....	0 00:07:38

**Subbasin : Blake2**

**Input Data**

Area (ac) ..... 0.57  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 82.1  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.57	-	82.1
Composite Area & Weighted CN	0.57		82.1

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 5.54  
Peak Runoff (cfs) ..... 3.16  
Weighted Curve Number ..... 82.1  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Culvert2L-DA**

**Input Data**

Area (ac) ..... 1.39  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 70.2  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	1.39	-	70.2
Composite Area & Weighted CN	1.39		70.2

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	426	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.33	0	0
Total TOC (min) .....	7.59		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.19  
 Peak Runoff (cfs) ..... 5.85  
 Weighted Curve Number ..... 70.2  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:35

**Subbasin : Culvert2P-DA**

**Input Data**

Area (ac) ..... 2.87  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 73.5  
 Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	2.87	-	73.5
Composite Area & Weighted CN	2.87		73.5

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	10	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.51	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	317	0	0
Slope (%) :	10	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.1	0	0
Computed Flow Time (min) :	1.04	0	0
Total TOC (min) .....	7.55		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.56  
 Peak Runoff (cfs) ..... 13.08  
 Weighted Curve Number ..... 73.5  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:33

**Subbasin : EX32-DA**

**Input Data**

Area (ac) ..... 0.21  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.21	-	98
Composite Area & Weighted CN	0.21		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 1.36  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : EX33-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	5	-	98
Composite Area & Weighted CN	5		98

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 1.03  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Hildreth-DA**

**Input Data**

Area (ac) ..... 2.35  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 87  
Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	2.35	-	87
Composite Area & Weighted CN	2.35		87

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	96	0	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	0.55	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.013	0	0
Flow Length (ft) :	553	0	0
Channel Slope (%) :	3	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.785	0	0
Wetted Perimeter (ft) :	3	0	0
Velocity (ft/sec) :	8.12	0	0
Computed Flow Time (min) :	1.13	0	0
Total TOC (min) .....	15.59		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 6.11  
Peak Runoff (cfs) ..... 11.82  
Weighted Curve Number ..... 87  
Time of Concentration (days hh:mm:ss) ..... 0 00:15:35

**Subbasin : Str102-DA**

**Input Data**

Area (ac) ..... 0.08  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.08	-	98
Composite Area & Weighted CN	0.08		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.54  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str103-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	98
Composite Area & Weighted CN	0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.83  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str105-DA**

**Input Data**

Area (ac) ..... 0.03  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.03	-	98
Composite Area & Weighted CN	0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.38  
Peak Runoff (cfs) ..... 0.17  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str106-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.99  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str11-DA**

**Input Data**

Area (ac) ..... 0.22  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.22	-	98
Composite Area & Weighted CN	0.22		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 1.44  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str12-DA**

**Input Data**

Area (ac) ..... 0.04  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.04	-	98
Composite Area & Weighted CN	0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.4  
Peak Runoff (cfs) ..... 0.25  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str15-DA**

**Input Data**

Area (ac) ..... 0.13  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.13	-	98
Composite Area & Weighted CN	0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.83  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str16-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 1.07  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str16L-DA**

**Input Data**

Area (ac) ..... 1.77  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 71.3  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.77	-	71.3
Composite Area & Weighted CN	1.77		71.3

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	381	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.19	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	223	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.2	0	0
Total TOC (min) .....	7.65		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.31  
 Peak Runoff (cfs) ..... 7.64  
 Weighted Curve Number ..... 71.3  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:39

**Subbasin : Str19-DA**

**Input Data**

Area (ac) ..... 0.16  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.16	-	98
Composite Area & Weighted CN	0.16		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 1.03  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str19L-DA**

**Input Data**

Area (ac) ..... 1.85  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 74  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.85	-	74
Composite Area & Weighted CN	1.85		74

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	11	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.13	0	0
Computed Flow Time (min) :	6.27	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	389	0	0
Slope (%) :	11	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.35	0	0
Computed Flow Time (min) :	1.21	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	144	0	0
Channel Slope (%) :	5.5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	18.82	0	0
Computed Flow Time (min) :	0.13	0	0
Total TOC (min) .....	7.61		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.61  
 Peak Runoff (cfs) ..... 8.55  
 Weighted Curve Number ..... 74  
 Time of Concentration (days hh:mm:ss) ..... 0 00:07:37

**Subbasin : Str22-DA**

**Input Data**

Area (ac) ..... 0.14  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.2  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.14	-	97.2
Composite Area & Weighted CN	0.14		97.2

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.31  
Peak Runoff (cfs) ..... 0.91  
Weighted Curve Number ..... 97.2  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str23-DA**

**Input Data**

Area (ac) ..... 0.08  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.08	-	98
Composite Area & Weighted CN	0.08		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.54  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str23L-DA**

**Input Data**

Area (ac) ..... 4.7  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 77.1  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	4.7	-	77.1
Composite Area & Weighted CN	4.7		77.1

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	8.59	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	463	0	0
Slope (%) :	9.8	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.05	0	0
Computed Flow Time (min) :	1.53	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	221	0	0
Channel Slope (%) :	5.9	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	19.49	0	0
Computed Flow Time (min) :	0.19	0	0
Total TOC (min) .....	10.31		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.97  
 Peak Runoff (cfs) ..... 22.1  
 Weighted Curve Number ..... 77.1  
 Time of Concentration (days hh:mm:ss) ..... 0 00:10:19

**Subbasin : Str25-DA**

**Input Data**

Area (ac) ..... 0.19  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 94  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.19	-	94
Composite Area & Weighted CN	0.19		94

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 6.93  
Peak Runoff (cfs) ..... 1.22  
Weighted Curve Number ..... 94  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str27-DA**

**Input Data**

Area (ac) ..... 0.15  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 97.8  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.15	-	97.8
Composite Area & Weighted CN	0.15		97.8

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.39  
Peak Runoff (cfs) ..... 0.95  
Weighted Curve Number ..... 97.8  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str28-DA**

**Input Data**

Area (ac) ..... 0.05  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.05	-	98
Composite Area & Weighted CN	0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.4  
Peak Runoff (cfs) ..... 0.29  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str28L-DA**

**Input Data**

Area (ac) ..... 4.17  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 75.4  
 Rain Gage ID ..... \*

**Composite Curve Number**

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	4.17	-	75.4
Composite Area & Weighted CN	4.17		75.4

**Time of Concentration**

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.5	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	13.9	0	0

Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	367	0	0
Slope (%) :	10.3	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.18	0	0
Computed Flow Time (min) :	1.18	0	0

Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	294	0	0
Channel Slope (%) :	2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.35	0	0
Computed Flow Time (min) :	0.43	0	0
Total TOC (min) .....	15.52		

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 4.77  
 Peak Runoff (cfs) ..... 17.09  
 Weighted Curve Number ..... 75.4  
 Time of Concentration (days hh:mm:ss) ..... 0 00:15:31

**Subbasin : Str30-DA**

**Input Data**

Area (ac) ..... 0.15  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.15	-	98
Composite Area & Weighted CN	0.15		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 0.99  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str32-DA**

**Input Data**

Area (ac) ..... 0.2  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
-	0.2	-	98
Composite Area & Weighted CN	0.2		98

**Time of Concentration**

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.41  
Peak Runoff (cfs) ..... 1.28  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:00:00

**Subbasin : Str33-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.4
Peak Runoff (cfs) .....	0.29
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str33L-DA**

**Input Data**

Area (ac) .....	3.18
Peak Rate Factor .....	484
Weighted Curve Number .....	75.4
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area (acres)	Soil Group	Curve Number
Soil/Surface Description				
-		3.18	-	75.4
Composite Area & Weighted CN		3.18		75.4

**Time of Concentration**

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	6	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.1	0	0
Computed Flow Time (min) :	7.99	0	0

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	497	0	0
Slope (%) :	7	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.27	0	0
Computed Flow Time (min) :	1.94	0	0

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	39	0	0
Channel Slope (%) :	3.6	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	15.23	0	0
Computed Flow Time (min) :	0.04	0	0
Total TOC (min) .....	9.97		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.77
Peak Runoff (cfs) .....	14.48
Weighted Curve Number .....	75.4
Time of Concentration (days hh:mm:ss) .....	0 00:09:58

**Subbasin : Str37-DA**

**Input Data**

Area (ac) ..... 0.13  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 98  
 Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.13	-	98
Composite Area & Weighted CN		0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 7.41  
 Peak Runoff (cfs) ..... 0.87  
 Weighted Curve Number ..... 98  
 Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str38-DA**

**Input Data**

Area (ac) ..... 0.13  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 98  
 Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.13	-	98
Composite Area & Weighted CN		0.13		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 7.41  
 Peak Runoff (cfs) ..... 0.83  
 Weighted Curve Number ..... 98  
 Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str38L-DA**

**Input Data**

Area (ac) .....	3.72
Peak Rate Factor .....	484
Weighted Curve Number .....	73.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		3.72	-	73.3
Composite Area & Weighted CN		3.72		73.3

**Time of Concentration**

	Subarea		
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.4	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.06	0	0
Computed Flow Time (min) :	12.93	0	0

	Subarea		
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	623	0	0
Slope (%) :	3.2	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.89	0	0
Computed Flow Time (min) :	3.59	0	0

	Subarea		
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	23	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	16.54		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.54
Peak Runoff (cfs) .....	14.22
Weighted Curve Number .....	73.3
Time of Concentration (days hh:mm:ss) .....	0 00:16:32

**Subbasin : Str40-DA**

**Input Data**

Area (ac) ..... 0.14  
 Peak Rate Factor ..... 484  
 Weighted Curve Number ..... 98  
 Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
 Total Runoff (in) ..... 7.41  
 Peak Runoff (cfs) ..... 0.91  
 Weighted Curve Number ..... 98  
 Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str41-DA**

**Input Data**

Area (ac) .....	0.09
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	98
Composite Area & Weighted CN		0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.41
Peak Runoff (cfs) .....	0.54
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str41L-DA**

**Input Data**

Area (ac) .....	2.56
Peak Rate Factor .....	484
Weighted Curve Number .....	72.1
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area (acres)	Soil Group	Curve Number
Soil/Surface Description		2.56	-	72.1
Composite Area & Weighted CN		2.56		72.1

**Time of Concentration**

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2.2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	20.77	0	0

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	498	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	8.38	0	0

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	59	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.05	0	0
Total TOC (min) .....	29.21		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.4
Peak Runoff (cfs) .....	7.69
Weighted Curve Number .....	72.1
Time of Concentration (days hh:mm:ss) .....	0 00:29:13

**Subbasin : Str43-DA**

**Input Data**

Area (ac) ..... 0.03  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.38  
Peak Runoff (cfs) ..... 0.17  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

**Subbasin : Str43L-DA**

**Input Data**

Area (ac) .....	0.5
Peak Rate Factor .....	484
Weighted Curve Number .....	73.7
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		0.5	-	73.7
Composite Area & Weighted CN		0.5		73.7

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.9	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.02	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	406	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	6.84	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	20	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.02	0	0
Total TOC (min) .....	28.88		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.58
Peak Runoff (cfs) .....	1.58
Weighted Curve Number .....	73.7
Time of Concentration (days hh:mm:ss) .....	0 00:28:53

**Subbasin : Str45-DA**

**Input Data**

Area (ac) .....	0.14
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.14	-	98
Composite Area & Weighted CN		0.14		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.41
Peak Runoff (cfs) .....	0.91
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00



**Subbasin : Str46-DA**

**Input Data**

Area (ac) .....	0.09
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.05	-	98
Composite Area & Weighted CN		0.05		98

**Time of Concentration**

User-Defined TOC override (minutes): 5.00

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.41
Peak Runoff (cfs) .....	0.58
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str46L-DA**

**Input Data**

Area (ac) .....	2.2
Peak Rate Factor .....	484
Weighted Curve Number .....	76.4
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area (acres)	Soil Group	Curve Number
Soil/Surface Description		2.01	-	76.4
Composite Area & Weighted CN		2.01		76.4

**Time of Concentration**

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	659	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.09	0	0

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	104	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.1	0	0
Total TOC (min) .....	32.77		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.89
Peak Runoff (cfs) .....	6.95
Weighted Curve Number .....	76.4
Time of Concentration (days hh:mm:ss) .....	0 00:32:46

**Subbasin : Str49-DA**

**Input Data**

Area (ac) .....	2.2
Peak Rate Factor .....	484
Weighted Curve Number .....	74.2
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		2.2	-	74.2
Composite Area & Weighted CN		2.2		74.2

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.8	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	22.5	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	706	0	0
Slope (%) :	1.8	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.94	0	0
Computed Flow Time (min) :	12.52	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	35	0	0
Channel Slope (%) :	5	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	17.95	0	0
Computed Flow Time (min) :	0.03	0	0
Total TOC (min) .....	35.05		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.64
Peak Runoff (cfs) .....	6.41
Weighted Curve Number .....	74.2
Time of Concentration (days hh:mm:ss) .....	0 00:35:03

**Subbasin : Str4-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.4
Peak Runoff (cfs) .....	0.29
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str51-DA**

**Input Data**

Area (ac) .....	0.03
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.03	-	98
Composite Area & Weighted CN		0.03		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.4
Peak Runoff (cfs) .....	0.21
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str51L-DA**

**Input Data**

Area (ac) .....	2.4
Peak Rate Factor .....	484
Weighted Curve Number .....	73.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.4	-	73.3
Composite Area & Weighted CN		2.4		73.3

**Time of Concentration**

	Subarea		
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	21.58	0	0
	Subarea		
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	706	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	11.89	0	0
Total TOC (min) .....	33.46		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.54
Peak Runoff (cfs) .....	6.98
Weighted Curve Number .....	73.3
Time of Concentration (days hh:mm:ss) .....	0 00:33:28

**Subbasin : Str53-AD**

**Input Data**

Area (ac) .....	0.09
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.09	-	98
Composite Area & Weighted CN		0.09		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.41
Peak Runoff (cfs) .....	0.58
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str54-DA**

**Input Data**

Area (ac) ..... 0.04  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... \*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) ..... 7.65  
Total Runoff (in) ..... 7.4  
Peak Runoff (cfs) ..... 0.21  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00



**Subbasin : Str54L-DA**

**Input Data**

Area (ac) .....	2.11
Peak Rate Factor .....	484
Weighted Curve Number .....	77
Rain Gage ID .....	*

**Composite Curve Number**

	32	Area	Soil	Curve
Soil/Surface Description		(acres)	Group	Number
-		2.11	-	77
Composite Area & Weighted CN		2.11		77

**Time of Concentration**

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	0.8	0	0
Flow Length (ft) :	50	0	0
Slope (%) :	1.7	0	0
2 yr, 24 hr Rainfall (in) :	3.17	0	0
Velocity (ft/sec) :	0.04	0	0
Computed Flow Time (min) :	23.02	0	0

	Subarea	Subarea	Subarea
	A	B	C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	714	0	0
Slope (%) :	1.8	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.94	0	0
Computed Flow Time (min) :	12.66	0	0

	Subarea	Subarea	Subarea
	A	B	C
Channel Flow Computations			
Manning's Roughness :	0.016	0	0
Flow Length (ft) :	219	0	0
Channel Slope (%) :	2.2	0	0
Cross Section Area (ft <sup>2</sup> ) :	0.8	0	0
Wetted Perimeter (ft) :	1	0	0
Velocity (ft/sec) :	11.9	0	0
Computed Flow Time (min) :	0.31	0	0
Total TOC (min) .....	35.99		

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	4.95
Peak Runoff (cfs) .....	6.45
Weighted Curve Number .....	77
Time of Concentration (days hh:mm:ss) .....	0 00:35:59

**Subbasin : Str56-DA**

**Input Data**

Area (ac) .....	0.04
Peak Rate Factor .....	484
Weighted Curve Number .....	98
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		0.04	-	98
Composite Area & Weighted CN		0.04		98

**Time of Concentration**

User-Defined TOC override (minutes): 5

**Subbasin Runoff Results**

Total Rainfall (in) .....	7.65
Total Runoff (in) .....	7.4
Peak Runoff (cfs) .....	0.21
Weighted Curve Number .....	98
Time of Concentration (days hh:mm:ss) .....	0 00:05:00

**Subbasin : Str56L-DA**

**Input Data**

Area (ac) .....	2.12
Peak Rate Factor .....	484
Weighted Curve Number .....	75.3
Rain Gage ID .....	*

**Composite Curve Number**

Soil/Surface Description	32	Area (acres)	Soil Group	Curve Number
-		2.12	-	75.3
Composite Area & Weighted CN		2.12		75.3

**Time of Concentration**

**Junction Input**

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft <sup>2</sup> )	Minimum Pipe Cover (in)
1	Culvert2In	270.70	274.50	3.80	270.70	0.00	274.50	0.00	0.00	0.00
2	DMH3c	268.70	271.83	3.13	268.70	0.00	271.83	0.00	0.00	0.00
3	DMH4c	268.10	271.22	3.12	268.10	0.00	271.22	0.00	0.00	0.00
4	DMH5c	265.90	269.46	3.56	265.90	0.00	269.46	0.00	0.00	0.00
5	DMH6c	253.60	258.48	4.88	253.60	0.00	258.48	0.00	0.00	0.00
6	DMH9c	268.90	271.70	2.80	268.90	0.00	271.70	0.00	0.00	0.00
7	DP_2_1	249.00	255.00	6.00	249.00	0.00	255.00	0.00	0.00	0.00
8	DP_2_2	250.00	256.00	6.00	250.00	0.00	256.00	0.00	0.00	0.00
9	DP-1	327.00	336.00	9.00	327.00	0.00	336.00	0.00	0.00	0.00
10	FSP1-Out	273.00	276.00	3.00	273.00	0.00	276.00	0.00	7794.00	0.00
11	FSP2-Out	272.00	276.00	4.00	272.00	0.00	276.00	0.00	3746.00	0.00
12	PondRiser	249.50	255.90	6.40	249.50	0.00	257.50	1.60	0.00	0.00
13	SD-16	290.00	294.30	4.30	290.00	0.00	294.30	0.00	0.00	0.00
14	SD-19	302.75	307.59	4.84	302.75	0.00	307.59	0.00	0.00	0.00
15	SD-23	323.75	328.31	4.56	323.75	0.00	328.31	0.00	0.00	0.00
16	SD-28	331.94	335.69	3.75	331.94	0.00	335.69	0.00	0.00	0.00
17	SD-33	341.55	345.42	3.87	341.55	0.00	345.42	0.00	0.00	0.00
18	SD-38	355.60	359.61	4.01	355.60	0.00	359.61	0.00	0.00	0.00
19	STR-10	267.50	273.38	5.88	267.50	0.00	273.38	0.00	0.00	0.00
20	STR-100	256.50	261.94	5.44	256.50	0.00	261.94	0.00	0.00	0.00
21	STR-101	258.50	262.54	4.04	258.50	0.00	262.54	0.00	0.00	0.00
22	STR-104	262.08	265.84	3.76	262.08	0.00	265.84	0.00	0.00	0.00
23	STR-13	269.10	274.10	5.00	269.10	0.00	274.10	0.00	0.00	0.00
24	STR-14	274.00	280.22	6.22	274.00	0.00	280.22	0.00	0.00	0.00
25	STR-17	282.30	287.81	5.51	282.30	0.00	287.81	0.00	0.00	0.00
26	STR-18	289.30	294.76	5.46	289.30	0.00	294.76	0.00	0.00	0.00
27	STR-2	253.60	261.00	7.40	253.60	0.00	261.00	0.00	0.00	0.00
28	STR-20	296.30	301.69	5.39	296.30	0.00	301.69	0.00	0.00	0.00
29	STR-21	302.10	307.72	5.62	302.10	0.00	307.72	0.00	0.00	0.00
30	STR-24	313.50	318.70	5.20	313.50	0.00	318.70	0.00	0.00	0.00
31	STR-26	322.80	328.00	5.20	322.80	0.00	328.00	0.00	0.00	0.00
32	STR-29	326.75	332.13	5.38	326.75	0.00	332.13	0.00	0.00	0.00
33	STR-3	259.30	269.66	10.36	259.30	0.00	269.66	0.00	0.00	0.00
34	STR-34	330.32	336.12	5.80	330.32	0.00	336.12	0.00	0.00	0.00
35	STR-36	341.00	346.20	5.20	341.00	0.00	346.20	0.00	0.00	0.00
36	STR-39	354.40	359.65	5.25	354.40	0.00	359.65	0.00	0.00	0.00
37	STR-42	365.50	370.42	4.92	365.50	0.00	370.42	0.00	0.00	0.00
38	STR-44	367.50	372.84	5.34	367.50	0.00	372.84	0.00	0.00	0.00
39	STR-47	370.40	376.35	5.95	370.40	0.00	376.35	0.00	0.00	0.00
40	STR-50	372.50	378.03	5.53	372.50	0.00	378.03	0.00	0.00	0.00
41	STR-52	374.40	379.58	5.18	374.40	0.00	379.58	0.00	0.00	0.00
42	STR-55	376.70	381.70	5.00	376.70	0.00	381.70	0.00	0.00	0.00
43	STR-57	379.05	383.70	4.65	379.05	0.00	383.70	0.00	0.00	0.00
44	STR-6	260.10	270.06	9.96	260.10	0.00	270.06	0.00	0.00	0.00
45	STR-60	382.35	386.80	4.45	382.35	0.00	386.80	0.00	0.00	0.00
46	STR-62	386.00	390.16	4.16	386.00	0.00	390.16	0.00	0.00	0.00
47	STR-65	388.10	392.29	4.19	388.10	0.00	392.29	0.00	0.00	0.00
48	STR-67	390.10	394.40	4.30	390.10	0.00	394.40	0.00	0.00	0.00
49	STR-7	262.00	271.28	9.28	262.00	0.00	271.28	0.00	0.00	0.00
50	STR-70	391.20	396.78	5.58	391.20	0.00	396.78	0.00	0.00	0.00
51	STR-72	391.70	397.36	5.66	391.70	0.00	397.36	0.00	0.00	0.00
52	STR-75	392.70	397.98	5.28	392.70	0.00	397.98	0.00	0.00	0.00
53	STR-78	393.90	398.98	5.08	393.90	0.00	398.98	0.00	0.00	0.00
54	STR-80	394.90	398.92	4.02	394.90	0.00	398.92	0.00	0.00	0.00
55	STR-82	395.15	399.57	4.42	395.15	0.00	399.57	0.00	0.00	0.00

**Junction Results**

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation (ft)	Max HGL Depth (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Average HGL Elevation (ft)	Average HGL Depth (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Culvert2In	11.19	5.85	273.60	2.90	0.00	0.90	272.71	2.01	0 12:14	0 00:00	0.00	0.00
2	DMH3c	11.28	0.00	271.83	3.13	0.00	0.00	268.90	0.20	0 11:59	0 12:02	0.34	20.00
3	DMH4c	10.21	0.00	269.70	1.60	0.00	1.52	268.38	0.28	0 12:01	0 00:00	0.00	0.00
4	DMH5c	10.20	0.00	266.73	0.83	0.00	2.73	266.10	0.20	0 12:01	0 00:00	0.00	0.00
5	DMH6c	4.02	0.00	255.81	2.21	0.00	2.67	255.21	1.61	0 12:07	0 00:00	0.00	0.00
6	DMH9c	14.58	3.16	271.70	2.80	0.00	0.00	269.14	0.24	0 12:01	0 12:08	0.69	17.00
7	DP_2_1	71.79	0.00	251.50	2.50	0.00	4.90	249.52	0.52	0 12:12	0 00:00	0.00	0.00
8	DP_2_2	5.01	0.00	250.65	0.65	0.00	5.35	250.11	0.11	0 12:07	0 00:00	0.00	0.00
9	DP-1	23.27	0.00	329.22	2.22	0.00	6.78	327.93	0.93	0 12:48	0 00:00	0.00	0.00
10	FSP1-Out	6.11	0.00	276.13	3.13	0.01	0.00	273.14	0.14	0 12:27	0 12:20	0.03	22.00
11	FSP2-Out	12.03	0.00	273.09	1.09	0.00	3.66	272.12	0.12	0 12:09	0 00:00	0.00	0.00
12	PondRiser	63.82	0.00	255.90	6.40	0.00	0.00	250.14	0.64	0 12:11	0 12:21	9.27	43.00
13	SD-16	7.64	7.64	294.30	4.30	0.00	0.00	290.11	0.11	0 12:01	0 12:07	0.13	10.00
14	SD-19	8.55	8.55	307.59	4.84	0.00	0.00	302.88	0.13	0 11:59	0 12:07	0.32	13.00
15	SD-23	22.10	22.10	328.31	4.56	0.00	0.00	323.92	0.17	0 12:01	0 12:08	0.66	13.00
16	SD-28	17.09	17.09	335.69	3.75	0.00	0.00	332.14	0.20	0 12:02	0 12:11	1.05	20.00
17	SD-33	14.48	14.48	345.42	3.87	0.00	0.00	341.73	0.18	0 11:58	0 12:08	1.28	21.00
18	SD-38	14.22	14.22	359.61	4.01	0.00	0.00	355.78	0.18	0 12:02	0 12:11	1.00	21.00
19	STR-10	93.27	0.00	269.87	2.37	0.00	3.51	268.59	1.09	0 12:02	0 00:00	0.00	0.00
20	STR-100	2.88	0.00	257.45	0.95	0.00	4.49	257.08	0.58	0 12:06	0 00:00	0.00	0.00
21	STR-101	2.88	0.00	259.04	0.54	0.00	3.50	258.76	0.26	0 12:06	0 00:00	0.00	0.00
22	STR-104	1.43	0.00	262.53	0.45	0.00	3.31	262.24	0.16	0 12:06	0 00:00	0.00	0.00
23	STR-13	91.51	0.00	271.70	2.60	0.00	2.40	269.78	0.68	0 12:02	0 00:00	0.00	0.00
24	STR-14	90.91	0.00	280.22	6.22	0.00	0.00	276.01	2.01	0 11:59	0 12:04	2.88	20.00
25	STR-17	82.20	0.00	283.93	1.63	0.00	3.88	282.66	0.36	0 12:04	0 00:00	0.00	0.00
26	STR-18	82.20	0.00	290.86	1.56	0.00	3.90	289.65	0.35	0 12:04	0 00:00	0.00	0.00
27	STR-2	106.18	0.00	261.00	7.40	0.00	0.00	254.15	0.55	0 12:00	0 12:03	1.34	20.00
28	STR-20	75.19	0.00	297.90	1.60	0.00	3.79	296.66	0.36	0 12:04	0 00:00	0.00	0.00
29	STR-21	75.19	0.00	304.35	2.25	0.00	3.37	303.50	1.40	0 12:04	0 00:00	0.00	0.00
30	STR-24	55.87	0.00	314.90	1.40	0.00	3.80	313.83	0.33	0 12:05	0 00:00	0.00	0.00
31	STR-26	54.66	0.00	324.30	1.50	0.00	3.70	323.19	0.39	0 12:41	0 00:00	0.00	0.00
32	STR-29	42.99	0.00	329.28	2.53	0.00	2.85	327.51	0.76	0 12:41	0 00:00	0.00	0.00
33	STR-3	106.50	0.00	263.79	4.49	0.00	5.87	263.55	4.25	0 12:06	0 00:00	0.00	0.00
34	STR-34	73.41	0.00	332.74	2.42	0.00	3.38	332.47	2.15	0 12:06	0 00:00	0.00	0.00
35	STR-36	73.57	0.00	342.71	1.71	0.00	3.49	341.43	0.43	0 12:22	0 00:00	0.00	0.00
36	STR-39	58.89	0.00	356.01	1.61	0.00	3.64	355.13	0.73	0 12:22	0 00:00	0.00	0.00
37	STR-42	51.89	0.00	367.37	1.87	0.00	3.05	366.00	0.50	0 12:38	0 00:00	0.00	0.00
38	STR-44	49.03	0.00	372.84	5.34	0.00	0.00	368.73	1.23	0 12:00	0 12:22	1.69	37.00
39	STR-47	48.81	0.00	376.35	5.95	0.00	0.00	372.82	2.42	0 12:00	0 12:34	2.57	38.00
40	STR-50	51.32	0.00	378.03	5.53	0.00	0.00	373.71	1.21	0 12:00	0 12:28	3.65	34.00
41	STR-52	49.89	0.00	379.58	5.18	0.00	0.00	374.88	0.48	0 12:02	0 12:20	2.14	26.00
42	STR-55	48.33	0.00	381.70	5.00	0.00	0.00	377.62	0.92	0 12:03	0 12:21	1.35	22.00
43	STR-57	42.13	0.00	383.70	4.65	0.00	0.00	379.44	0.39	0 12:13	0 12:21	0.04	8.00
44	STR-6	104.86	0.00	265.96	5.86	0.00	4.10	265.26	5.16	0 12:01	0 00:00	0.00	0.00
45	STR-60	36.68	0.00	383.84	1.49	0.00	2.96	382.67	0.32	0 12:21	0 00:00	0.00	0.00
46	STR-62	32.23	0.00	387.35	1.35	0.00	2.81	386.34	0.34	0 12:21	0 00:00	0.00	0.00
47	STR-65	27.99	0.00	389.35	1.25	0.00	2.94	388.52	0.42	0 12:20	0 00:00	0.00	0.00
48	STR-67	24.42	0.00	392.20	2.10	0.00	2.20	390.74	0.64	0 12:04	0 00:00	0.00	0.00
49	STR-7	95.88	0.00	265.79	3.79	0.00	5.49	265.56	3.56	0 12:07	0 00:00	0.00	0.00
50	STR-70	24.79	0.00	396.78	5.58	0.00	0.00	392.47	1.27	0 12:01	0 12:06	0.95	19.00
51	STR-72	22.39	0.00	393.46	1.76	0.00	3.90	392.98	1.28	0 12:06	0 00:00	0.00	0.00
52	STR-75	19.28	0.00	394.37	1.67	0.00	3.61	393.82	1.12	0 12:07	0 00:00	0.00	0.00
53	STR-78	15.70	0.00	395.65	1.75	0.00	3.33	394.95	1.05	0 12:06	0 00:00	0.00	0.00
54	STR-80	12.83	11.82	398.92	4.02	0.00	0.00	395.97	1.07	0 12:04	0 12:09	0.26	12.00
55	STR-82	5.17	0.00	399.57	4.42	0.00	0.00	395.41	0.26	0 12:01	0 12:09	0.31	19.00

**Channel Input**

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 102_Bypass	233.14	263.07	3.50	256.90	3.80	6.17	2.6500	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
2 103_bypass	238.82	263.13	3.50	257.18	2.18	5.95	2.4900	Trapezoidal	0.320	16.000	0.0320	0.5000	0.5000	0.0000	0.00	No
3 105_Bypass	144.56	266.08	3.50	263.07	3.50	3.01	2.0800	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
4 106_Bypass	143.60	265.74	3.50	263.13	3.50	2.61	1.8200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
5 11_Bypass	310.73	272.87	3.87	272.08	6.17	0.79	0.2500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
6 12_Bypass	306.16	273.43	4.73	270.92	4.93	2.51	0.8200	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
7 15_Bypass	299.12	280.19	4.19	272.87	3.87	7.32	2.4500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
8 16_Bypass	302.37	280.17	5.17	273.43	4.73	6.74	2.2300	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
9 19_Bypass	252.79	294.30	4.55	280.17	5.17	14.13	5.5900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
10 22_Bypass	494.76	307.33	3.33	280.19	4.19	27.14	5.4900	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
11 23_Bypass	228.51	307.59	4.09	294.30	4.55	13.29	5.8200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
12 25_Bypass	205.10	318.10	4.10	307.33	3.33	10.77	5.2500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
13 27-Bypass	194.95	327.02	3.52	318.10	4.10	8.92	4.5800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
14 28_Bypass	408.97	328.31	4.81	307.59	4.09	20.72	5.0700	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
15 30_Bypass	198.67	331.70	3.95	327.02	3.52	4.68	2.3600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
16 33_Bypass	357.58	335.69	4.00	328.31	4.81	7.38	2.0600	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
17 35_Bypass	196.77	335.63	3.13	331.70	3.95	3.93	2.0000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
18 37_Bypass	249.72	346.40	4.50	335.63	3.13	10.77	4.3100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
19 38_Bypass	270.06	345.42	4.12	335.69	4.00	9.73	3.6000	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
20 4_Bypass	153.05	269.29	4.29	266.08	3.50	3.21	2.1000	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
21 40_bypass	261.30	359.60	4.25	346.40	4.50	13.20	5.0500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
22 41_Bypass	286.28	359.61	4.25	345.42	4.12	14.19	4.9600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
23 43_Bypass	214.88	370.25	4.33	359.61	4.25	10.64	4.9500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
24 45_Bypass	287.18	372.97	4.27	359.60	4.25	13.37	4.6600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
25 46_Bypass	69.33	373.15	4.46	370.25	4.33	2.90	4.1800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
26 49_Bypass	115.00	376.30	3.50	373.15	4.46	3.15	2.7400	Trapezoidal	0.320	16.000	0.0320	0.5000	0.5000	0.0000	0.00	No
27 5_Bypass	149.01	268.12	3.62	265.74	3.50	2.38	1.6000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
28 51-bypass	200.00	377.77	4.00	373.15	4.46	4.62	2.3100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
29 53_Bypass	266.58	379.35	4.70	372.97	4.27	6.38	2.3900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
30 54_Bypass	73.90	379.95	5.27	377.77	4.00	2.18	2.9500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
31 56-bypass	94.37	381.80	4.34	379.95	5.27	1.85	1.9600	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
32 58_Bypass	86.78	383.51	4.22	381.80	4.34	1.71	1.9700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
33 59_Bypass	188.00	383.54	4.00	379.35	4.70	4.19	2.2300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
34 61-bypass	153.24	386.90	4.33	383.51	4.22	3.39	2.2100	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
35 63_Bypass	295.23	389.71	3.51	383.54	4.00	6.17	2.0900	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
36 64-Bypass	140.44	389.96	3.81	386.90	4.33	3.06	2.1800	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
37 66-bypass	100.35	392.10	3.62	389.96	3.81	2.14	2.1300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
38 68_Bypass	193.86	394.22	3.52	389.71	3.51	4.51	2.3300	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
39 69_bypass	94.31	394.12	3.42	392.10	3.62	2.02	2.1400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
40 71-Bypass	190.28	396.60	4.05	394.12	3.42	2.48	1.3000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
41 73_Bypass	272.03	397.14	4.10	394.22	3.52	2.92	1.0700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
42 74-Bypass	83.69	397.05	3.95	396.60	4.05	0.45	0.5400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
43 76_Bypass	101.19	397.78	4.04	397.05	3.95	0.73	0.7200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
44 77_Bypass	98.85	397.80	4.50	397.14	4.10	0.66	0.6700	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
45 79_Bypass	265.71	398.87	3.89	397.80	4.50	1.07	0.4000	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
46 8_Bypass	175.38	272.08	6.17	269.29	4.29	2.79	1.5900	Trapezoidal	0.100	5.000	0.0130	0.5000	0.5000	0.0000	0.00	No
47 81_Bypass	207.03	398.90	2.90	397.78	4.04	1.12	0.5400	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
48 83_bypass	139.00	399.62	4.07	398.90	2.90	0.72	0.5200	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
49 9_Bypass	169.63	270.92	4.93	268.12	3.62	2.80	1.6500	Trapezoidal	0.320	16.000	0.0130	0.5000	0.5000	0.0000	0.00	No
50 EX32-bypass	156.00	257.18	2.18	255.47	0.00	1.71	1.1000	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
51 EX33-bypass	70.00	256.90	3.80	255.70	0.00	1.20	1.7100	Trapezoidal	0.300	15.000	0.0130	0.5000	0.5000	0.0000	0.00	No
52 Outfall-1	333.49	327.00	0.00	286.00	0.00	41.00	12.2900	Trapezoidal	3.000	13.000	0.0320	0.5000	0.5000	0.0000	0.00	No

**Channel Results**

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 102_Bypass	0.15	0 12:07	11.66	0.01	1.90	2.05	0.06	0.19	0.00		
2 103_bypass	0.64	0 12:08	5.46	0.12	1.42	2.80	0.14	0.44	0.00		
3 105_Bypass	0.07	0 12:07	10.34	0.01	1.37	1.76	0.05	0.16	0.00		
4 106_Bypass	0.80	0 12:07	11.48	0.07	2.36	1.01	0.12	0.37	0.00		
5 11_Bypass	0.79	0 12:09	4.29	0.18	1.27	4.08	0.17	0.52	0.00		
6 12_Bypass	0.19	0 12:09	0.35	0.54	1.38	3.70	0.08	0.78	0.00		
7 15_Bypass	0.34	0 12:08	13.32	0.03	2.26	2.21	0.08	0.25	0.00		
8 16_Bypass	0.39	0 12:08	0.57	0.68	2.31	2.18	0.09	0.86	0.00		
9 19_Bypass	0.29	0 12:07	20.13	0.01	2.87	1.47	0.07	0.20	0.00		
10 22_Bypass	0.45	0 12:08	0.90	0.50	3.44	2.40	0.08	0.77	0.00		
11 23_Bypass	0.11	0 12:08	20.53	0.01	2.36	1.61	0.04	0.14	0.00		
12 25_Bypass	0.59	0 12:07	19.51	0.03	3.27	1.05	0.09	0.27	0.00		
13 27-Bypass	0.58	0 12:07	18.20	0.03	3.07	1.06	0.09	0.27	0.00		
14 28_Bypass	0.13	0 12:09	0.86	0.15	2.33	2.93	0.05	0.48	0.00		
15 30_Bypass	0.61	0 12:07	13.08	0.05	2.46	1.35	0.10	0.32	0.00		
16 33_Bypass	0.31	0 12:08	0.55	0.56	1.99	2.99	0.08	0.80	0.00		
17 35_Bypass	0.61	0 12:07	12.03	0.05	2.33	1.41	0.10	0.33	0.00		
18 37_Bypass	0.33	0 12:07	17.75	0.02	2.71	1.54	0.07	0.22	0.00		
19 38_Bypass	0.73	0 12:03	0.73	1.00	3.01	1.50	0.10	1.00	45.00		
20 4_Bypass	0.21	0 12:07	0.55	0.38	1.77	1.44	0.07	0.70	0.00		
21 40_bypass	0.34	0 12:07	19.08	0.02	2.87	1.52	0.07	0.22	0.00		
22 41_Bypass	10.94	0 12:22	18.96	0.58	6.46	0.74	0.26	0.81	0.00		
23 43_Bypass	9.86	0 12:23	18.95	0.52	6.29	0.57	0.25	0.78	0.00		
24 45_Bypass	0.32	0 12:07	18.37	0.02	2.75	1.74	0.07	0.22	0.00		
25 46_Bypass	12.60	0 12:23	17.41	0.72	6.27	0.18	0.28	0.89	0.00		
26 49_Bypass	0.99	0 12:25	5.72	0.17	1.45	1.32	0.17	0.52	0.00		
27 5_Bypass	0.94	0 12:07	10.76	0.09	2.34	1.06	0.13	0.40	0.00		
28 51-bypass	9.23	0 12:23	12.94	0.71	4.65	0.72	0.28	0.88	0.00		
29 53_Bypass	0.27	0 12:08	13.17	0.02	2.12	2.10	0.07	0.23	0.00		
30 54_Bypass	8.27	0 12:23	14.62	0.57	4.95	0.25	0.26	0.81	0.00		
31 56-bypass	7.52	0 12:21	10.77	0.70	3.85	0.41	0.28	0.87	0.00		
32 58_Bypass	7.07	0 12:20	12.93	0.55	4.34	0.33	0.26	0.80	0.00		
33 59_Bypass	0.37	0 12:07	12.71	0.03	2.14	1.46	0.08	0.27	0.00		
34 61-bypass	5.69	0 12:19	12.13	0.47	3.92	0.65	0.24	0.75	0.00		
35 63_Bypass	0.26	0 12:08	12.31	0.02	2.03	2.42	0.07	0.23	0.00		
36 64-Bypass	4.86	0 12:17	13.13	0.37	4.00	0.59	0.22	0.69	0.00		
37 66-bypass	4.16	0 12:16	12.23	0.34	3.65	0.46	0.21	0.67	0.00		
38 68_Bypass	0.29	0 12:07	12.99	0.02	2.06	1.57	0.08	0.24	0.00		
39 69_bypass	2.54	0 12:14	12.64	0.20	3.31	0.47	0.18	0.55	0.00		
40 71-Bypass	1.78	0 12:11	9.84	0.18	2.51	1.26	0.17	0.53	0.00		
41 73_Bypass	0.19	0 12:08	8.82	0.02	1.50	3.02	0.07	0.23	0.00		
42 74-Bypass	2.19	0 12:09	6.58	0.33	1.96	0.71	0.21	0.66	0.00		
43 76_Bypass	1.83	0 12:08	6.77	0.27	1.92	0.88	0.20	0.61	0.00		
44 77_Bypass	0.32	0 12:07	6.96	0.05	1.29	1.28	0.10	0.32	0.00		
45 79_Bypass	0.34	0 12:08	5.40	0.06	1.23	3.60	0.11	0.35	0.00		
46 8_Bypass	0.48	0 12:02	0.48	1.00	2.00	1.46	0.10	1.00	8.00		
47 81_Bypass	0.48	0 12:08	6.23	0.08	1.42	2.43	0.12	0.38	0.00		
48 83_bypass	0.13	0 12:08	6.04	0.02	1.03	2.25	0.08	0.24	0.00		
49 9_Bypass	0.57	0 12:07	10.94	0.05	2.12	1.33	0.11	0.33	0.00		
50 EX32-bypass	0.83	0 12:07	7.51	0.11	1.97	1.32	0.13	0.44	0.00		
51 EX33-bypass	0.18	0 12:06	9.39	0.02	1.58	0.74	0.07	0.23	0.00		
52 Outfall-1	23.11	0 11:57	439.39	0.05	10.24	0.54	0.85	0.28	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	101-100	30.00	258.50	0.00	257.00	0.50	1.50	5.0000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	102-101	60.00	259.57	0.00	258.70	0.20	0.87	1.4500	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
3	103-101	30.00	259.63	0.00	258.70	0.20	0.93	3.1000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
4	104-101	190.00	262.08	0.00	258.70	0.20	3.38	1.7800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
5	105-104	29.00	262.58	0.00	262.18	0.10	0.40	1.3800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
6	106-104	6.00	262.24	0.00	262.18	0.10	0.06	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
7	7-Oct	303.00	267.50	0.00	262.10	0.10	5.40	1.7800	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
8	10-Nov	17.00	269.00	0.00	268.50	1.00	0.50	2.9400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
9	10-Dec	5.00	268.70	0.00	268.50	1.00	0.20	4.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
10	13-10	93.00	269.10	0.00	267.60	0.10	1.50	1.6100	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
11	14-13	195.00	274.00	0.00	269.20	0.10	4.80	2.4600	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
12	15-14	15.00	276.00	0.00	275.90	1.90	0.10	0.6700	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
13	16-14	7.00	275.00	0.00	274.60	0.60	0.40	5.7100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
14	17-14	133.00	282.30	0.00	274.50	0.50	7.80	5.8600	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
15	18-17	115.00	289.30	0.00	282.40	0.10	6.90	6.0000	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
16	19-18	7.00	289.75	0.00	289.30	0.00	0.45	6.4300	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
17	20-18	118.00	296.30	0.00	289.40	0.10	6.90	5.8500	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
18	1-Feb	27.00	253.60	0.00	253.20	3.20	0.40	1.4800	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
19	21-20	106.00	302.10	0.00	296.40	0.10	5.70	5.3800	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
20	22-21	19.00	304.00	0.00	302.10	0.00	1.90	10.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
21	23-21	4.00	303.50	0.00	303.35	1.25	0.15	3.7500	CIRCULAR	18.000	18.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
22	24-21	192.00	313.50	0.00	302.20	0.10	11.30	5.8900	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
23	25-24	17.00	314.00	0.00	313.50	0.00	0.50	2.9400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
24	26-24	206.00	322.80	0.00	313.60	0.10	9.20	4.4700	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
25	27-26	16.00	323.50	0.00	323.00	0.20	0.50	3.1300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
26	28-26	8.00	323.50	0.00	323.00	0.20	0.50	6.2500	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
27	29-26	188.00	326.75	0.00	322.90	0.10	3.85	2.0500	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
28	30-29	8.00	327.75	0.00	327.40	0.65	0.35	4.3800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
29	31-29	156.00	327.90	0.25	326.85	0.10	1.05	0.6700	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
30	31-Out	37.00	327.70	0.05	327.45	0.45	0.25	0.6800	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
31	2-Mar	260.00	259.30	0.00	253.70	0.10	5.60	2.1500	CIRCULAR	36.000	36.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
32	32-6	18.00	255.00	0.00	254.20	0.60	0.80	4.4400	CIRCULAR	6.000	6.000	0.0110	0.5000	0.5000	0.0000	0.00	No	2
33	33-31	10.00	331.69	0.00	330.89	3.24	0.80	8.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
34	33-out	40.00	253.10	0.00	250.00	0.00	3.10	7.7500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
35	34-31	34.00	330.72	0.40	329.70	2.05	1.02	3.0000	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
36	35-34	11.00	332.50	0.00	332.40	2.08	0.10	0.9100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
37	36-34	240.00	340.60	-0.40	330.82	0.50	9.78	4.0800	CIRCULAR	30.000	30.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
38	37-36	18.00	341.90	0.00	341.10	0.10	0.80	4.4400	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
39	38-36	16.00	341.30	0.00	341.10	0.10	0.20	1.2500	CIRCULAR	18.000	18.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
40	39-36	266.00	354.40	0.00	341.10	0.10	13.30	5.0000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
41	40-39	17.00	355.35	0.00	355.00	0.60	0.35	2.0600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
42	41-39	6.00	355.36	0.00	355.00	0.60	0.36	6.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
43	42-39	217.00	365.50	0.00	354.50	0.10	11.00	5.0700	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
44	3-Apr	19.00	265.00	0.00	263.50	4.20	1.50	7.8900	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
45	43-42	5.00	365.92	0.00	365.80	0.30	0.12	2.4000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
46	44-42	66.00	367.50	0.00	365.60	0.10	1.90	2.8800	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
47	45-44	18.00	368.70	0.00	368.50	1.00	0.20	1.1100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
48	46-44	7.00	368.69	0.00	368.50	1.00	0.19	2.7100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
49	47-44	119.00	370.40	0.00	367.60	0.10	2.80	2.3500	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
50	49-47	14.00	372.80	0.00	372.60	2.20	0.20	1.4300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
51	50-47	74.00	372.62	0.12	370.90	0.50	1.72	2.3200	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
52	51-50	8.00	373.77	0.00	373.50	1.00	0.27	3.3700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
53	52-50	67.00	374.40	0.00	372.72	0.22	1.68	2.5100	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
54	3-May	38.00	264.50	0.00	263.50	4.20	1.00	2.6300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
55	53-52	15.00	374.65	0.00	374.40	0.00	0.25	1.6700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
56	54-52	11.00	374.68	0.00	374.40	0.00	0.28	2.5500	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
57	55-52	95.00	376.70	0.00	374.50	0.10	2.20	2.3200	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
58	56-55	6.00	377.46	0.00	377.40	0.70	0.06	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
59	57-55	95.00	379.05	0.00	376.77	0.07	2.28	2.4000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
60	58-57	6.00	379.29	0.00	379.17	0.12	0.12	2.0000	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
61	59-57	18.00	379.54	0.00	379.17	0.12	0.37	2.0600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
62	60-57	140.00	382.35	0.00	379.15	0.10	3.20	2.2900	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
63	61-60	6.00	382.57	0.00	382.50	0.15	0.07	1.1700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
64	62-60	150.00	386.00	0.00	382.40	0.05	3.60	2.4000	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
65	3-Jun	38.00	260.10	0.00	259.40	0.10	0.70	1.8400	CIRCULAR	36.000	36.0							



Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
76 71-70	8.00	392.55	0.00	392.34	1.14	0.21	2.6300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
77 72-70	78.00	391.90	0.20	391.30	0.10	0.60	0.7700	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
78 73-72	18.00	393.04	0.00	392.68	0.98	0.36	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
79 74-72	7.00	393.10	0.00	392.90	1.20	0.20	2.8600	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
80 75-72	99.00	392.70	0.00	392.00	0.30	0.70	0.7100	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
81 76-75	6.00	393.74	0.00	393.70	1.00	0.04	0.6700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
82 77-75	17.00	393.30	0.00	393.13	0.43	0.17	1.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
83 78-75	201.00	393.90	0.00	392.80	0.10	1.10	0.5500	CIRCULAR	24.000	24.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
84 79-78	4.00	394.98	0.00	394.90	1.00	0.08	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
85 80-78	25.00	394.90	0.00	394.40	0.50	0.50	2.0000	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
86 81-80	3.00	396.00	0.00	395.90	1.00	0.10	3.3300	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
87 82-78	107.00	395.15	0.00	394.40	0.50	0.75	0.7000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
88 83-82	50.00	395.55	0.00	395.25	0.10	0.30	0.6000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
89 84-82	42.00	395.80	0.00	395.25	0.10	0.55	1.3100	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
90 7-Aug	26.00	265.91	0.00	265.50	3.50	0.41	1.5800	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
91 7-Sep	6.00	265.99	0.00	265.50	3.50	0.49	8.1700	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
92 Culvert2	25.00	270.70	0.00	269.63	0.53	1.07	4.2800	CIRCULAR	24.000	24.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
93 EX1-6	153.00	256.50	0.00	255.10	1.50	1.40	0.9200	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
94 EX3-4	62.00	268.60	-0.10	268.20	0.10	0.40	0.6500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
95 EX4-5	22.00	268.10	0.00	266.00	0.10	2.10	9.5500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
96 EX5-6	28.00	265.90	0.00	265.13	5.03	0.77	2.7500	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
97 EX9-3	20.00	268.90	0.00	268.70	0.00	0.20	1.0000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
98 FSP1-Out	20.00	273.00	0.00	272.60	1.90	0.40	2.0000	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
99 FSP2-Out	178.00	272.00	0.00	269.00	0.10	3.00	1.6900	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
100 Out2_1	297.73	249.00	0.00	249.00	0.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
101 Out2_2	345.60	250.00	0.00	250.00	1.00	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
102 Pond_Outfall	50.00	249.50	0.00	249.00	0.00	0.50	1.0000	CIRCULAR	30.000	30.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
103 SD-16	250.00	290.00	0.00	275.10	0.10	14.90	5.9600	CIRCULAR	9.960	9.960	0.0110	0.5000	0.5000	0.0000	0.00	No	1
104 SD-19	224.00	302.75	0.00	290.00	0.25	12.75	5.6900	CIRCULAR	9.960	9.960	0.0110	0.5000	0.5000	0.0000	0.00	No	1
105 SD-23	411.00	323.75	0.00	302.75	-0.75	21.00	5.1100	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
106 SD-28	357.00	331.94	0.00	323.75	0.25	8.19	2.2900	CIRCULAR	15.000	15.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
107 SD-33	268.00	341.55	0.00	331.94	0.25	9.61	3.5900	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1
108 SD-38	284.00	355.60	0.00	341.55	0.25	14.05	4.9500	CIRCULAR	12.000	12.000	0.0110	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1 101-100	2.88	0 12:06	6.90	0.42	8.39	0.06	0.45	0.45	0.00		Calculated
2 102-101	0.46	0 12:06	5.07	0.09	4.03	0.25	0.20	0.20	0.00		Calculated
3 103-101	0.99	0 12:06	7.41	0.13	6.57	0.08	0.25	0.25	0.00		Calculated
4 104-101	1.43	0 12:06	5.62	0.25	5.98	0.53	0.34	0.34	0.00		Calculated
5 105-104	0.30	0 12:06	4.95	0.06	3.48	0.14	0.17	0.17	0.00		Calculated
6 106-104	1.12	0 12:06	4.21	0.27	4.54	0.02	0.35	0.35	0.00		Calculated
7 7-Oct	94.07	0 12:02	105.23	0.89	17.25	0.29	2.19	0.73	0.00		Calculated
8 10-Nov	0.98	0 12:06	7.22	0.14	6.42	0.04	0.25	0.25	0.00		Calculated
9 10-Dec	0.45	0 12:06	8.42	0.05	5.69	0.01	0.16	0.16	0.00		Calculated
10 13-10	91.91	0 12:02	100.11	0.92	16.41	0.09	2.25	0.75	0.00		Calculated
11 14-13	82.29	0 12:02	76.05	1.08	18.21	0.18	2.50	1.00	17.00		SURCHARGED
12 15-14	0.92	0 12:06	6.23	0.15	3.64	0.07	0.32	0.26	0.00		Calculated
13 16-14	7.80	0 12:04	10.07	0.78	14.16	0.01	0.66	0.66	0.00		Calculated
14 17-14	82.21	0 12:04	117.39	0.70	25.91	0.09	1.54	0.62	0.00		Calculated
15 18-17	82.20	0 12:04	118.74	0.69	26.14	0.07	1.53	0.61	0.00		Calculated
16 19-18	7.49	0 12:01	19.36	0.39	14.76	0.01	0.54	0.43	0.00		Calculated
17 20-18	75.19	0 12:04	117.22	0.64	25.39	0.08	1.46	0.58	0.00		Calculated
18 1-Feb	102.89	0 12:03	95.94	1.07	15.76	0.03	3.00	1.00	1.00		SURCHARGED
19 21-20	75.19	0 12:04	112.41	0.67	24.57	0.07	1.50	0.60	0.00		Calculated
20 22-21	1.05	0 12:06	13.32	0.08	10.12	0.03	0.19	0.19	0.00		Calculated
21 23-21	18.84	0 12:04	24.04	0.78	15.06	0.00	1.00	0.67	0.00		Calculated
22 24-21	55.89	0 12:05	117.60	0.48	23.72	0.13	1.21	0.49	0.00		Calculated
23 25-24	1.20	0 12:06	7.22	0.17	6.80	0.04	0.28	0.28	0.00		Calculated
24 26-24	54.68	0 12:05	102.44	0.53	21.30	0.16	1.30	0.52	0.00		Calculated
25 27-26	0.97	0 12:06	7.44	0.13	6.55	0.04	0.24	0.24	0.00		Calculated
26 28-26	12.95	0 12:04	19.09	0.68	16.70	0.01	0.76	0.60	0.00		Calculated
27 29-26	41.97	0 12:41	69.37	0.61	15.17	0.21	1.40	0.56	0.00		Calculated
28 30-29	0.99	0 12:06	8.81	0.11	7.41	0.02	0.23	0.23	0.00		Calculated
29 31-29	42.86	0 12:41	39.77	1.08	9.82	0.26	2.30	0.92	0.00		> CAPACITY
30 31-Out	23.27	0 12:48	21.98	1.06	8.16	0.08	1.87	0.94	0.00		> CAPACITY
31 2-Mar	106.18	0 12:03	115.68	0.92	18.77	0.23	2.26	0.75	0.00		Calculated
32 32-6	1.14	0 12:06	2.80	0.41	6.76	0.04	0.22	0.44	0.00		Calculated
33 33-31	9.23	0 12:20	11.91	0.78	16.75	0.01	0.66	0.66	0.00		Calculated
34 33-out	1.00	0 12:06	9.92	0.10	8.09	0.08	0.21	0.21	0.00		Calculated
35 34-31	73.40	0 12:24	83.96	0.87	19.27	0.03	1.81	0.72	0.00		Calculated
36 35-34	0.99	0 12:06	4.01	0.25	4.23	0.04	0.34	0.34	0.00		Calculated
37 36-34	73.05	0 12:24	99.84	0.73	22.24	0.18	1.59	0.64	0.00		Calculated
38 37-36	0.87	0 12:06	8.88	0.10	7.19	0.04	0.21	0.21	0.00		Calculated
39 38-36	14.47	0 12:24	13.88	1.04	9.12	0.03	1.37	0.91	0.00		> CAPACITY
40 39-36	58.89	0 12:22	59.78	0.99	21.92	0.20	1.61	0.81	0.00		Calculated
41 40-39	0.88	0 12:06	6.04	0.15	5.49	0.05	0.26	0.26	0.00		Calculated
42 41-39	6.69	0 12:22	10.31	0.65	13.96	0.01	0.59	0.59	0.00		Calculated
43 42-39	51.89	0 12:22	60.19	0.86	22.03	0.16	1.43	0.72	0.00		Calculated
44 3-Apr	0.56	0 12:05	11.83	0.05	7.74	0.04	0.15	0.15	0.00		Calculated
45 43-42	4.33	0 12:23	6.52	0.66	8.88	0.01	0.60	0.60	0.00		Calculated
46 44-42	48.01	0 12:38	45.36	1.06	17.07	0.06	1.87	0.94	0.00		> CAPACITY
47 45-44	0.86	0 12:06	4.44	0.19	4.37	0.07	0.30	0.30	0.00		Calculated
48 46-44	4.70	0 12:23	6.94	0.68	9.49	0.01	0.60	0.60	0.00		Calculated
49 47-44	44.38	0 12:34	41.01	1.08	15.39	0.13	1.94	0.97	0.00		> CAPACITY
50 49-47	5.26	0 12:24	5.03	1.05	7.44	0.03	0.93	0.93	0.00		> CAPACITY
51 50-47	44.10	0 12:03	40.76	1.08	15.14	0.08	2.00	1.00	31.00		SURCHARGED
52 51-50	6.08	0 12:23	7.74	0.79	10.91	0.01	0.67	0.67	0.00		Calculated
53 52-50	45.81	0 12:10	42.34	1.08	15.92	0.07	2.00	1.00	18.00		SURCHARGED
54 3-May	1.22	0 12:06	6.83	0.18	6.57	0.10	0.29	0.29	0.00		Calculated
55 53-52	0.67	0 12:06	5.44	0.12	4.71	0.05	0.24	0.24	0.00		Calculated
56 54-52	5.73	0 12:23	12.18	0.47	9.77	0.02	0.60	0.48	0.00		Calculated
57 55-52	43.96	0 12:20	40.69	1.08	15.15	0.10	2.00	1.00	5.00		SURCHARGED
58 56-55	4.54	0 12:35	4.21	1.08	6.20	0.02	1.00	1.00	25.00		SURCHARGED
59 57-55	44.12	0 12:21	41.42	1.07	15.41	0.10	1.83	0.91	0.00		> CAPACITY
60 58-57	5.27	0 12:19	10.80	0.49	8.74	0.01	0.62	0.49	0.00		Calculated
61 59-57	0.78	0 12:06	6.04	0.13	5.31	0.06	0.24	0.24	0.00		Calculated
62 60-57	36.58	0 12:21	40.42	0.90	14.62	0.16	1.49	0.75	0.00		Calculated
63 61-60	4.68	0 12:23	4.55	1.03	6.69	0.01	0.92	0.92	0.00		> CAPACITY
64 62-60	32.07	0 12:21	41.42	0.77	14.61	0.17	1.32	0.66	0.00		Calculated
65 3-Jun	104.76	0 12:02	106.99	0.98	17.29	0.04	2.41	0.80	0.00		Calculated
66 63-62	0.65	0 12:06	3.23	0.20	3.22	0.09	0.30	0.30	0.00		Calculated
67 64-62	4.32	0 12:16	11.33	0.38	5.98	0.02	0.64	0.43	0.00		Calculated
68 65-62	27.85	0 12:21	39.21	0.71	13.64	0.11	1.24	0.62	0.00		Calculated
69 66-65	3.99	0 12:15	4.21	0.95	6.09	0.03	0.78	0.78	0.00		Calculated
70 7-Jun	95.42	0 12:02	103.21	0.92	16.70	0.10	2.28	0.76	0.00		Calculated
71 67-65	24.36	0 12:04	38.81	0.63	13.26	0.12	1.15	0.57	0.00		Calculated
72 68-67	0.70	0 12:06	3.23	0.22	3.29	0.09	0.32	0.32	0.00		Calculated
73 69-67	3.10	0 12:14	4.01	0.77	5.64	0.03	0.66	0.66	0.00		Calculated
74 6-out	4.02	0 12:07	5.26	0.76	7.39	0.37	0.65	0.65	0.00		Calculated

**Pipe Results**

SN Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
75 70-67	21.27	0 12:04	19.66	1.08	7.39	0.42	2.00	1.00	16.00		SURCHARGED
76 71-70	2.66	0 12:11	6.82	0.39	8.14	0.02	0.43	0.43	0.00		Calculated
77 72-70	22.32	0 12:06	23.45	0.95	8.52	0.15	1.56	0.78	0.00		Calculated
78 73-72	0.46	0 12:06	5.95	0.08	4.50	0.07	0.19	0.19	0.00		Calculated
79 74-72	2.97	0 12:08	7.12	0.42	8.65	0.01	0.45	0.45	0.00		Calculated
80 75-72	19.05	0 12:06	22.48	0.85	8.07	0.20	1.41	0.71	0.00		Calculated
81 76-75	2.70	0 12:07	3.44	0.79	4.85	0.02	0.67	0.67	0.00		Calculated
82 77-75	0.62	0 12:06	4.21	0.15	3.83	0.07	0.26	0.26	0.00		Calculated
83 78-75	15.99	0 12:06	19.78	0.81	7.20	0.47	1.34	0.67	0.00		Calculated
84 79-78	0.62	0 12:05	5.95	0.10	4.90	0.01	0.22	0.22	0.00		Calculated
85 80-78	11.56	0 12:06	10.80	1.07	10.24	0.04	1.25	1.00	9.00		SURCHARGED
86 81-80	1.37	0 12:06	7.69	0.18	7.38	0.01	0.29	0.29	0.00		Calculated
87 82-78	3.81	0 12:03	3.53	1.08	5.31	0.34	1.00	1.00	17.00		SURCHARGED
88 83-82	0.50	0 12:06	3.26	0.15	3.00	0.28	0.26	0.26	0.00		Calculated
89 84-82	4.78	0 12:10	4.82	0.99	7.00	0.10	0.81	0.81	0.00		Calculated
90 7-Aug	0.99	0 12:07	5.29	0.19	5.16	0.08	0.29	0.29	0.00		Calculated
91 7-Sep	0.94	0 12:06	12.03	0.08	9.13	0.01	0.19	0.19	0.00		Calculated
92 Culvert2	11.19	0 12:08	46.80	0.24	12.22	0.03	0.67	0.33	0.00		Calculated
93 EX1-6	2.88	0 12:07	3.41	0.84	4.90	0.52	0.71	0.71	0.00		Calculated
94 EX3-4	10.21	0 12:01	9.43	1.08	6.27	0.16	1.50	1.00	18.00		SURCHARGED
95 EX4-5	10.20	0 12:01	32.45	0.31	16.25	0.02	0.58	0.39	0.00		Calculated
96 EX5-6	10.20	0 12:01	17.42	0.59	10.32	0.05	0.83	0.55	0.00		Calculated
97 EX9-3	11.28	0 12:02	10.50	1.07	6.92	0.05	1.50	1.00	15.00		SURCHARGED
98 FSP1-Out	6.35	0 12:14	5.95	1.07	9.12	0.04	1.00	1.00	21.00		SURCHARGED
99 FSP2-Out	12.03	0 12:10	13.64	0.88	8.71	0.34	1.09	0.73	0.00		Calculated
100 Out2_1	71.79	0 12:21	0.00	0.88	0.00		1.09	0.73	0.00		Calculated
101 Out2_2	5.01	0 12:06	0.00	0.88	0.00		1.09	0.73	0.00		Calculated
102 Pond_Outfall	44.38	0 12:12	41.02	1.08	9.75	0.09	2.50	1.00	41.00		SURCHARGED
103 SD-16	6.84	0 12:04	6.32	1.08	13.74	0.30	0.83	1.00	6.00		SURCHARGED
104 SD-19	6.68	0 12:01	6.18	1.08	13.40	0.28	0.83	1.00	11.00		SURCHARGED
105 SD-23	18.33	0 12:04	16.95	1.08	16.39	0.42	1.25	1.00	10.00		SURCHARGED
106 SD-28	12.51	0 12:04	11.56	1.08	11.17	0.53	1.25	1.00	17.00		SURCHARGED
107 SD-33	8.63	0 11:59	7.97	1.08	11.99	0.37	1.00	1.00	20.00		SURCHARGED
108 SD-38	10.13	0 12:04	9.37	1.08	14.08	0.34	1.00	1.00	19.00		SURCHARGED

**Inlet Input**

SN ID	Element Manufacturer	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft <sup>2</sup> )	Grate Clogging Factor (%)
1	CBEX-32	FHWA HEC-22 GENERIC	N/A	On Grade	1	255.00	257.18	2.18	0.00	0.00	N/A	0.00
2	CBEX-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	253.10	256.90	3.80	0.00	0.00	N/A	0.00
3	STR-102	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.57	263.07	3.50	0.00	0.00	N/A	0.00
4	STR-103	FHWA HEC-22 GENERIC	N/A	On Grade	1	259.63	263.13	3.50	0.00	0.00	N/A	0.00
5	STR-105	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.58	266.08	3.50	0.00	0.00	N/A	0.00
6	STR-106	FHWA HEC-22 GENERIC	N/A	On Grade	1	262.24	265.74	3.50	0.00	0.00	N/A	0.00
7	STR-11	FHWA HEC-22 GENERIC	N/A	On Grade	1	269.00	272.87	3.87	0.00	0.00	N/A	0.00
8	STR-12	FHWA HEC-22 GENERIC	N/A	On Grade	1	268.70	273.43	4.73	0.00	0.00	N/A	0.00
9	STR-15	FHWA HEC-22 GENERIC	N/A	On Grade	1	276.00	280.19	4.19	0.00	0.00	N/A	0.00
10	STR-16	FHWA HEC-22 GENERIC	N/A	On Grade	1	275.00	280.17	5.17	0.00	0.00	N/A	0.00
11	STR-19	FHWA HEC-22 GENERIC	N/A	On Grade	1	289.75	294.30	4.55	0.00	0.00	N/A	0.00
12	STR-22	FHWA HEC-22 GENERIC	N/A	On Grade	1	304.00	307.33	3.33	0.00	0.00	N/A	0.00
13	STR-23	FHWA HEC-22 GENERIC	N/A	On Grade	1	303.50	307.59	4.09	0.00	0.00	N/A	0.00
14	STR-25	FHWA HEC-22 GENERIC	N/A	On Grade	1	314.00	318.10	4.10	0.00	0.00	N/A	0.00
15	STR-27	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	327.01	3.51	0.00	0.00	N/A	0.00
16	STR-28	FHWA HEC-22 GENERIC	N/A	On Grade	1	323.50	328.31	4.81	0.00	0.00	N/A	0.00
17	STR-30	FHWA HEC-22 GENERIC	N/A	On Grade	1	327.75	331.70	3.95	0.00	0.00	N/A	0.00
18	STR-33	FHWA HEC-22 GENERIC	N/A	On Grade	1	331.69	335.69	4.00	0.00	0.00	N/A	0.00
19	STR-35	FHWA HEC-22 GENERIC	N/A	On Grade	1	332.50	335.63	3.13	0.00	0.00	N/A	0.00
20	STR-37	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.90	346.48	4.58	0.00	0.00	N/A	0.00
21	STR-38	FHWA HEC-22 GENERIC	N/A	On Grade	1	341.30	345.42	4.12	0.00	0.00	N/A	0.00
22	STR-4	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.00	269.29	4.29	0.00	0.00	N/A	0.00
23	STR-40	FHWA HEC-22 GENERIC	N/A	On Grade	1	355.35	359.60	4.25	0.00	0.00	N/A	0.00
24	STR-41	FHWA HEC-22 GENERIC	N/A	On Grade	2	355.36	359.61	4.25	0.00	0.00	N/A	0.00
25	STR-43	FHWA HEC-22 GENERIC	N/A	On Grade	1	365.92	370.25	4.33	0.00	0.00	N/A	0.00
26	STR-45	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.70	372.97	4.27	0.00	0.00	N/A	0.00
27	STR-46	FHWA HEC-22 GENERIC	N/A	On Grade	1	368.69	373.15	4.46	0.00	0.00	N/A	0.00
28	STR-49	FHWA HEC-22 GENERIC	N/A	N/A	1	372.80	376.30	3.50	0.00	0.00	N/A	0.00
29	STR-5	FHWA HEC-22 GENERIC	N/A	On Grade	1	264.50	268.12	3.62	0.00	0.00	N/A	0.00
30	STR-51	FHWA HEC-22 GENERIC	N/A	On Grade	2	373.77	377.77	4.00	0.00	0.00	N/A	0.00
31	STR-53	FHWA HEC-22 GENERIC	N/A	On Grade	1	374.65	379.35	4.70	0.00	0.00	N/A	0.00
32	STR-54	FHWA HEC-22 GENERIC	N/A	On Grade	2	374.68	379.95	5.27	0.00	0.00	N/A	0.00
33	STR-56	FHWA HEC-22 GENERIC	N/A	On Grade	2	377.46	381.46	4.00	0.00	0.00	N/A	0.00
34	STR-58	FHWA HEC-22 GENERIC	N/A	On Grade	2	379.29	383.46	4.17	0.00	0.00	N/A	0.00
35	STR-59	FHWA HEC-22 GENERIC	N/A	On Grade	1	379.54	383.54	4.00	0.00	0.00	N/A	0.00
36	STR-61	FHWA HEC-22 GENERIC	N/A	On Grade	2	382.57	386.57	4.00	0.00	0.00	N/A	0.00
37	STR-63	FHWA HEC-22 GENERIC	N/A	On Grade	1	386.20	389.71	3.51	0.00	0.00	N/A	0.00
38	STR-64	FHWA HEC-22 GENERIC	N/A	On Grade	2	386.15	389.91	3.76	0.00	0.00	N/A	0.00
39	STR-66	FHWA HEC-22 GENERIC	N/A	On Grade	2	388.48	391.98	3.50	0.00	0.00	N/A	0.00
40	STR-68	FHWA HEC-22 GENERIC	N/A	On Grade	1	390.70	394.22	3.52	0.00	0.00	N/A	0.00
41	STR-69	FHWA HEC-22 GENERIC	N/A	On Grade	2	390.70	394.06	3.36	0.00	0.00	N/A	0.00
42	STR-71	FHWA HEC-22 GENERIC	N/A	On Grade	2	392.55	396.60	4.05	0.00	0.00	N/A	0.00
43	STR-73	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.04	397.14	4.10	0.00	0.00	N/A	0.00
44	STR-74	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.10	397.10	4.00	0.00	0.00	N/A	0.00
45	STR-76	FHWA HEC-22 GENERIC	N/A	On Grade	2	393.74	397.74	4.00	0.00	0.00	N/A	0.00
46	STR-77	FHWA HEC-22 GENERIC	N/A	On Grade	1	393.30	397.80	4.50	0.00	0.00	N/A	0.00
47	STR-79	FHWA HEC-22 GENERIC	N/A	On Grade	1	394.98	398.87	3.89	0.00	0.00	N/A	0.00
48	STR-8	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.91	272.08	6.17	0.00	0.00	N/A	0.00
49	STR-81	FHWA HEC-22 GENERIC	N/A	On Grade	2	396.00	398.85	2.85	0.00	0.00	N/A	0.00
50	STR-83	FHWA HEC-22 GENERIC	N/A	On Grade	1	395.55	399.55	4.00	0.00	0.00	N/A	0.00
51	STR-84	FHWA HEC-22 GENERIC	N/A	On Sag	2	395.80	399.80	4.00	0.00	0.00	0.00	0.00
52	STR-9	FHWA HEC-22 GENERIC	N/A	On Grade	1	265.99	270.92	4.93	0.00	0.00	N/A	0.00

**Roadway & Gutter Input**

SN Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1 CBEX-32	0.0170	0.0200	0.0130	0.0200	3.00	0.0328	10.50
2 CBEX-33	0.0170	0.0200	0.0130	0.0620	2.00	0.0000	10.50
3 STR-102	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
4 STR-103	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
5 STR-105	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
6 STR-106	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
7 STR-11	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
8 STR-12	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
9 STR-15	0.0590	0.0200	0.0130	0.0200	5.00	0.0000	10.50
10 STR-16	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
11 STR-19	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
12 STR-22	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
13 STR-23	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
14 STR-25	0.0550	0.0200	0.0130	0.0200	5.00	0.0000	10.50
15 STR-27	0.0200	0.0200	0.0130	0.0200	5.00	0.0000	10.50
16 STR-28	0.0200	0.0200	0.0130	0.0200	5.00	0.0000	10.50
17 STR-30	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
18 STR-33	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
19 STR-35	0.0190	0.0200	0.0130	0.0200	5.00	0.0000	10.50
20 STR-37	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
21 STR-38	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
22 STR-4	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
23 STR-40	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
24 STR-41	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
25 STR-43	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
26 STR-45	0.0500	0.0200	0.0130	0.0200	5.00	0.0000	10.50
27 STR-46	0.0500	0.0200	0.0130	0.0300	5.00	0.0000	10.50
28 STR-5	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
29 STR-51	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
30 STR-53	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
31 STR-54	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
32 STR-56	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
33 STR-58	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
34 STR-59	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
35 STR-61	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
36 STR-63	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
37 STR-64	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
38 STR-66	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
39 STR-68	0.0220	0.0200	0.0130	0.0200	5.00	0.0000	10.50
40 STR-69	0.0220	0.0200	0.0130	0.0300	5.00	0.0000	10.50
41 STR-71	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
42 STR-73	0.0065	0.0200	0.0130	0.0200	5.00	0.0000	10.50
43 STR-74	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
44 STR-76	0.0065	0.0200	0.0130	0.0300	5.00	0.0000	10.50
45 STR-77	0.0065	0.0200	0.0130	0.0200	5.00	0.0000	10.50
46 STR-79	0.0050	0.0200	0.0130	0.0200	5.00	0.0000	10.50
47 STR-8	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50
48 STR-81	0.0050	0.0200	0.0130	0.0300	5.00	0.0000	10.50
49 STR-83	0.0050	0.0200	0.0130	0.0300	5.00	0.0000	10.50
50 STR-84	N/A	0.0200	0.0130	0.0620	2.00	0.0000	10.50
51 STR-9	0.0170	0.0200	0.0130	0.0200	5.00	0.0000	10.50

### Median & Ditch Input

SN Element ID	Median Ditch Longitudinal Slope (ft/ft)	Median Ditch Bottom Width (ft)	Median Ditch Left Side Slope	Median Ditch Right Side Slope	Median Ditch Manning's Roughness
1 STR-49	0.0250	2.0000	1:01	1:01	0.0160

**Inlet Results**

SN Element ID	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)	Time of Max Depth Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1 CBEX-32	1.97	1.36	1.14	0.82	58.09	7.77	257.34	0.16	0 12:06	0.00	0.00
2 CBEX-33	1.17	1.03	1.00	0.17	85.44	5.21	257.09	0.19	0 12:06	0.00	0.00
3 STR-102	0.61	0.54	0.47	0.14	77.30	5.02	263.17	0.10	0 12:06	0.00	0.00
4 STR-103	1.62	0.82	0.99	0.63	61.16	7.24	263.27	0.14	0 12:06	0.00	0.00
5 STR-105	0.38	0.17	0.32	0.06	84.68	4.21	266.16	0.08	0 12:06	0.00	0.00
6 STR-106	1.93	0.99	1.13	0.80	58.38	7.73	265.89	0.15	0 12:06	0.00	0.00
7 STR-11	1.77	1.44	0.98	0.78	55.57	9.42	273.06	0.19	0 12:06	0.00	0.00
8 STR-12	0.63	0.25	0.45	0.18	71.67	6.43	273.56	0.13	0 12:06	0.00	0.00
9 STR-15	1.26	0.82	0.92	0.33	73.44	5.24	280.29	0.10	0 12:06	0.00	0.00
10 STR-16	1.36	1.07	0.98	0.38	71.81	5.44	280.28	0.11	0 12:05	0.00	0.00
11 STR-19	1.13	1.03	0.85	0.29	74.80	5.09	294.40	0.10	0 12:01	0.00	0.00
12 STR-22	1.50	0.91	1.05	0.45	69.98	5.66	307.44	0.11	0 12:06	0.00	0.00
13 STR-23	0.64	0.54	0.54	0.10	84.05	4.11	307.67	0.08	0 12:04	0.00	0.00
14 STR-25	1.79	1.22	1.20	0.59	67.02	6.05	318.22	0.12	0 12:06	0.00	0.00
15 STR-27	1.55	0.95	0.97	0.58	62.82	6.90	327.15	0.14	0 12:06	0.00	0.00
16 STR-28	0.59	0.29	0.46	0.12	78.91	4.79	328.41	0.10	0 12:05	0.00	0.00
17 STR-30	1.60	0.99	0.99	0.61	61.91	7.08	331.84	0.14	0 12:06	0.00	0.00
18 STR-33	1.02	0.29	0.71	0.31	69.46	5.96	335.81	0.12	0 12:00	0.00	0.00
19 STR-35	1.60	1.28	0.99	0.61	61.88	7.08	335.77	0.14	0 12:06	0.00	0.00
20 STR-37	1.20	0.87	0.88	0.32	73.29	5.27	346.59	0.11	0 12:06	0.00	0.00
21 STR-38	11.21	0.82	3.91	7.31	34.85	11.40	345.70	0.28	0 12:24	0.00	0.00
22 STR-4	0.77	0.29	0.57	0.21	73.33	5.50	269.40	0.11	0 12:05	0.00	0.00
23 STR-40	1.22	0.91	0.89	0.33	72.83	5.33	359.71	0.11	0 12:06	0.00	0.00
24 STR-41	17.64	7.90	6.66	10.97	37.77	13.74	359.93	0.32	0 12:22	0.00	0.00
25 STR-43	14.20	1.65	4.35	9.85	30.64	12.65	370.55	0.30	0 12:23	0.00	0.00
26 STR-45	1.17	0.91	0.86	0.31	73.50	5.25	373.07	0.10	0 12:06	0.00	0.00
27 STR-46	17.30	7.14	4.70	12.61	27.13	13.66	373.47	0.32	0 12:23	0.00	0.00
28 STR-49	6.41	6.41	5.42	0.99	85.00	2.80	376.70	0.40	0 12:17	0.07	16.00
29 STR-5	2.16	1.60	1.22	0.94	56.48	8.09	268.28	0.16	0 12:06	0.00	0.00
30 STR-51	15.31	7.05	6.08	9.23	39.73	15.40	378.13	0.36	0 12:23	0.00	0.00
31 STR-53	0.94	0.58	0.67	0.27	71.45	5.66	379.46	0.11	0 12:06	0.00	0.00
32 STR-54	14.00	6.51	5.73	8.27	40.94	14.85	380.30	0.35	0 12:23	0.00	0.00
33 STR-56	12.97	6.16	5.45	7.52	42.01	14.37	381.80	0.34	0 12:07	0.39	31.00
34 STR-58	12.34	6.98	5.27	7.07	42.70	14.10	383.79	0.33	0 12:19	0.00	0.00
35 STR-59	1.15	0.91	0.79	0.37	68.27	6.07	383.66	0.12	0 12:06	0.00	0.00
36 STR-61	10.39	5.77	4.70	5.70	45.18	13.15	386.88	0.31	0 12:15	0.01	8.00
37 STR-63	0.91	0.62	0.65	0.25	72.11	5.58	389.82	0.11	0 12:06	0.00	0.00
38 STR-64	9.18	5.03	4.32	4.86	47.09	12.42	390.21	0.30	0 12:16	0.00	0.00
39 STR-66	8.15	5.65	3.99	4.17	48.90	11.89	392.27	0.29	0 12:15	0.00	0.00
40 STR-68	1.00	0.82	0.70	0.29	70.59	5.77	394.34	0.12	0 12:06	0.00	0.00
41 STR-69	5.64	3.91	3.10	2.54	54.98	10.16	394.31	0.25	0 12:14	0.00	0.00
42 STR-71	4.44	2.51	2.66	1.78	59.94	11.89	396.89	0.29	0 12:11	0.00	0.00
43 STR-73	0.65	0.33	0.47	0.18	71.96	6.16	397.26	0.12	0 12:06	0.00	0.00
44 STR-74	5.16	3.34	2.97	2.18	57.66	12.68	397.40	0.30	0 12:08	0.00	0.00
45 STR-76	4.54	4.06	2.70	1.84	59.54	11.96	398.03	0.29	0 12:07	0.00	0.00
46 STR-77	0.94	0.62	0.62	0.32	65.96	7.09	397.94	0.14	0 12:06	0.00	0.00
47 STR-79	0.95	0.95	0.62	0.33	65.27	7.46	399.02	0.15	0 12:05	0.00	0.00
48 STR-8	1.63	0.91	0.99	0.64	60.90	7.30	272.23	0.15	0 12:07	0.00	0.00
49 STR-81	1.84	1.71	1.37	0.47	74.48	8.55	399.07	0.22	0 12:06	0.00	0.00
50 STR-83	0.63	0.63	0.50	0.13	79.93	4.95	399.70	0.15	0 12:06	0.00	0.00
51 STR-84	4.78	4.78	N/A	N/A	N/A	15.95	400.14	0.34	0 12:10	0.00	0.00
52 STR-9	1.52	1.36	0.94	0.57	62.15	7.09	271.06	0.14	0 12:06	0.00	0.00

## Storage Nodes

### Storage Node : FSP-1

#### Input Data

Invert Elevation (ft) .....	272
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	4
Initial Water Elevation (ft) .....	272
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	7794
Evaporation Loss .....	0

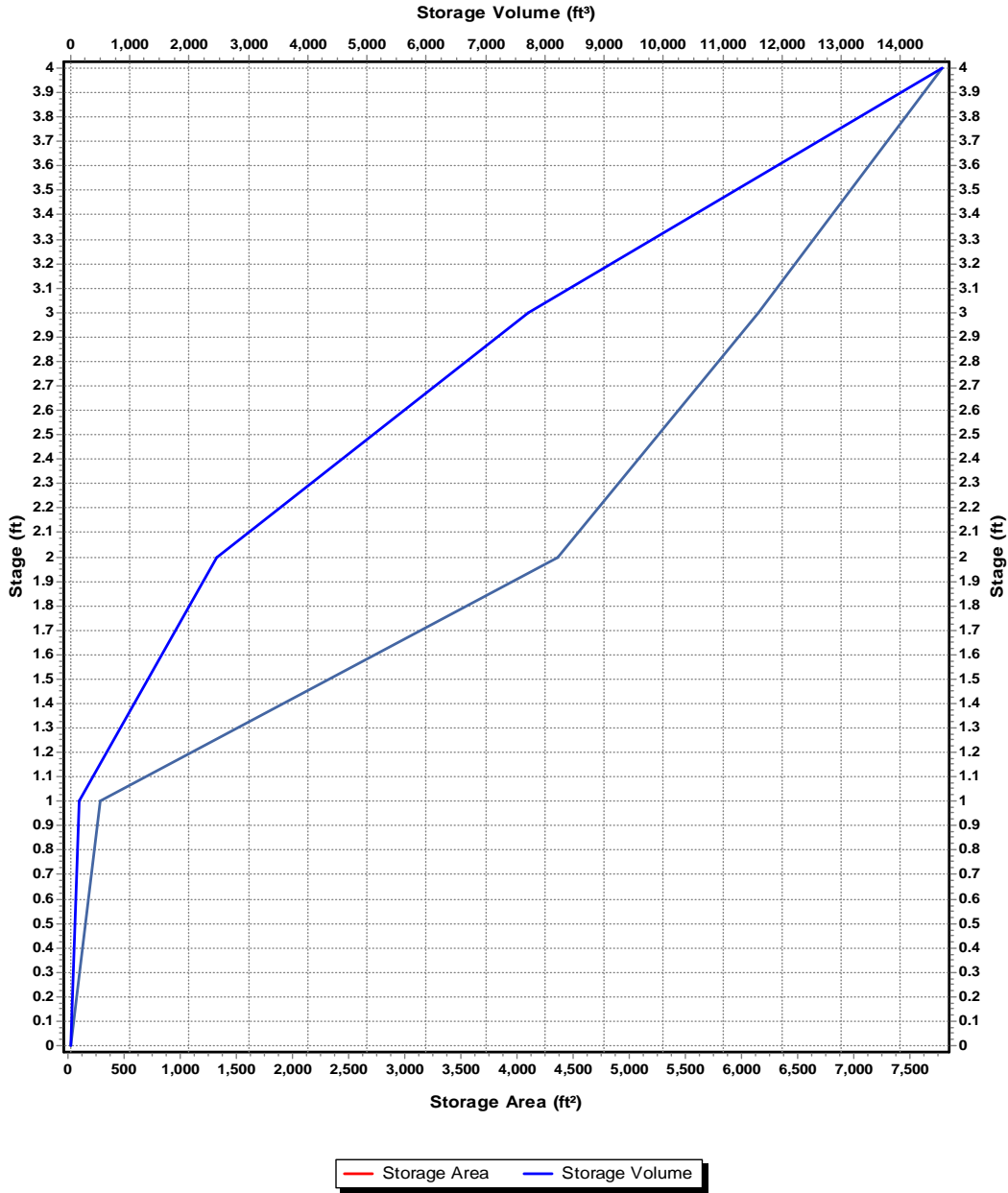
#### Storage Area Volume Curves

Storage Curve : FH-Pond1

Stage	Storage Area	Storage Volume
(ft)	(ft <sup>2</sup> )	(ft <sup>3</sup> )
0	20	0
1	277	148.5
2	4361	2467.5
3	6157	7726.5
4	7794	14702



### Storage Area Volume Curves



**Storage Node : FSP-1 (continued)**

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 FSP1-1	Side	CIRCULAR	No	8.00			274.00	0.60
2 FSP1-2	Side	CIRCULAR	No	12.00			274.12	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	13.08
Peak Lateral Inflow (cfs) .....	13.08
Peak Outflow (cfs) .....	6.11
Peak Exfiltration Flow Rate (cfm) .....	10.55
Max HGL Elevation Attained (ft) .....	275.79
Max HGL Depth Attained (ft) .....	3.79
Average HGL Elevation Attained (ft) .....	273.44
Average HGL Depth Attained (ft) .....	1.44
Time of Max HGL Occurrence (days hh:mm) .....	0 12:19
Total Exfiltration Volume (1000-ft <sup>3</sup> ) .....	8.49
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : FSP-2**

**Input Data**

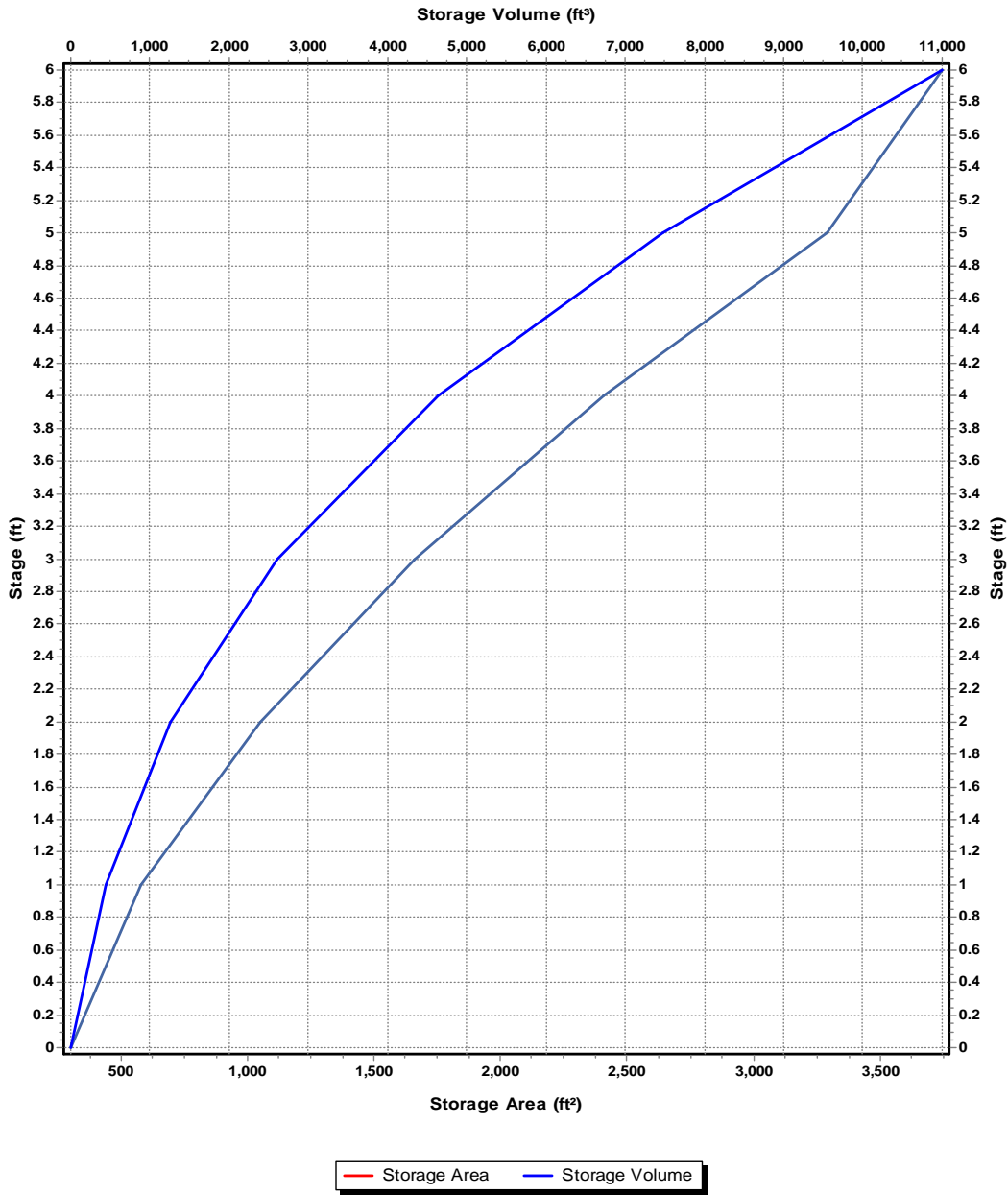
Invert Elevation (ft) .....	270
Max (Rim) Elevation (ft) .....	276
Max (Rim) Offset (ft) .....	6
Initial Water Elevation (ft) .....	270
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	3746
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : FH-Pond2

Stage (ft)	Storage Area (ft <sup>2</sup> )	Storage Volume (ft <sup>3</sup> )
0	300	0
1	578	439
2	1048	1252
3	1659	2605.5
4	2406	4638
5	3289	7485.5
6	3746	11003

### Storage Area Volume Curves



**Storage Node : FSP-2 (continued)**

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 FSP2-1	Side	CIRCULAR	No	8.00			273.00	0.60
2 FSP2-2	Side	CIRCULAR	No	15.00			273.25	0.60
3 FSP2-3	Side	CIRCULAR	No	15.00			273.50	0.60

**Output Summary Results**

Peak Inflow (cfs) .....	13.48
Peak Lateral Inflow (cfs) .....	13.48
Peak Outflow (cfs) .....	12.03
Peak Exfiltration Flow Rate (cfm) .....	4.32
Max HGL Elevation Attained (ft) .....	274.73
Max HGL Depth Attained (ft) .....	4.73
Average HGL Elevation Attained (ft) .....	272.09
Average HGL Depth Attained (ft) .....	2.09
Time of Max HGL Occurrence (days hh:mm) .....	0 12:09
Total Exfiltration Volume (1000-ft³) .....	3.629
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

**Storage Node : Pond\_1**

**Input Data**

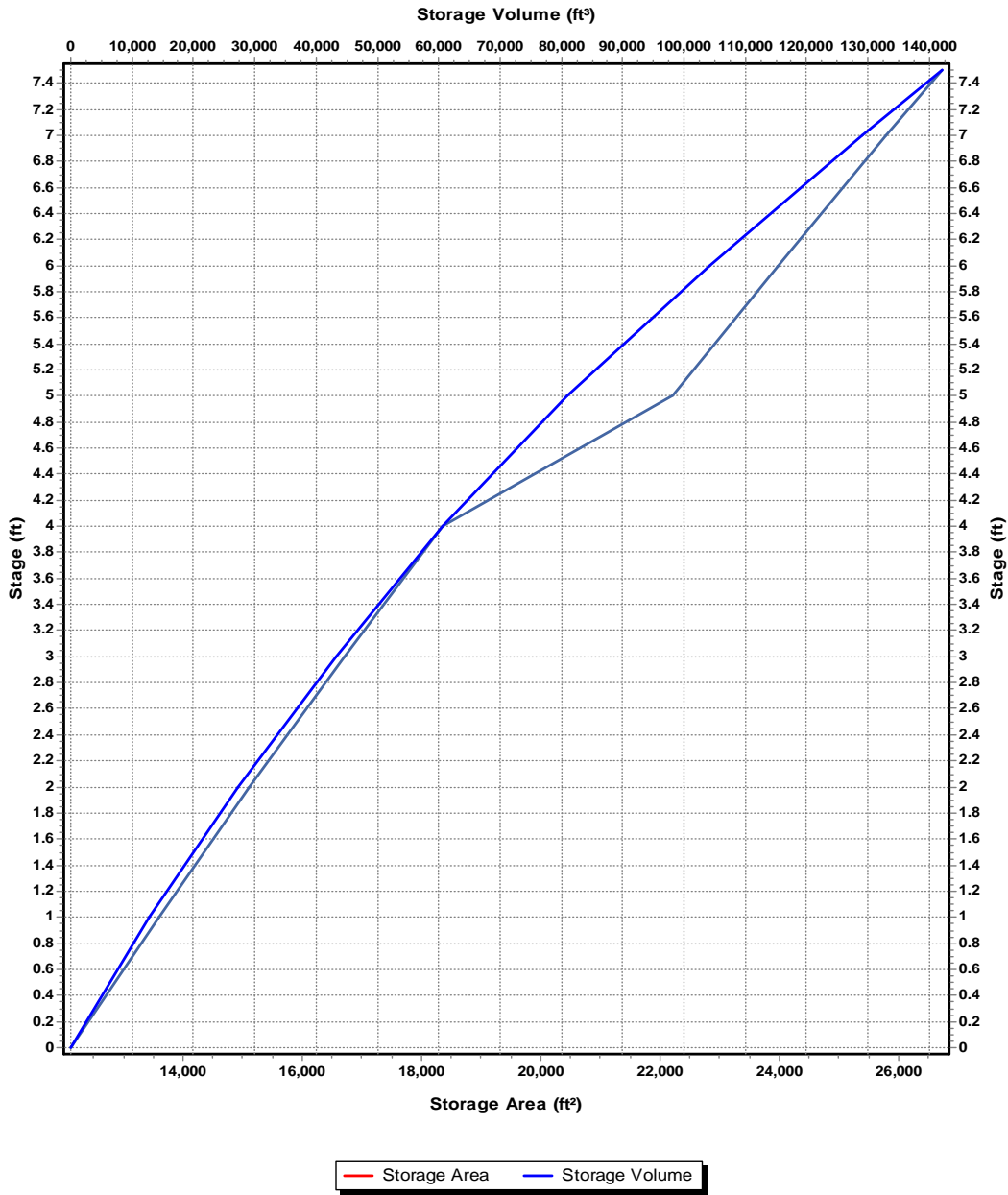
Invert Elevation (ft) .....	250
Max (Rim) Elevation (ft) .....	257.5
Max (Rim) Offset (ft) .....	7.5
Initial Water Elevation (ft) .....	250
Initial Water Depth (ft) .....	0
Ponded Area (ft²) .....	25046
Evaporation Loss .....	0

**Storage Area Volume Curves**

Storage Curve : Pond 1

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	12130	0
1	13618	12874
2	15124	27245
3	16705	43159.5
4	18355	60689.5
5	22210	80972
6	23978	104066
7	25802	128956
7.5	26736	142090.5

### Storage Area Volume Curves



**Storage Node : Pond\_1 (continued)**

**Outflow Weirs**

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 PondOverflow	Trapezoidal	No	255.90	5.90	20.00	1.50	3.33

**Outflow Orifices**

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Pond_LowFlow	Side	Rectangular	No		18.00	18.00	250.00	0.63
2 primary	Side	Rectangular	No		17.00	12.00	252.65	0.63
3 RiserTop	Bottom	Rectangular	No		48.00	48.00	255.90	0.63

**Output Summary Results**

Peak Inflow (cfs) .....	102.89
Peak Lateral Inflow (cfs) .....	0
Peak Outflow (cfs) .....	94.6
Peak Exfiltration Flow Rate (cfm) .....	0
Max HGL Elevation Attained (ft) .....	256.49
Max HGL Depth Attained (ft) .....	6.49
Average HGL Elevation Attained (ft) .....	251.08
Average HGL Depth Attained (ft) .....	1.08
Time of Max HGL Occurrence (days hh:mm) .....	0 12:21
Total Exfiltration Volume (1000-ft³) .....	0
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0



**Storage Node : STR-31**

**Input Data**

Invert Elevation (ft) .....	327.65
Max (Rim) Elevation (ft) .....	335.28
Max (Rim) Offset (ft) .....	7.63
Initial Water Elevation (ft) .....	327.65
Initial Water Depth (ft) .....	0
Ponded Area (ft <sup>2</sup> ) .....	0
Evaporation Loss .....	0

**Output Summary Results**

Peak Inflow (cfs) .....	82.01
Peak Lateral Inflow (cfs) .....	0
Peak Outflow (cfs) .....	61.75
Peak Exfiltration Flow Rate (cfm) .....	0
Max HGL Elevation Attained (ft) .....	335.28
Max HGL Depth Attained (ft) .....	7.63
Average HGL Elevation Attained (ft) .....	328.35
Average HGL Depth Attained (ft) .....	0.7
Time of Max HGL Occurrence (days hh:mm) .....	0 12:01
Total Exfiltration Volume (1000-ft <sup>3</sup> ) .....	0
Total Flooded Volume (ac-in) .....	9.27
Total Time Flooded (min) .....	40
Total Retention Time (sec) .....	0

**E. OPERATIONS AND MAINTENANCE (O&M) PLAN AND LONG-TERM POLLUTION PREVENTION PLAN (LTPPP)**

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# *Roadway Improvement Project*

## Stormwater Management System Operation and Maintenance Plan and Long-Term Pollution Prevention Plan *Boston Road, Westford, MA*

PREPARED FOR

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10 Park Plaza  
Boston, MA 02116



Town of Westford  
Department of Public Works  
28 North Street  
Westford, MA 01886

PREPARED BY

---



282 Merrimack Street, 2<sup>nd</sup> Floor  
Lawrence, Massachusetts, 01843

March 22, 2023

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# 1

## Stormwater Management System Operation and Maintenance (O&M) Plan

This Stormwater Management System Operation and Maintenance (O&M) Plan describes the approach for inspection and maintenance of drainage infrastructure and structural stormwater control measures (SCMs) to minimize contaminant loading for Boston Road in Westford, MA. In general, inspection and maintenance activities will be conducted consistent with the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer System (MS4) and MassDOT's anticipated NPDES Transportation Separate Storm Sewer System (TS4) Permit.

This document has been prepared per the requirements of Massachusetts Department of Environmental Protection (MassDEP) Regulations 310 CMR 10.05 (6)(k)(9) and satisfies the requirements of Massachusetts Stormwater Standard 9.

### 1.1 Responsible Party

In accordance with MassDOT procedures, the MassDOT District 3 office located in Worcester, MA, is responsible for the maintenance of all stormwater management system components within the project limits within and adjacent to State Highway Layout (SHLO) (Station 49+42 to Station 75+50).

Questions or concerns regarding activities associated with this O&M Plan applicable to the portion with or adjacent to SHLO should be addressed to MassDOT's District 3 office located at 449 Plantation Parkway, Worcester, MA 01605, phone (857) 368-3000, during regular weekday hours, or to MassDOT's Highway Operations Center located in South Boston, MA at (800) 227-0608 during all other times and days, including weekends and holidays.

The Town of Westford will be responsible for the operation and maintenance of all stormwater management system components within the portion of the project area under Town jurisdiction (Station 0+00 to Station 49+42). Questions or concerns regarding activities associated with this O&M Plan applicable to the portion under Town jurisdiction should be address to the Westford Department of Public Works located at 28 North Street, Westford, MA 01886, phone (978) 692-5520.

MassDOT Project # 609035 - Rehabilitation of Boston Road, Westford, MA

## 1.2 Inspection and Maintenance Measures and Record-Keeping

See Rehabilitation of Boston Road Plans for the proposed MassDOT-owned stormwater system within the project limits (Station 49+42 to Station 75+50). The MassDOT stormwater management system covered by this O&M Plan consists of the following measures:

- Catch Basins
- Drainage Pipes and Manholes
- Wet Detention Basin with Sediment Forebay
- Riprap Spillway
- Outlet Control Structure

MassDOT uses a performance-based inspection and maintenance program for SCMs and catch basins. For SCMs, MassDOT's overall approach is to inspect SCMs, and based on the results of the inspections, perform maintenance to preserve functionality. For catch basins, MassDOT's overall approach is to perform maintenance at an interval that maintains the functionality of the catch basin (e.g., sump is less than 50% full of sediment). Catch basin inspections, including documentation of sediment accumulation, and maintenance will generally occur simultaneously.

MassDOT's O&M program is data driven. Inspections and maintenance are recorded by personnel using hand-held tablets in the field to document sediment accumulation, maintenance action performed, and follow-up actions needed. Data are recorded in MassDOT's asset management system which is accessible in the field (mobile) or the office (desktop).

The table below summarizes data that is generally collected for each asset type. For all assets, the inspector and inspection date are recorded. Photo documentation of structure condition is taken and attached to the inspection record.

MassDOT Project # 609035 - Rehabilitation of Boston Road, Westford, MA

Inspection Form	Applicable Stormwater Assets	Information Collected
Inlets	<ul style="list-style-type: none"> <li>› Catch basins</li> <li>› Outlet control structures</li> </ul>	<ul style="list-style-type: none"> <li>› Sediment accumulation</li> <li>› Trash/Debris accumulation</li> <li>› Signs of contamination</li> <li>› Frame and grate condition</li> <li>› Overall structure condition</li> </ul>
SCMs	<ul style="list-style-type: none"> <li>› Wet Detention Basin with Sediment Forebay</li> </ul>	<ul style="list-style-type: none"> <li>› SCM accessibility</li> <li>› Presence of standing water</li> <li>› Level of erosion</li> <li>› Sediment accumulation</li> <li>› Trash/Debris accumulation</li> <li>› Vegetation condition</li> <li>› Overall SCM condition</li> </ul>
Storm Discharge Points	<ul style="list-style-type: none"> <li>› Outlets to SCMs</li> </ul>	<ul style="list-style-type: none"> <li>› Presence of flow</li> <li>› Signs of contaminated flow</li> <li>› Sediment accumulation</li> <li>› Level of erosion</li> <li>› Pipe condition</li> <li>› Scour protection condition</li> <li>› Overall structure condition</li> </ul>

Inspection and maintenance records can be made available using the asset management system through request with the MassDOT District 3 Environmental Engineer. Records will be kept for at least three years. Representatives of the Town of Westford Conservation Commission(s), MassDEP, and US EPA may obtain access to these records, upon request. Additionally, MassDOT will allow members and agents of MassDEP and the Conservation Commission to enter and inspect the premises, upon request, to evaluate and ensure that the Operation and Maintenance Plan requirements for each SCM are being followed.

Maintenance actions will not occur at any set frequency, but rather will be based on condition and impact to functionality. Maintenance to be performed on the stormwater system includes:

Stormwater Feature	Potential Maintenance Actions	
Surface SCMs	<ul style="list-style-type: none"> <li>• Remove and properly dispose of accumulated material (e.g., sediment, trash, leaf litter, debris)</li> <li>• Mow vegetated areas and remove and dispose of grass clippings</li> <li>• Regrade areas that show signs of unwanted ponding and channelization</li> <li>• Stabilize or reconstruct eroded areas and reseed</li> <li>• Replace stones/soil and/or replant vegetation</li> </ul>	<ul style="list-style-type: none"> <li>• Remove woody growth</li> <li>• Treat invasive plants according to MassDOT Landscape Design Section</li> </ul>
Underground SCMs	<ul style="list-style-type: none"> <li>• Remove and properly dispose of trash, sediment, debris, and root intrusions</li> <li>• Clean out sumps at an interval to maintain functionality (less than 50% full of sediment)</li> <li>• Jet and repair pipes</li> </ul>	<ul style="list-style-type: none"> <li>• Rehabilitate filtering and infiltration materials (e.g., geotextile fabric, crushed stone)</li> <li>• Stabilize and replace deteriorated structures</li> <li>• Perform evaluations (e.g., test pits) to evaluate subsurface conditions</li> </ul>
Inlets and Outlets to SCMs	<ul style="list-style-type: none"> <li>• Clear inlet and remove and properly dispose of sediment, trash, leaf litter, debris, and vegetation</li> <li>• Regrade areas that show signs of ponding and channelization</li> <li>• Repair or replace structural components</li> <li>• Repair damaged or eroded areas</li> </ul>	<ul style="list-style-type: none"> <li>• Provide or rehabilitate erosion control at the outlet</li> <li>• Regrade and replace the channel materials</li> <li>• Remove woody growth</li> <li>• Stabilize or reconstruct eroded areas</li> <li>• Treat invasive plants according to MassDOT Vegetation Management Plan</li> </ul>

Based on the results of the inspection, repairs will be made in accordance with MassDOT standard practices. Maintenance will be prioritized given the urgency of the required maintenance and availability of staff, contracts, etc. Maintenance may require contracting if existing contracts are unavailable to perform the work. More intensive remedial activities may require permitting and/or an engineering solution.



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See the Rehabilitation of Boston Road Plans for the proposed Town-owned stormwater system within the project limits (Station 0+00 to Sta 49+42). The municipal stormwater management system covered by this O&M Plan consists of the following measures:

- Catch Basins
- Drainage Pipes and Manholes
- Outlet Sediment Trap (i.e. Sediment Forebay)
- Riprap Spillway

Inspection Form	Applicable Stormwater Assets	Information Collected
Inlets	› Catch basins	› Sediment accumulation › Trash/Debris accumulation › Signs of contamination › Frame and grate condition › Overall structure condition
SCMs	› Outlet Sediment Trap (i.e. Sediment Forebay)	› SCM accessibility › Presence of standing water › Level of erosion › Sediment accumulation › Trash/Debris accumulation › Vegetation condition › Overall SCM condition
Storm Discharge Points	› Outlets to SCMs	› Presence of flow › Signs of contaminated flow › Sediment accumulation › Level of erosion › Pipe condition › Scour protection condition › Overall structure condition

Maintenance actions will not occur at any set frequency, but rather will be based on condition and impact to functionality. Maintenance to be performed on the stormwater system includes:

Stormwater Feature	Potential Maintenance Actions	
Surface SCMs	<ul style="list-style-type: none"> <li>• Remove and properly dispose of accumulated material (e.g., sediment, trash, leaf litter, debris)</li> <li>• Mow vegetated areas and remove and dispose of grass clippings</li> <li>• Regrade areas that show signs of unwanted ponding and channelization</li> <li>• Stabilize or reconstruct eroded areas and reseed</li> <li>• Replace stones/soil and/or replant vegetation</li> </ul>	<ul style="list-style-type: none"> <li>• Remove woody growth</li> <li>• Treat invasive plants on a case-by-case basis as required</li> </ul>
Underground SCMs	<ul style="list-style-type: none"> <li>• Remove and properly dispose of trash, sediment, debris, and root intrusions</li> <li>• Clean out sumps at an interval to maintain functionality (less than 50% full of sediment)</li> <li>• Jet and repair pipes</li> </ul>	<ul style="list-style-type: none"> <li>• Rehabilitate filtering and infiltration materials (e.g., geotextile fabric, crushed stone)</li> <li>• Stabilize and replace deteriorated structures</li> <li>• Perform evaluations (e.g., test pits) to evaluate subsurface conditions</li> </ul>
Inlets and Outlets to SCMs	<ul style="list-style-type: none"> <li>• Clear inlet and remove and properly dispose of sediment, trash, leaf litter, debris, and vegetation</li> <li>• Regrade areas that show signs of ponding and channelization</li> <li>• Repair or replace structural components</li> <li>• Repair damaged or eroded areas</li> </ul>	<ul style="list-style-type: none"> <li>• Provide or rehabilitate erosion control at the outlet</li> <li>• Regrade and replace the channel materials</li> <li>• Remove woody growth</li> <li>• Stabilize or reconstruct eroded areas</li> <li>• Treat invasive plants on a case-by-case basis as required</li> </ul>

Based on the results of the inspection, repairs will be made in accordance with Town of Westford standard practices. Maintenance will be prioritized given the urgency of the required maintenance and availability of staff, etc. Maintenance may require contracting if existing contracts are unavailable to perform the work. More intensive remedial activities may require permitting and/or an engineering solution.

MassDOT Project # 609035 - Rehabilitation of Boston Road, Westford, MA

### **1.3 Erosion and Sediment Control Measures during Maintenance Activities**

For maintenance activities that could result in discharges of sediments or other contaminants into wetlands, waterways, or other resource areas regulated under 310 CMR 10.00, the responsible maintenance personnel at MassDOT and the Town of Westford will employ measures to prevent migration of these sediments/contaminants. Such temporary measures may include, but are not necessarily limited to, the use of siltation barriers, catch basin silt sacks/filter bags, pipe plugs, cofferdams deployed within the stormwater structure, turbidity curtains, or other practices designed to prevent such discharges.

Where maintenance occurs in areas that are confined, with no risk of discharge to adjacent water bodies, no special measures may be needed. Examples include, but are not limited to: (1) cleaning of a forebay under dry conditions when the work can be completed and exposed surfaces stabilized prior to placing it back into service; and (2) catch basin cleaning where the activity is limited to removing material from a sump below the elevation of the outlet pipe.

### **1.4 O&M Budget**

MassDOT performs maintenance for stormwater management systems as part of their routine operation and maintenance budget for roadways and bridges. Budgets are managed at the district level and vary by fiscal year, depending on funding sources.

The Town of Westford performs maintenance for stormwater management systems as part of its routine operation and maintenance budget for roadways. Budgets vary by fiscal year, depending on appropriation approved at annual Town Meeting.

Roadway Improvement Project: Boston Road, Westford, MA

# 2

## Long-Term Pollution Prevention Plan

This Long-Term Pollution Prevention Plan (LTPPP) describes the approach for pollution prevention and related maintenance activities for Boston Road, Westford. In general, long-term pollution prevention and related maintenance activities will be conducted consistent with:

- The National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer System (MS4),
- MassDOT's anticipated NPDES Transportation Separate Storm Sewer System (TS4) Permit, and
- Measures outlined in MassDOT's Stormwater Management Plan (SWMP).
- The Town of Westford's Stormwater Management Master Plan, Volume 4: NPDES Stormwater Program Compliance Plan

This LTPPP satisfies the requirements related to pollution prevention under Massachusetts Stormwater Standards 4, 5, 6, and 10.

### 2.1 Practices for Long-Term Pollution Prevention

For the MassDOT-owned and Town of Westford-owned facilities covered, long-term pollution prevention includes the following measures:

- good housekeeping;
- storing materials and waste products inside or under cover;
- vehicle washing;
- routine inspections and maintenance of SCMs;
- spill prevention and response;
- maintenance of lawns, gardens, and other landscaped areas;
- storage and use of fertilizers, herbicides, and pesticides;
- pet waste management;
- operation and management of septic systems; and
- proper management of deicing chemicals and snow.

Roadway Improvement Project: Boston Road, Westford, MA

### **2.1.1 Litter Pick-up**

MassDOT and the Town of Westford will conduct litter pick-up from the stormwater management facilities in conjunction with routine road maintenance activities.

### **2.1.2 Inspection and Maintenance of Stormwater Assets**

MassDOT and the Town of Westford will conduct inspection and maintenance of drainage infrastructure and the stormwater control measures (SCMs) in accordance with the O&M Plan, as described in Section 1.

### **2.1.3 Maintenance of Landscaped Areas**

Routine mowing will be conducted according to standard MassDOT and Town of Westford practices. SCM basin bottoms and embankments designed to impound water should be mowed as required to prevent establishment of woody vegetation.

Except in rare circumstances, MassDOT and the Town of Westford do not use fertilizers, herbicides, and pesticides for the maintenance of facilities. Exceptions include using fertilizer to ensure the survival of new plantings and herbicides to control invasive plants. Use of fertilizers and herbicides is reviewed and approved by the MassDOT Landscape Design Section and District 3 Environmental Engineer prior to application. Local Conservation Commission review may also be required.

### **2.1.4 Snow and Ice Management**

Snow and Ice Management within SHLO will be conducted consistent with the practices outlined in the MassDOT Snow and Ice Control Program Environmental Status and Planning Report (ESPR), formerly known as the Snow and Ice Control Generic Environmental Impact Report (GEIR) as well as the Town of Westford standard practices.

In accordance with the Snow and Ice Control ESPR, no sand is used on MassDOT properties for snow and ice control. The exception to this rule is within reduced salt areas where high sodium levels have been found in drinking water sources.

Snow and Ice Management within areas under municipal jurisdiction will be conducted in accordance with the Town of Westford Highway Department's standard practices and *Snow & Ice Procedures*.

### **2.1.5 Street Sweeping**

Routine highway cleaning, with a brush-type street sweeper, will be conducted in accordance with standard MassDOT and the Town of Westford practices. Sweeping will occur annually in the Spring.

Roadway Improvement Project: Boston Road, Westford, MA

### 2.1.6 Prohibition of Illicit Discharges

The MassDEP Stormwater Management Standard 10 prohibits illicit discharges to the stormwater management system. Illicit discharges are discharges that do not consist entirely of stormwater, except for certain specified non-stormwater discharges.

In accordance with the existing MS4 permit and anticipated TS4 permit requirements, examples of discharges from the following sources are not considered illicit discharges:

- › Firefighting activities\*
- › Foundation drains
- › Water line flushing
- › Footing drains
- › Landscape irrigation
- › Individual residential car washing
- › Uncontaminated groundwater
- › Rising groundwater
- › Diverted stream flows
- › Flows from riparian habitats/wetlands
- › Potable water sources
- › Dechlorinated swimming pool water
- › Street wash waters
- › Wash water from residential buildings (no detergents)
- › Condensation from air conditioning units
- › Run-on from private driveways caused by precipitation
- › Lawn watering
- › Water from crawl space pumps

\*Water from firefighting activities is allowed and need only be addressed where they are identified as significant sources of pollutants to waters of the United States.

Based on plan review and confirmation in the field, there are no known or proposed illicit connections associated with the Rehabilitation of Boston Road Project. Should an interconnection to the stormwater management system be identified, the MassDOT PM will coordinate with the District Permits Engineer to confirm if the connections are authorized. For unauthorized connections, the MassDOT PM and/or MassDOT Environmental Services Section will investigate the connections and if they are determined to be illicit, the connections will be managed through MassDOT’s Illicit Discharge Detection and Elimination (IDDE) program and/or through other agencies.

### 2.1.7 Spill Prevention and Response

Response procedures will be implemented at the sediment forebay and wet detention basin outlets for any significant release of hazardous materials such as fuels, oils, or chemical materials that have the potential of discharging to the adjacent wetlands. Spill containment measures such as spill kits including booms, caps, covers, pneumatic plugs, absorbent material etc. will be stored at the Town of Westford Department of Public Works and at the MassDOT District 3 Maintenance Depot (located on Boston Road).

Reportable quantities will immediately be reported to the applicable Federal, State, and local agencies as required by law. Reportable quantities of chemical, fuels, or oils are established under the Clean Water Act and enforced through MassDEP. The MassDEP Emergency Response Program shall be immediately notified in accordance with required procedures for the report of a release (telephone (888) 304-1133).

Roadway Improvement Project: Boston Road, Westford, MA

MassDOT works with first responders and/or public water supply owners to determine the best approach to protect water supplies, and provides training and materials to carry out action plans. In the case of a spill, applicable containment and clean-up procedures will be performed immediately. These procedures are implemented in accordance with the Unified Response Manual at the local level by first responders, which includes the Town of Westford's local public safety departments (e.g., fire, police, public works, board of health). MassDOT will be on-site to aid with traffic control and to provide clean-up supplies, as necessary. Spill material collected during the response will be promptly removed and disposed of in accordance with Federal, State, and local requirements. If necessary, a licensed emergency response contractor will assist in cleanup of releases depending on the amount of the release and the ability of the responsible party to perform the required response.

## FIGURES

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North  
1" = 1000'

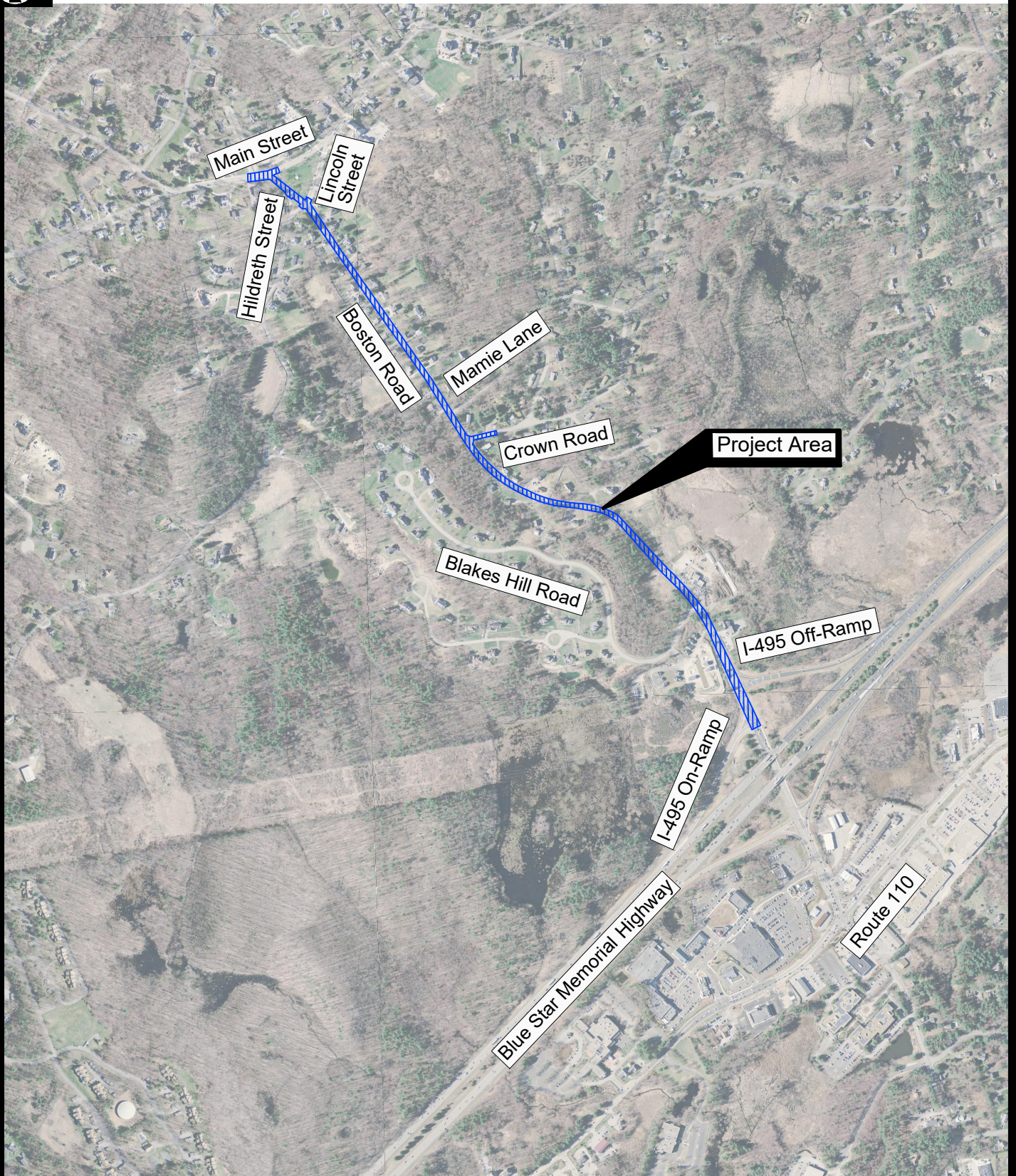
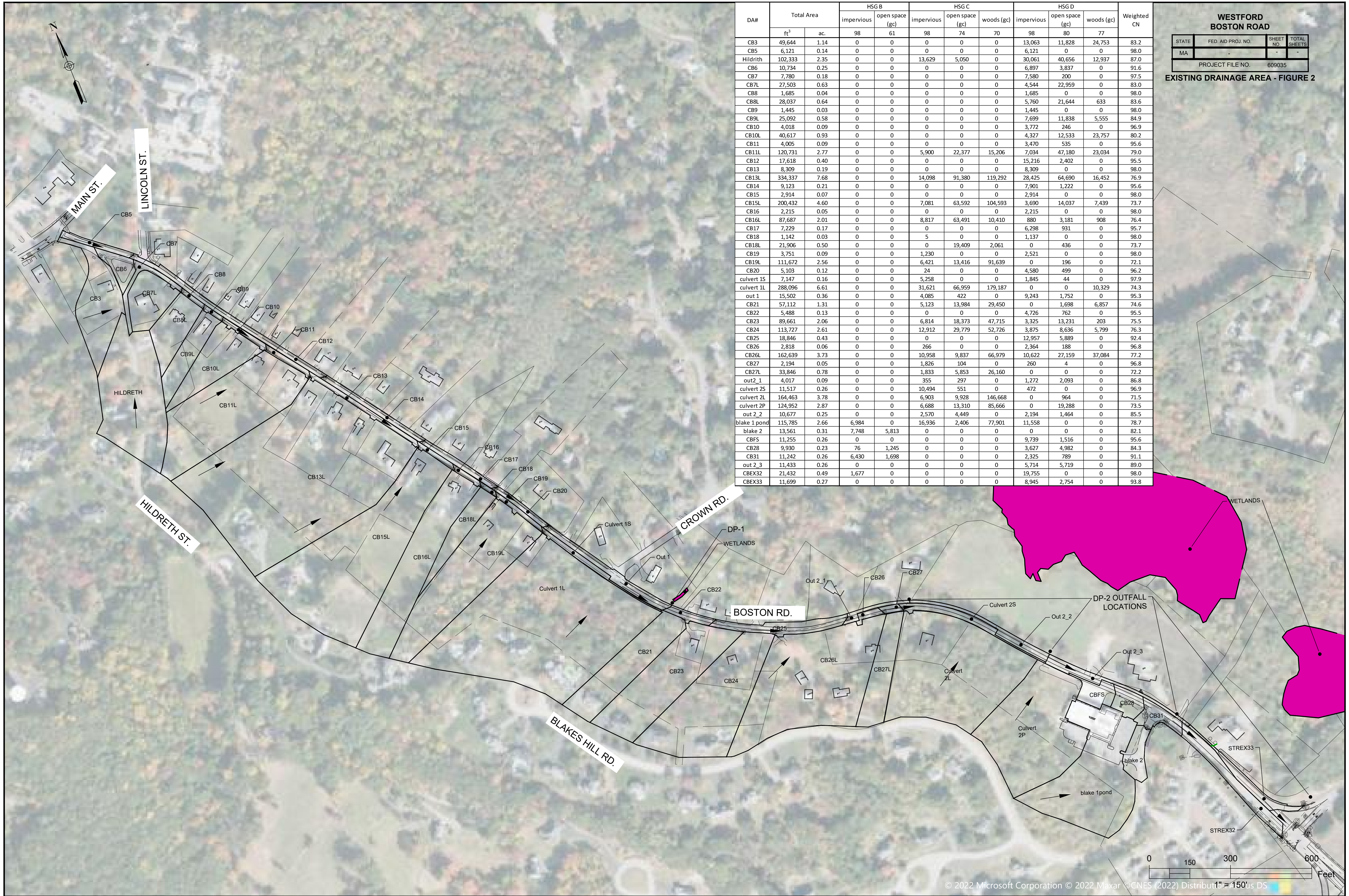


Figure 1

Project Location Map



T:\T0713\CAD\Highway\Graphics\T0713\_NOI\_Locus Map.dwg 3/17/2022 8:51:03 AM



DA#	Total Area		HSG B		HSG C			HSG D			Weighted CN
	ft <sup>2</sup>	ac.	impervious	open space (gc)	impervious	open space (gc)	woods (gc)	impervious	open space (gc)	woods (gc)	
CB3	49,644	1.14	0	0	0	0	0	13,063	11,828	24,753	83.2
CB5	6,121	0.14	0	0	0	0	0	6,121	0	0	98.0
Hildreth	102,333	2.35	0	0	13,629	5,050	0	30,061	40,656	12,937	87.0
CB6	10,734	0.25	0	0	0	0	0	6,897	3,837	0	91.6
CB7	7,780	0.18	0	0	0	0	0	7,580	200	0	97.5
CB7L	27,503	0.63	0	0	0	0	0	4,544	22,959	0	83.0
CB8	1,685	0.04	0	0	0	0	0	1,685	0	0	98.0
CB8L	28,037	0.64	0	0	0	0	0	5,760	21,644	633	83.6
CB9	1,445	0.03	0	0	0	0	0	1,445	0	0	98.0
CB9L	25,092	0.58	0	0	0	0	0	7,699	11,838	5,555	84.9
CB10	4,018	0.09	0	0	0	0	0	3,772	246	0	96.9
CB10L	40,617	0.93	0	0	0	0	0	4,327	12,533	23,757	80.2
CB11	4,005	0.09	0	0	0	0	0	3,470	535	0	95.6
CB11L	120,731	2.77	0	0	5,900	22,377	15,206	7,034	47,180	23,034	79.0
CB12	17,618	0.40	0	0	0	0	0	15,216	2,402	0	95.5
CB13	8,309	0.19	0	0	0	0	0	8,309	0	0	98.0
CB13L	334,337	7.68	0	0	14,098	91,380	119,292	28,425	64,690	16,452	76.9
CB14	9,123	0.21	0	0	0	0	0	7,901	1,222	0	95.6
CB15	2,914	0.07	0	0	0	0	0	2,914	0	0	98.0
CB15L	200,432	4.60	0	0	7,081	63,592	104,593	3,690	14,037	7,439	73.7
CB16	2,215	0.05	0	0	0	0	0	2,215	0	0	98.0
CB16L	87,687	2.01	0	0	8,817	63,491	10,410	880	3,181	908	76.4
CB17	7,229	0.17	0	0	0	0	0	6,298	931	0	95.7
CB18	1,142	0.03	0	0	5	0	0	1,137	0	0	98.0
CB18L	21,906	0.50	0	0	0	19,409	2,061	0	436	0	73.7
CB19	3,751	0.09	0	0	1,230	0	0	2,521	0	0	98.0
CB19L	111,672	2.56	0	0	6,421	13,416	91,639	0	196	0	72.1
CB20	5,103	0.12	0	0	24	0	0	4,580	499	0	96.2
culvert 1S	7,147	0.16	0	0	5,258	0	0	1,845	44	0	97.9
culvert 1L	288,096	6.61	0	0	31,621	66,959	179,187	0	0	10,329	74.3
out 1	15,502	0.36	0	0	4,085	422	0	9,243	1,752	0	95.3
CB21	57,112	1.31	0	0	5,123	13,984	29,450	0	1,698	6,857	74.6
CB22	5,488	0.13	0	0	0	0	0	4,726	762	0	95.5
CB23	89,661	2.06	0	0	6,814	18,373	47,715	3,325	13,231	203	75.5
CB24	113,727	2.61	0	0	12,912	29,779	52,726	3,875	8,636	5,799	76.3
CB25	18,846	0.43	0	0	0	0	0	12,957	5,889	0	92.4
CB26	2,818	0.06	0	0	266	0	0	2,364	188	0	96.8
CB26L	162,639	3.73	0	0	10,958	9,837	66,979	10,622	27,159	37,084	77.2
CB27	2,194	0.05	0	0	1,826	104	0	260	4	0	96.8
CB27L	33,846	0.78	0	0	1,833	5,853	26,160	0	0	0	72.2
out2_1	4,017	0.09	0	0	355	297	0	1,272	2,093	0	86.8
culvert 2S	11,517	0.26	0	0	10,494	551	0	472	0	0	96.9
culvert 2L	164,463	3.78	0	0	6,903	9,928	146,668	0	964	0	71.5
culvert 2P	124,952	2.87	0	0	6,688	13,310	85,666	0	19,288	0	73.5
out 2_2	10,677	0.25	0	0	2,570	4,449	0	2,194	1,464	0	85.5
blake 1 pond	115,785	2.66	6,984	0	16,936	2,406	77,901	11,558	0	0	78.7
blake 2	13,561	0.31	7,748	5,813	0	0	0	0	0	0	82.1
CBFS	11,255	0.26	0	0	0	0	0	9,739	1,516	0	95.6
CB28	9,930	0.23	76	1,245	0	0	0	3,627	4,982	0	84.3
CB31	11,242	0.26	6,430	1,698	0	0	0	2,325	789	0	91.1
out 2_3	11,433	0.26	0	0	0	0	0	5,714	5,719	0	89.0
CBEX32	21,432	0.49	1,677	0	0	0	0	19,755	0	0	98.0
CBEX33	11,699	0.27	0	0	0	0	0	8,945	2,754	0	93.8

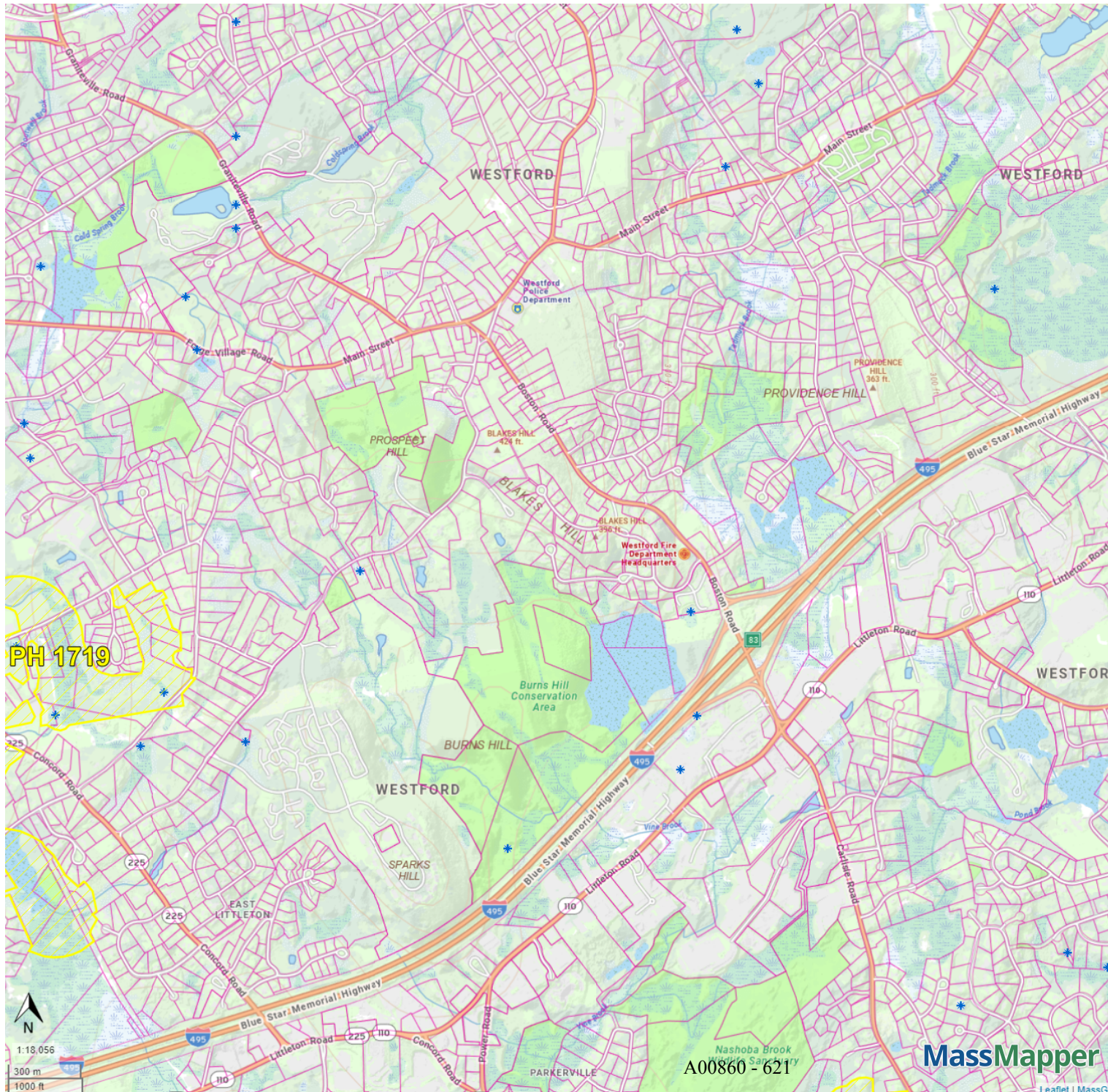
**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		-	-
PROJECT FILE NO. 609035			

**EXISTING DRAINAGE AREA - FIGURE 2**



# Boston Rd



NHESP Priority Habitats of Rare Species



NHESP Natural Communities



NHESP Estimated Habitats of Rare Wildlife



NHESP Certified Vernal Pools



NHESP Ecoregions



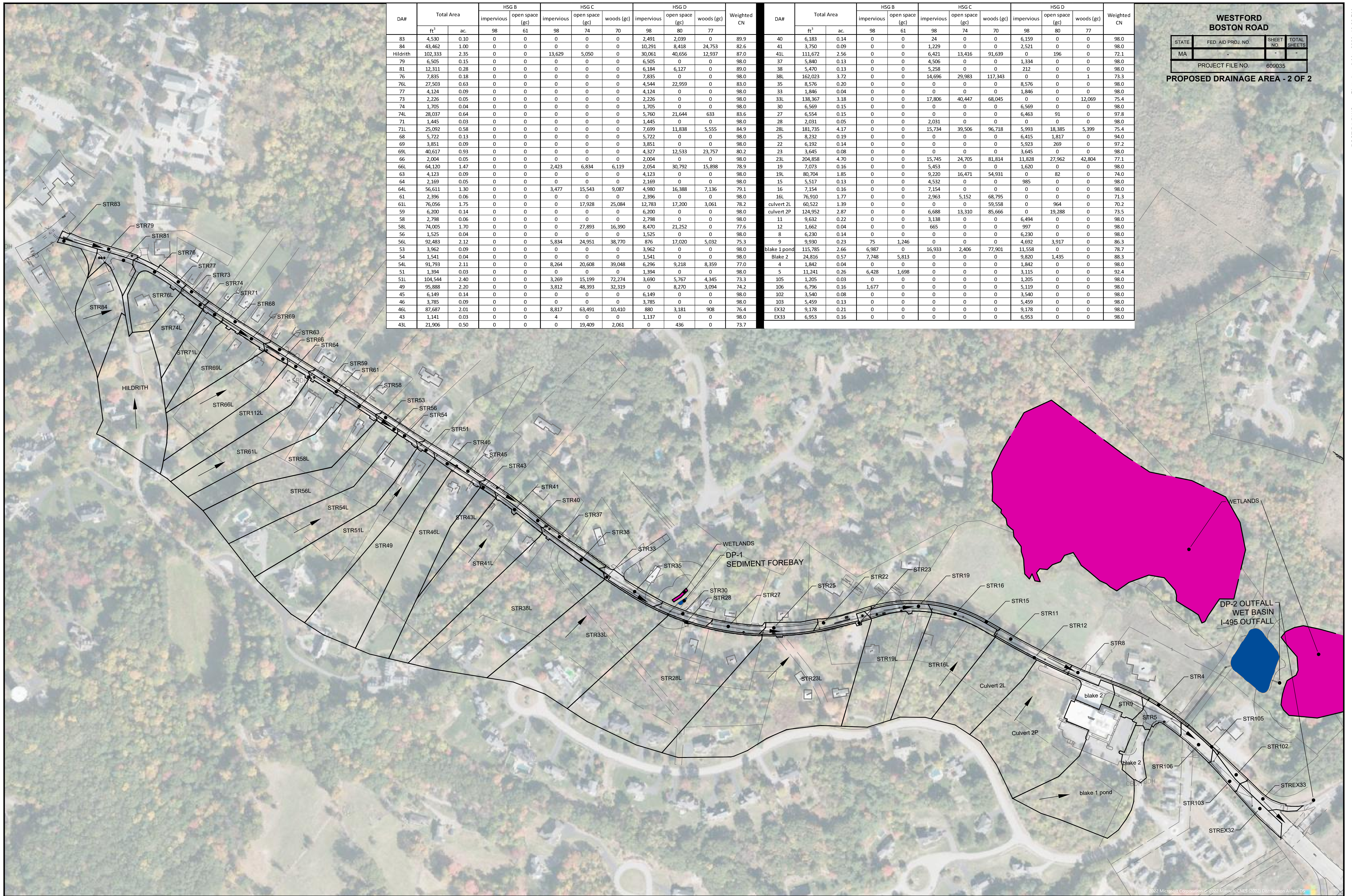
Property Tax Parcels

Figure 3

Proposal No. 609035- 126590  
 Custom Soil Resource Report  
 Soil Map (Boston Road, Westford, MA)



Figure 4



DA#	Total Area		HSG B		HSG C		HSG D			Weighted CN	DA#	Total Area		HSG B		HSG C		HSG D			Weighted CN		
			impervious	open space (gc)	impervious	open space (gc)	woods (gc)	impervious	open space (gc)					woods (gc)	impervious	open space (gc)	woods (gc)	impervious	open space (gc)	woods (gc)			
	ft <sup>2</sup>	ac.	98	61	98	74	70	98	80			77	ft <sup>2</sup>	ac.	98	61	98	74	70	98		80	77
83	4,530	0.10	0	0	0	0	0	2,491	2,039	0	89.9	40	6,183	0.14	0	0	0	6,159	0	0	98.0		
84	43,462	1.00	0	0	0	0	0	10,291	8,418	24,753	82.6	41	3,750	0.09	0	0	1,229	0	0	2,521	0	98.0	
Hildrith	102,333	2.35	0	0	13,629	5,050	0	30,061	40,656	12,937	87.0	41L	111,672	2.56	0	0	6,421	13,416	91,639	0	196	0	72.1
79	6,505	0.15	0	0	0	0	0	6,505	0	0	98.0	37	5,840	0.13	0	0	4,506	0	0	1,334	0	0	98.0
81	12,311	0.28	0	0	0	0	0	6,184	6,127	0	89.0	38	5,470	0.13	0	0	5,258	0	0	212	0	0	98.0
76	7,835	0.18	0	0	0	0	0	7,835	0	0	98.0	38L	162,023	3.72	0	0	14,696	29,983	117,343	0	0	1	73.3
76L	27,503	0.63	0	0	0	0	0	4,544	22,959	0	83.0	35	8,576	0.20	0	0	0	0	0	8,576	0	0	98.0
77	4,124	0.09	0	0	0	0	0	4,124	0	0	98.0	33L	1,846	0.04	0	0	0	0	0	1,846	0	0	98.0
73	2,226	0.05	0	0	0	0	0	2,226	0	0	98.0	33L	138,367	3.18	0	0	17,806	40,447	68,045	0	0	12,069	75.4
74	1,705	0.04	0	0	0	0	0	1,705	0	0	98.0	30	6,569	0.15	0	0	0	0	0	6,569	0	0	98.0
74L	28,037	0.64	0	0	0	0	0	5,760	21,644	633	83.6	27	6,554	0.15	0	0	0	0	0	6,463	91	0	97.8
71	1,445	0.03	0	0	0	0	0	1,445	0	0	98.0	28	2,031	0.05	0	0	2,031	0	0	0	0	0	98.0
71L	25,092	0.58	0	0	0	0	0	7,699	11,838	5,555	84.9	28L	181,735	4.17	0	0	15,734	39,506	96,718	5,993	18,385	5,399	75.4
68	5,722	0.13	0	0	0	0	0	5,722	0	0	98.0	25	8,232	0.19	0	0	0	0	0	6,415	1,817	0	94.0
69	3,851	0.09	0	0	0	0	0	3,851	0	0	98.0	22	6,192	0.14	0	0	0	0	0	5,923	269	0	97.2
69L	40,617	0.93	0	0	0	0	0	4,327	12,533	23,757	80.2	23	3,645	0.08	0	0	0	0	0	3,645	0	0	98.0
66	2,004	0.05	0	0	0	0	0	2,004	0	0	98.0	23L	204,858	4.70	0	0	15,745	24,705	81,814	11,828	27,962	42,804	77.1
66L	64,120	1.47	0	0	2,423	6,834	6,119	2,054	30,792	15,898	78.9	19	7,073	0.16	0	0	5,453	0	0	1,620	0	0	98.0
63	4,123	0.09	0	0	0	0	0	4,123	0	0	98.0	19L	80,704	1.85	0	0	9,220	16,471	54,931	0	82	0	74.0
64	2,169	0.05	0	0	0	0	0	2,169	0	0	98.0	15	5,517	0.13	0	0	4,532	0	0	985	0	0	98.0
64L	56,611	1.30	0	0	3,477	15,543	9,087	4,980	16,388	7,136	79.1	16	7,154	0.16	0	0	7,154	0	0	0	0	0	98.0
61	2,396	0.06	0	0	0	0	0	2,396	0	0	98.0	16L	76,910	1.77	0	0	2,963	5,152	68,795	0	0	0	71.3
61L	76,056	1.75	0	0	0	17,928	25,084	12,783	17,200	3,061	78.2	culvert 2L	60,522	1.39	0	0	0	0	0	964	0	0	70.2
59	6,200	0.14	0	0	0	0	0	6,200	0	0	98.0	culvert 2P	124,952	2.87	0	0	6,688	13,310	85,666	0	19,288	0	73.5
58	2,798	0.06	0	0	0	0	0	2,798	0	0	98.0	11	9,632	0.22	0	0	3,138	0	0	6,494	0	0	98.0
58L	74,005	1.70	0	0	0	27,893	16,390	8,470	21,252	0	77.6	12	1,662	0.04	0	0	665	0	0	997	0	0	98.0
56	1,525	0.04	0	0	0	0	0	1,525	0	0	98.0	8	6,230	0.14	0	0	0	0	0	6,230	0	0	98.0
56L	92,483	2.12	0	0	5,834	24,951	38,770	876	17,020	5,032	75.3	9	9,930	0.23	75	1,246	0	0	0	4,692	3,917	0	86.3
53	3,962	0.09	0	0	0	0	0	3,962	0	0	98.0	blake 1 pond	115,785	2.66	6,987	0	16,933	2,406	77,901	11,558	0	0	78.7
54	1,541	0.04	0	0	0	0	0	1,541	0	0	98.0	Blake 2	24,816	0.57	7,748	5,813	0	0	0	9,820	1,435	0	88.3
54L	91,793	2.11	0	0	8,264	20,608	39,048	6,296	9,218	8,359	77.0	4	1,842	0.04	0	0	0	0	0	1,842	0	0	98.0
51	1,394	0.03	0	0	0	0	0	1,394	0	0	98.0	5	11,241	0.26	6,428	1,698	0	0	0	3,115	0	0	92.4
51L	104,544	2.40	0	0	3,269	15,199	72,274	3,690	5,767	4,345	73.3	105	1,205	0.03	0	0	0	0	0	1,205	0	0	98.0
49	95,888	2.20	0	0	3,812	48,393	32,319	0	8,270	3,094	74.2	106	6,796	0.16	1,677	0	0	0	5,119	0	0	98.0	
45	6,149	0.14	0	0	0	0	0	6,149	0	0	98.0	102	3,540	0.08	0	0	0	0	0	3,540	0	0	98.0
46	3,785	0.09	0	0	0	0	0	3,785	0	0	98.0	103	5,459	0.13	0	0	0	0	0	5,459	0	0	98.0
46L	87,687	2.01	0	0	8,817	63,491	10,410	880	3,181	908	76.4	EX32	9,178	0.21	0	0	0	0	0	9,178	0	0	98.0
43	1,141	0.03	0	0	4	0	0	1,137	0	0	98.0	EX33	6,953	0.16	0	0	0	0	0	6,953	0	0	98.0
43L	21,906	0.50	0	0	0	19,409	2,061	0	436	0	73.7												

**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		-	-
PROJECT FILE NO. 609035			

**PROPOSED DRAINAGE AREA - 2 OF 2**

## **4 SUPPORTING MAPS AND DATA**

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North  
1" = 1000'



Figure 1

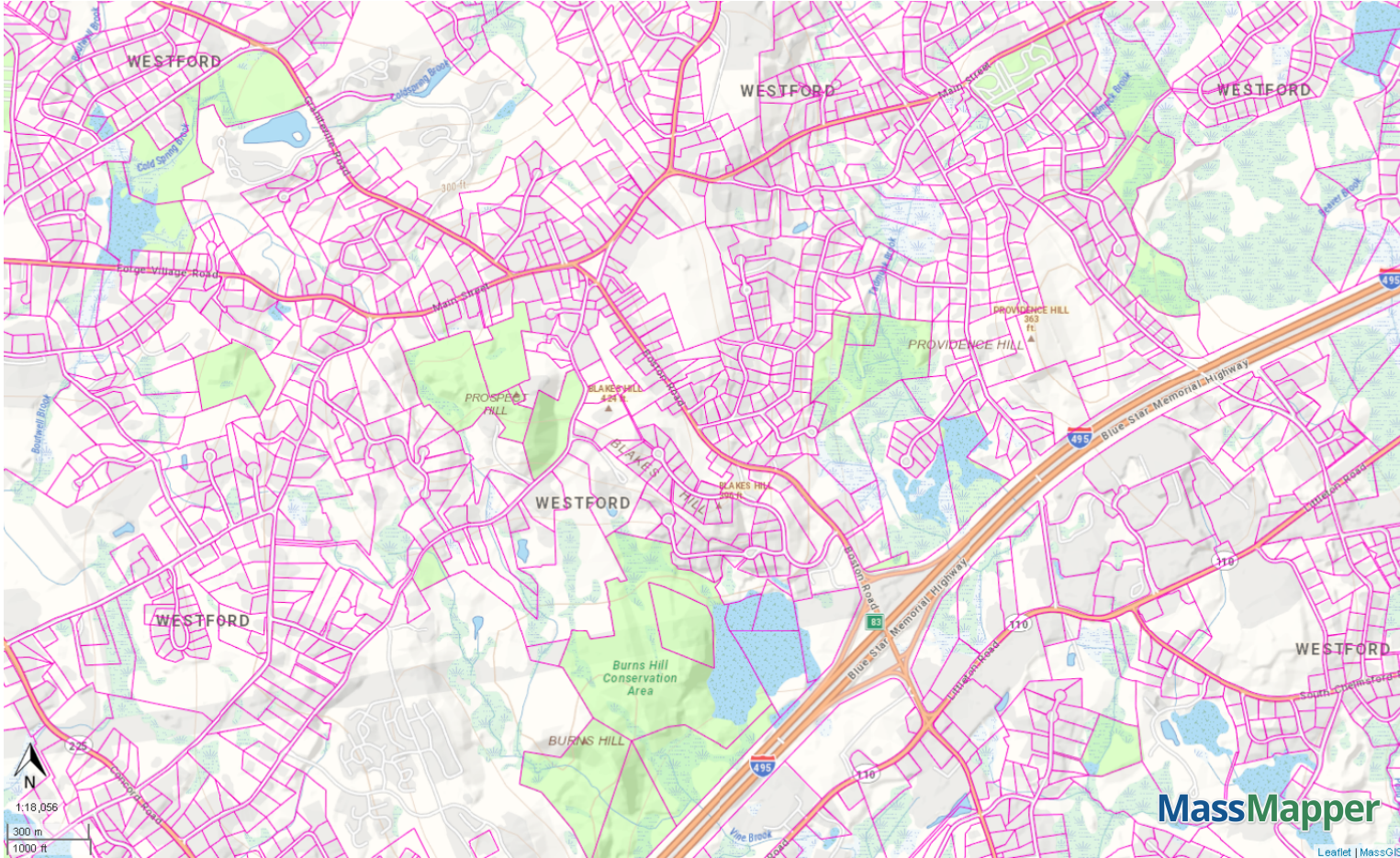
Project Location Map



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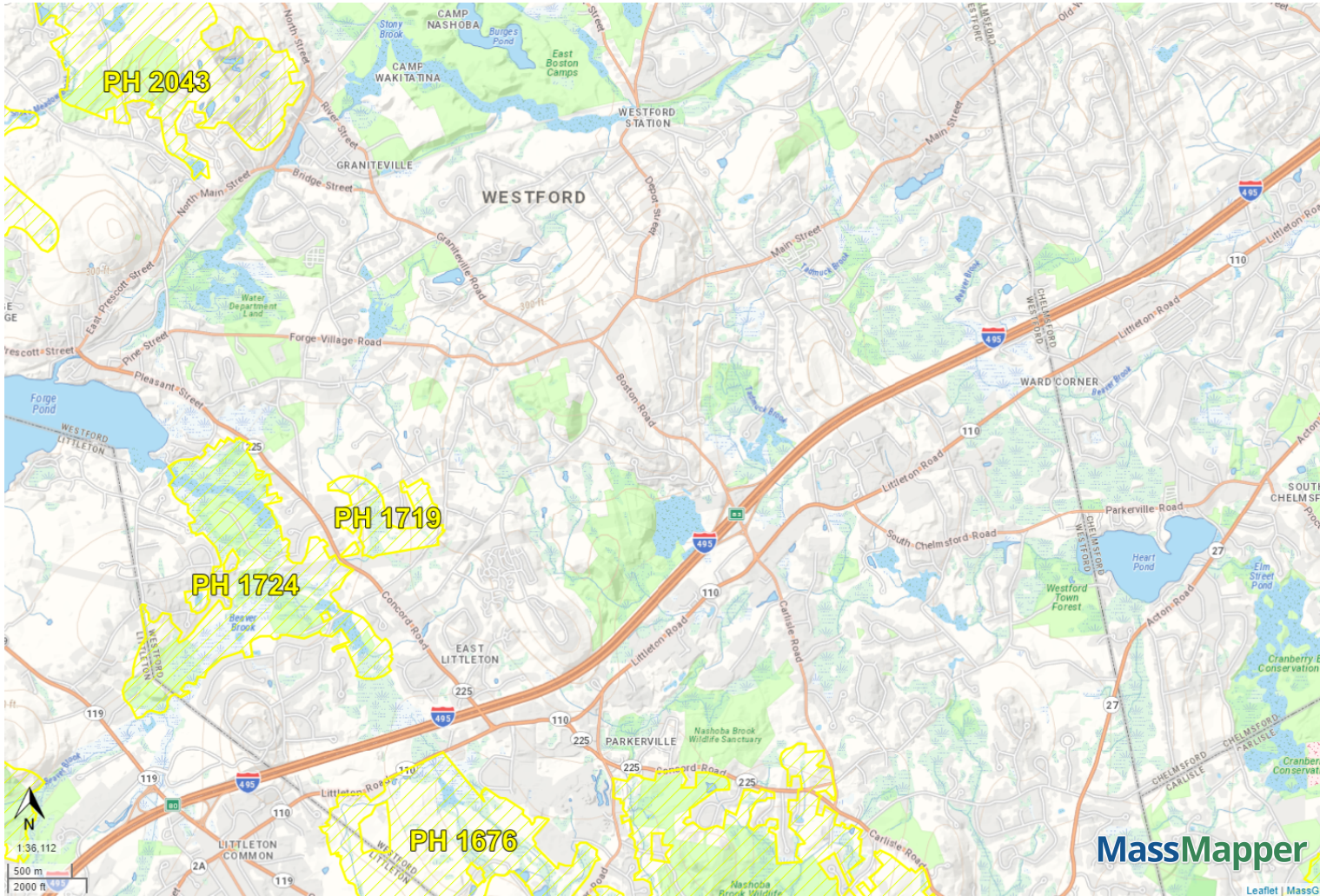
Proposal No. 609035-126590  
**Boston Road - Westford**

Property Tax Parcels





# NHESP Priority Habitats of Rare Species



NHESP Priority Habitats of Rare Species



NHESP Estimated Habitats of Rare Wildlife



Property Tax Parcels

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The projection used in the preparation of this map was Massachusetts State Plane Mainland Zone (FIPS zone 2001). The horizontal datum was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services  
NOAA, NNGS12  
National Geodetic Survey  
SSMC-3, #9202  
1315 East-West Highway  
Silver Spring, Maryland 20910-3282  
(301) 713-3242

To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was derived from orthophotography provided by MassGIS at a scale of 1:500 from photography dated April 2008.

The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

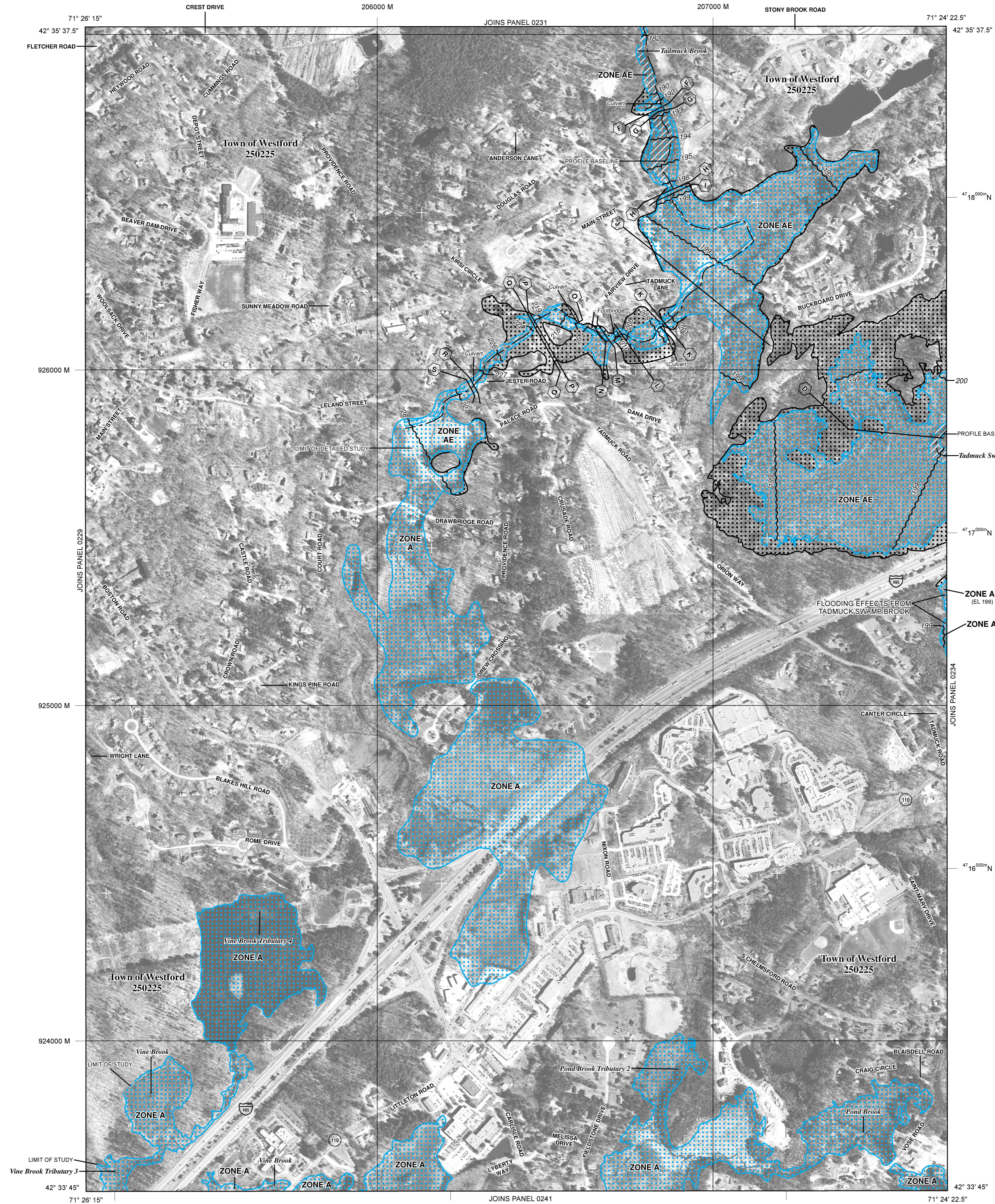
This map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed Map Index for an overview map of the county showing the layout of map panels, community map repository addresses, and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the Map Service Center (MSC) website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have questions about this map, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange (FMIX) at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.



LEGEND

LEGEND

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
- ZONE A: No Base Flood Elevations determined.
- ZONE AE: Base Flood Elevations determined.
- ZONE AH: Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR: Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently described. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99: Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V: Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE: Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE
- OTHER FLOOD AREAS
- ZONE X: Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS
- ZONE D: Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D: Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
- OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- Base Flood Elevation line and value; elevation in feet\*
- Base Flood Elevation value where uniform within zone; elevation in feet\*

\*Referenced to the North American Vertical Datum of 1988

- Cross section line
- Transect line
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 4989000 M
- 1000-meter ticks: Massachusetts State Plane Mainland Zone (FIPS Zone 2001), Lambert Conformal Conic projection
- 1000-meter Universal Transverse Mercator grid values, zone 19
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River Mile
- MAP REPOSITORIES
- Refer to Map Repositories list on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
- June 4, 2010
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
- July 7, 2014 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET  
150 0 150 300 METERS

PANEL 0233F

**FIRM**  
FLOOD INSURANCE RATE MAP  
MIDDLESEX COUNTY,  
MASSACHUSETTS  
(ALL JURISDICTIONS)

PANEL 233 OF 656  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
WESTFORD, TOWN OF	250225	0233	F

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER  
25017C0233F  
MAP REVISED  
JULY 7, 2014

Federal Emergency Management Agency

### NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' National North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Massachusetts State Plane Mainland zone (FIPSZONE 2001), meters. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services  
NOAA, NINGS12  
National Geodetic Survey  
SSMC-3, #9202  
1315 East-West Highway  
Silver Spring, Maryland 20910-3282  
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

**Base map** information shown on this FIRM was provided in digital format by the Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs. This information was derived from digital orthophotos produced at a scale of 1:5,000 from aerial photography dated April 2005.

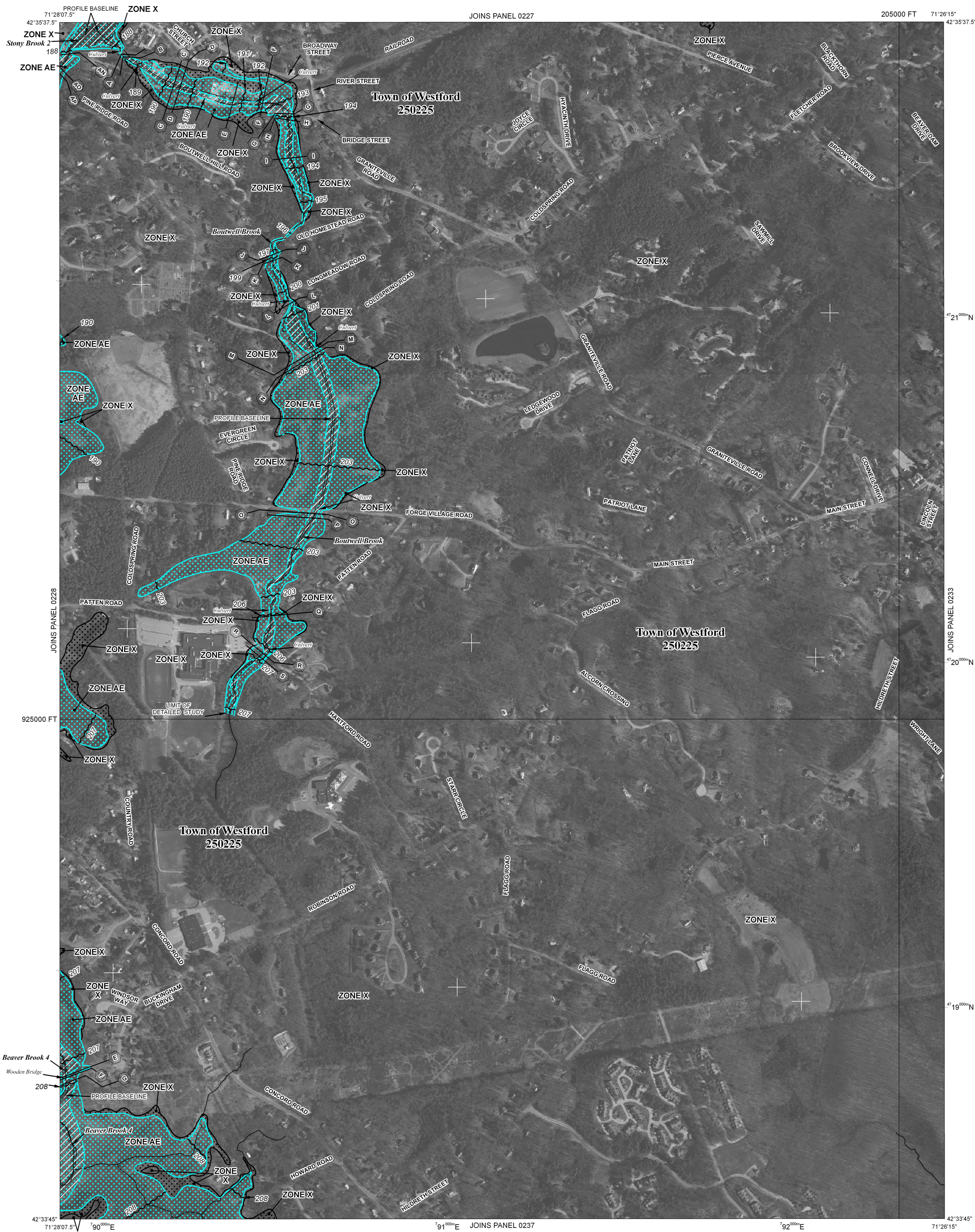
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at <http://msc.fema.gov>.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov>.



### LEGEND

- SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**
  - ZONE A** No Base Flood Elevations determined.
  - ZONE AE** Base Flood Elevations determined.
  - ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
  - ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
  - ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently desiccated. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
  - ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
  - ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
  - ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE**
  - The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- OTHER FLOOD AREAS**
  - ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS**
  - Areas determined to be outside the 0.2% annual chance floodplain.
  - Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
- OTHERWISE PROTECTED AREAS (OPAs)**
  - CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
- 1% annual chance floodplain boundary**
- 0.2% annual chance floodplain boundary**
- Floodway boundary**
- Zone D boundary**
- CBRS and OPA boundary**
- Boundary dividing Special Flood Hazard Area Zones and floodway dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.**
- Base Flood Elevation line and value; elevation in feet\***
- Base Flood Elevation value where uniform within zone; elevation in feet\***

\* Referenced to the North American Vertical Datum of 1988

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

1000-meter Universal Transverse Mercator grid values, zone 19

600000 FT 5000-foot grid values: Massachusetts State Plane coordinate system, Mainland zone (FIPSZONE 2001), Lambert Conformal Conic projection

DX5510 x Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORY  
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP  
June 4, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

PANEL 0229E

**FIRM**  
FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY,  
MASSACHUSETTS  
(ALL JURISDICTIONS)

PANEL 229 OF 656  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:  
COMMUNITY NUMBER PANEL SUFFIX  
WESTFORD, TOWN OF 250225 0229 E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER  
25017C0229E

EFFECTIVE DATE  
JUNE 4, 2010

Federal Emergency Management Agency

## **5 PHOTO LOG**

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Photo 1 – View looking North along Boston Road at Crown Road



**Photo 2 – View looking South along Boston Road Adjacent to #44 Boston Road**



**Photo 3 – View looking from roadway at Proposed Outlet Sediment Trap**



Photo 4 – View looking North at Proposed Outlet Sediment Trap – Existing Outlet Shown





**Photo 5 – View looking South along Boston Road at I-495 Southbound Ramp**



**Photo 6 – View looking East at Location of Future Access Road to Wet Detention Basin**



## **6 ABUTTERS INFORMATION**

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TOWN OF WESTFORD

55 Main Street  
WESTFORD, MA 01886  
978.692.5504

BOARD OF ASSESSORS  
Titus Palmer, Chair  
Diane Holmes, Member  
David J. Flanagan, Member

**REQUEST FOR CERTIFIED LIST OF ABUTTERS**

DATE OF REQUEST: March 13, 2023

PROPERTY OWNER: Naga Venkata Lakshmi, Sandeep Inampudi & Pallavi Doradla - 1 Crown Road  
Peter L Pozerski & Jessica L Pozerski - 44 Boston Road

PROPERTY LOCATION: 1 Crown Road a & 44 Boston Road  
021-0014-0000 - 1 Crown Road  
021-0115-000 - 44 Boston Road

PARCEL ID: map \_\_\_\_\_ parcel \_\_\_\_\_ lot \_\_\_\_\_  
(if multiple PARCELS, PLEASE CALL ASSESSING DEPT FIRST)

RADIUS IN FEET: 100'

REQUESTING BOARD/DEPT:  \*Planning Board  \*Zoning Board of Appeals  
 Health Dept.  Conservation Comm.  
 Liquor License (immediate & across street)  
 Scenic Road (100' of proposed action)  
*\*per MGL Chapter 40A s.11*

❖ *Planning Board is typically 300', Conservation Comm. is typically 100'*  
**HOWEVER, PLEASE CHECK WITH BOARD or DEPT FOR SPECIFIED RADIUS IN FEET, BEFORE PLACING REQUEST**

**APPLICANT**

Name: Tom Quinlan, P.E.  
Address: TEC, Inc. 282 Merrimack Street Lawrence, MA 01843  
Phone: 781-789-5231  
Email: tquinlan@theengineeringcorp.com

FEE: \$35 per list paid at time of request *No fee ✓*

- Pay online at <https://epay.cityhallsystems.com/selection>, OR
- Pay by check or cash. [additional fee may apply if non-standard list or multi-parcels]

**THIS LIST IS VALID FOR 90 DAYS FROM CERTIFICATION DATE. DEPARTMENT RESERVES 10 WORKING DAYS TO PROVIDE ALL CERTIFIED LISTS OF ABUTTERS.**

- Road Surface
- Dirt Road
- Paved Road
- Parking Lots
- Driveways
- Bridges
- EOC Markup - Lines
- EOC Markup Text
- Points Of Interest
- Westford Streets
- Streets
- Parcels for Identify
- Pools
- Railroad
- AthleticFields
- Road Outlines
- Bruce Freeman Rail T
- Buildings
- Old Buildings
- Parcels
- PartEasement
- WestfordStarfile
- Abutting Town Name
- Town Boundary
- MA Highways
- US Highway Interstate
- State Highway
- MA Abutting Towns
- NH Abutting Towns
- MA Water Bodies
- LAKE
- RESERVOIR
- Ponds
- Town Mask



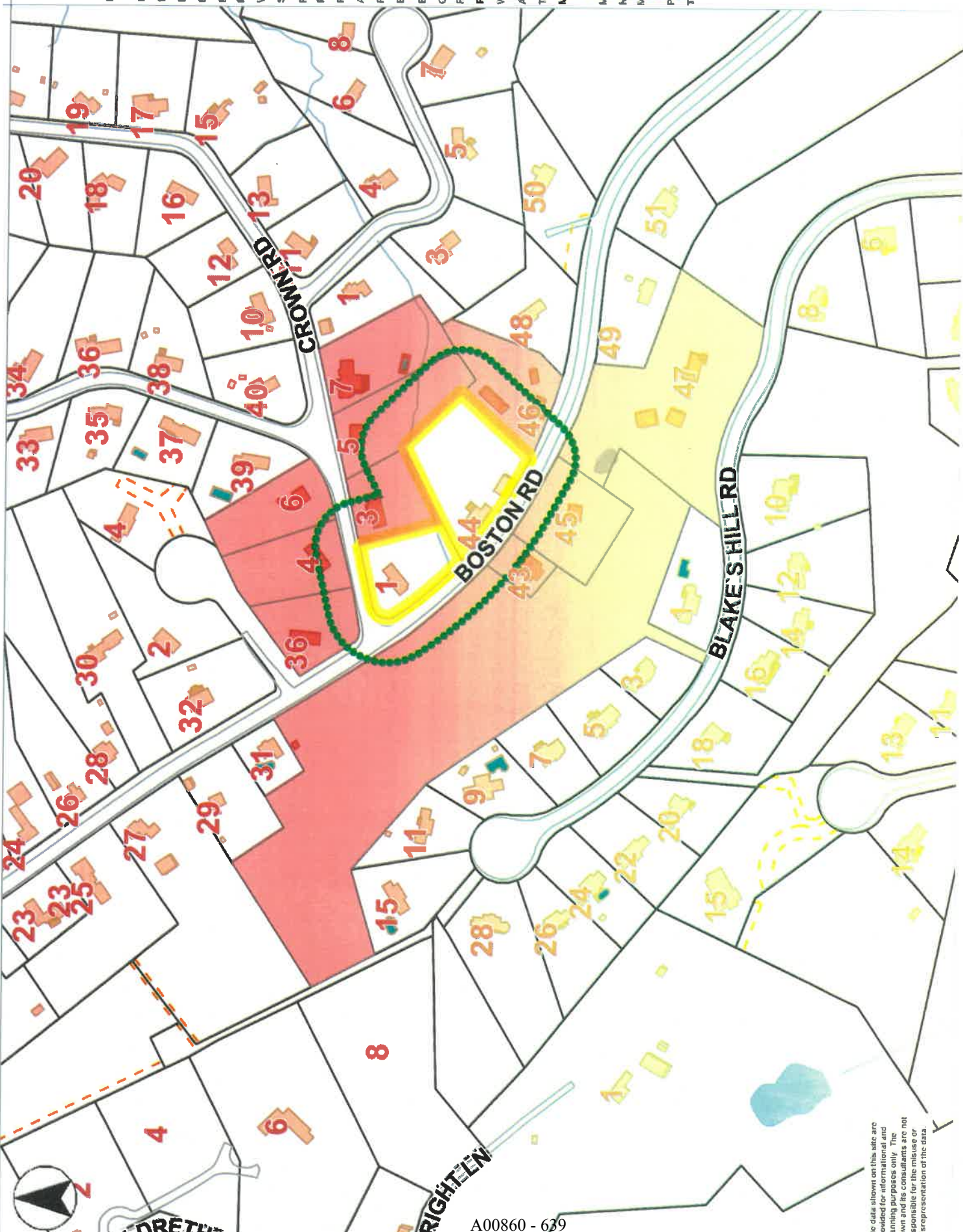
A00860 - 638

The data shown on this site are provided for informational and planning purposes only. The Town and its consultants are not responsible for the misuse or misrepresentation of the data.

400 800 ft

Printed on 03/13/2023 at 11:38 AM

- Road Surface
- Dirt Road
- Paved Road
- Parking Lots
- Driveways
- Bridges
- EOC Markup - Lines
- EOC Markup Text
- Points Of Interest
- Westford Streets
- Streets
- Parcels for Identify
- Pools
- Railroad
- Athletic Fields
- Road Outlines
- Bruce Freeman Rail T
- Buildings
- Out Buildings
- Parcels
- ParEasement
- WestfordSiteSite
- Abutting Town Name
- Town Boundary
- MA Highways
- US Highway
- State Highway
- MA Abutting Towns
- NH Abutting Towns
- MA Water Bodies
- LAKE
- RESERVOIR
- Ponds
- Town Mask



# Westford Staff MapsOnline

Printed on 03/13/2023 at 11:39 AM

800 ft  
400

The data shown on this site are provided for informational and planning purposes only. The town and its consultants are not responsible for the misuse or misrepresentation of the data.

**Abutters List**

Date: March 13, 2023

owner: Inampudi, Naga Venkata Lakshmi S  
Doradla, Pallavi  
1 Crown Rd.  
Westford, MA 01886

print this list

Subject Property Address: 1 CROWN RD Westford, MA  
Subject Property ID: 021 0114 0000

Subject Property Address: 44 BOSTON RD Westford, MA  
Subject Property ID: 021 0115 0000

owner: Pozerski, Peter J.  
Pozerski, Jessica L.  
44 Boston Rd.  
Westford, MA 01886

Search Distance: 100 Feet

THIS IS A CERTIFIED ABUTTERS LIST FROM THE TOWN OF WESTFORD. WE CERTIFY  
THAT ALL THE NAMES AND ADDRESSES OF ALL PROPERTY OWNERS ARE ACCURATE TO  
THE BEST OF OUR KNOWLEDGE.

Owner: NEWBOWER DANIEL L  
Co-Owner: NEWBOWER VANESSA M  
Prop ID: 021 0107 0000  
Prop Location: 45 BOSTON RD Westford, MA  
Mailing Address:

one side 3/13/23  
Office of the Board of Assessors Date



45 BOSTON RD  
WESTFORD, MA 01886

Owner: ZHANG JING LEI  
Co-Owner: GE JIAN PING  
Prop ID: 021 0108 0000  
Prop Location: 43 BOSTON RD Westford, MA  
Mailing Address:  
103 INDIAN HILL  
CARLISLE, MA 01741

Owner: ORCHARD HILL TRUST  
Co-Owner: AIMY TSE  
Prop ID: 021 0109 0001  
Prop Location: BLAKE`S HILL RD Westford, MA  
Mailing Address:  
9 BLAKES HILL RD  
WESTFORD, MA 01886

Owner: SCOTT, JR. JOHN RUSSELL  
Co-Owner:  
Prop ID: 021 0110 0000  
Prop Location: 36 BOSTON RD Westford, MA  
Mailing Address:

36 BOSTON RD  
WESTFORD, MA 01886

---

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Owner: ANDERSON NOMINEE TRUST U/D/T 12/21/00  
Co-Owner: DAVID B ANDERSON -TRUSTEE  
Prop ID: 021 0111 0000  
Prop Location: 4 CROWN RD Westford, MA  
Mailing Address:  
4 CROWN RD  
WESTFORD, MA 01886

---

---

Owner: MORSE CHRISTINA  
Co-Owner: MORSE EVAN  
Prop ID: 021 0112 0000  
Prop Location: 6 CROWN RD Westford, MA  
Mailing Address:  
6 CROWN RD  
WESTFORD, MA 01886

---

---

Owner: WANG JIM PO  
Co-Owner: LIU YI LING  
Prop ID: 021 0113 0000  
Prop Location: 3 CROWN RD Westford, MA  
Mailing Address:  
3 CROWN RD  
WESTFORD, MA 01886

---

---

Owner: MACDOUGALL STEPHEN C  
Co-Owner: MACDOUGALL SHIRLEY  
Prop ID: 022 0006 0004  
Prop Location: 47 BOSTON RD Westford, MA  
Mailing Address:  
47 BOSTON ROAD  
WESTFORD, MA 01886

---

---

Owner: MACKAY SCOTT D  
Co-Owner: MACKAY MARYANNE R  
Prop ID: 022 0112 0000

Prop Location: 7 CROWN RD Westford, MA

Mailing Address:

7 CROWN RD  
WESTFORD, MA 01886

---

Owner: MASOW ROBERT H

Co-Owner: MASOW JANET L

Prop ID: 022 0113 0000

Prop Location: 5 CROWN RD Westford, MA

Mailing Address:

5 CROWN RD  
WESTFORD, MA 01886

---

Owner: SRIRAM RADHIKA

Co-Owner: GANDHI MANISH

Prop ID: 022 0114 0001

Prop Location: 46 BOSTON RD Westford, MA

Mailing Address:

46 BOSTON ROAD  
WESTFORD, MA 01886

---



29 FEB 28  
TOWN OF WESTFORD



TOWN OF WESTFORD

55 Main Street  
WESTFORD, MA 01886  
978.692.5504

BOARD OF ASSESSORS  
Titus Palmer, Chair  
Diane Holmes, Member  
David J. Flanagan, Member

**REQUEST FOR CERTIFIED LIST OF ABUTTERS**

DATE OF REQUEST: February 28, 2023

PROPERTY OWNER: Town of Westford

PROPERTY LOCATION: Boston Road

PARCEL ID: map 022 parcel 0117 lot 0001 & 0002 #0016  
(if multiple PARCELS, PLEASE CALL ASSESSING DEPT FIRST)

RADIUS IN FEET: 100 Feet

REQUESTING BOARD/DEPT:  \*Planning Board  \*Zoning Board of Appeals  
 Health Dept.  Conservation Comm.  
 Liquor License (immediate & across street)  
 Scenic Road (100' of proposed action)  
\*per MGL Chapter 40A s.11

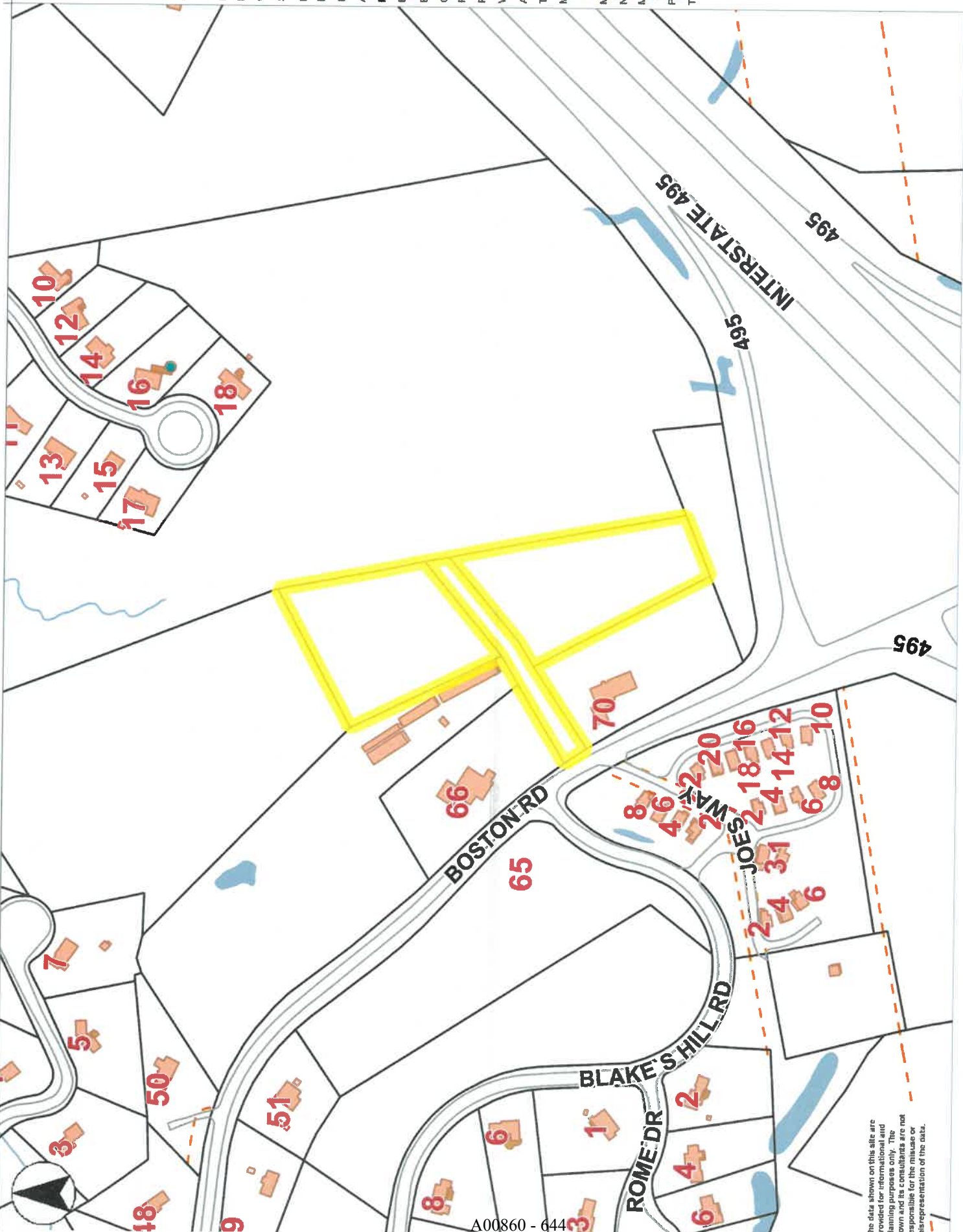
❖ *Planning Board is typically 300', Conservation Comm. is typically 100'*  
**HOWEVER, PLEASE CHECK WITH BOARD or DEPT FOR SPECIFIED RADIUS IN FEET, BEFORE PLACING REQUEST**

**APPLICANT**

Name: Tom Quinlan, P.E.  
Address: TEC, Inc. 282 Merrimack Street Lawrence, MA 01843  
Phone: 781-789-5231  
Email: tquinlan@theengineeringcorp.com

- o FEE: \$35 per list paid at time of request
  - o Pay online at <https://epay.cityhallsystems.com/selection>, OR
  - o Pay by check or cash. [additional fee may apply if non-standard list or multi-parcels]
- THIS LIST IS VALID FOR 90 DAYS FROM CERTIFICATION DATE. DEPARTMENT RESERVES 10 WORKING DAYS TO PROVIDE ALL CERTIFIED LISTS OF ABUTTERS.**

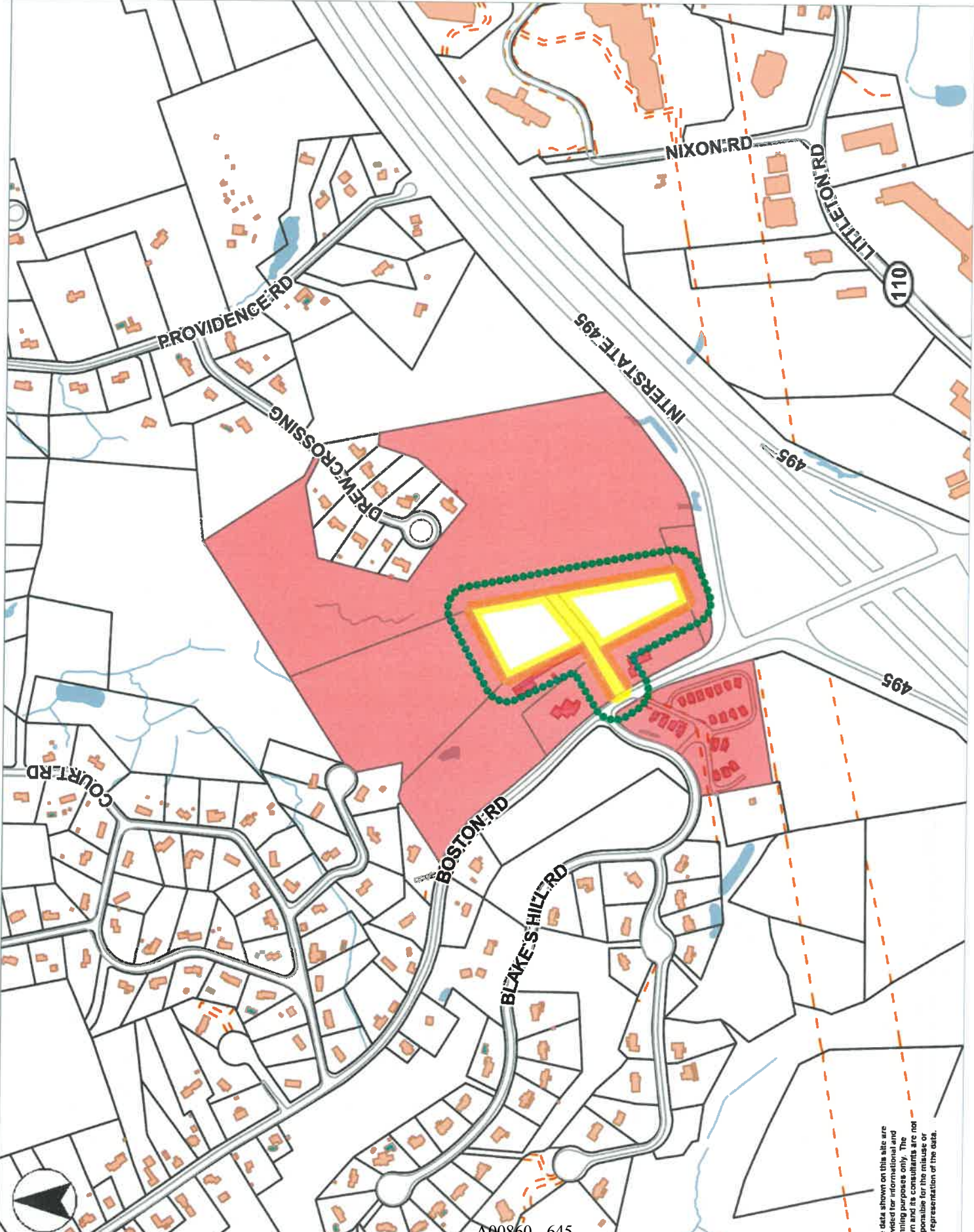
- Road Surface
- Dirt Road
- Paved Road
- Parking Lots
- Driveways
- Bridges
- EOC Markup - Lines
- EOC Markup Text
- Points Of Interest
- Westford Streets
- Streets
- Parcels for Identify
- Pools
- Railroad
- AthleticFields
- Road Outlines
- Bruce Freeman Rail T
- Buildings
- Out Buildings
- Parcels
- PartEasement
- WestfordStaflsile
- Abutting Town Name
- Town Boundary
- MA Highways
- Interstate
- US Highway
- State Highway
- MA Abutting Towns
- NH Abutting Towns
- MA Water Bodies
- LAKE
- RESERVOIR
- Ponds
- Town Mask



The data shown on this site are provided for informational and planning purposes only. The Town and its consultants are not responsible for the misuse or misrepresentation of the data.

A00860 - 644

- Road Surface
- Dirt Road
- Paved Road
- Parking Lots
- Driveways
- Bridges
- EOC Markup - Lines
- EOC Markup Text
- Points Of Interest
- Westford Streets
- Streets
- Parcels for Identify
- Pools
- Railroad
- Athletic Fields
- Road Outlines
- Bruce Freeman Rail T
- Buildings
- Out Buildings
- Parcels
- Particement
- Westford Steffsite
- Abutting Town Names
- Town Boundary
- MA Highways
- Interstate
- US Highway
- State Highway
- MA Abutting Towns
- NH Abutting Towns
- MA Water Bodies
- LAKE
- RESERVOIR
- Ponds
- Town Mask



# Westford Staff MapsOnline

Printed on 02/28/2023 at 12:15 PM

1600 ft  
800

The data shown on this site are provided for informational and planning purposes only. The town and its consultants are not responsible for the misuse or misrepresentation of the data.

**Abutters List**

print this list

Date: February 28, 2023

Subject Property Address: BOSTON RD Westford, MA  
Subject Property ID: 022 0117 0001

*owner: Town of Westford  
55 Main St.  
Westford, MA  
01886*

Subject Property Address: BOSTON RD Westford, MA  
Subject Property ID: 022 0117 0002

Subject Property Address: BOSTON RD Westford, MA  
Subject Property ID: 022 0117 0016

Search Distance: 100 Feet

THIS IS A CERTIFIED ABUTTERS LIST FROM THE TOWN OF WESTFORD. WE CERTIFY THAT ALL THE NAMES AND ADDRESSES OF ALL PROPERTY OWNERS ARE ACCURATE TO THE BEST OF OUR KNOWLEDGE.

Owner: BOSTON ROAD HOMES, LLC  
Co-Owner:  
Prop ID: 022 0003 0100  
Prop Location: LOT G-1 BOSTON RD Westford, MA  
Mailing Address:

*one file 2/28/23*  
Office of the Board of Assessors      Date



487 GROTON ROAD  
WESTFORD, MA 01886

Owner: MONTMINY ARTHUR G, III  
Co-Owner:  
Prop ID: 022 0003 0101  
Prop Location: 2 JOE`S WAY Westford, MA  
Mailing Address:  
2 JOE`S WAY  
WESTFORD, MA 01886

Owner: SACCHI JENNIFER LYN  
Co-Owner:  
Prop ID: 022 0003 0102  
Prop Location: 4 JOE`S WAY Westford, MA  
Mailing Address:  
4 JOE`S WAY  
WESTFORD, MA 01886

Owner: ABBOTT NICHOLAS E  
Co-Owner: ABBOTT LISA M  
Prop ID: 022 0003 0103

Prop Location: 6 JOE`S WAY Westford, MA  
Mailing Address:  
6 JOE`S WAY  
WESTFORD, MA 01886

---

Owner: ORTOLANO KATHLEEN  
Co-Owner:  
Prop ID: 022 0003 0104  
Prop Location: 8 JOE`S WAY Westford, MA  
Mailing Address:  
8 JOE`S WAY  
WESTFORD, MA 01886

---

Owner: KONG PAGNA M  
Co-Owner: KONG JULIE A  
Prop ID: 022 0003 0105  
Prop Location: 22 PORTER RD Westford, MA  
Mailing Address:  
22 PORTER RD  
WESTFORD, MA 01886

---

Owner: HIGGENBOTTOM AGUSTININGSIH  
Co-Owner:  
Prop ID: 022 0003 0106  
Prop Location: 20 PORTER RD Westford, MA  
Mailing Address:  
20 PORTER RD  
WESTFORD, MA 01886

---

Owner: LWIN AYE AYE  
Co-Owner: OO KHIN MAUNG  
Prop ID: 022 0003 0107  
Prop Location: 18 PORTER RD Westford, MA  
Mailing Address:  
18 PORTER RD  
WESTFORD, MA 01886

---

Owner: ANNAND CHRISTOPHER  
Co-Owner:

Prop ID: 022 0003 0108  
Prop Location: 16 PORTER RD Westford, MA  
Mailing Address:  
16 PORTER RD  
WESTFORD, MA 01886

---

Owner: TRACEY NICOLE M  
Co-Owner:  
Prop ID: 022 0003 0109  
Prop Location: 14 PORTER RD Westford, MA  
Mailing Address:  
14 PORTER RD  
WESTFORD, MA 01886

---

Owner: CAO THONG TUAN  
Co-Owner:  
Prop ID: 022 0003 0110  
Prop Location: 12 PORTER RD Westford, MA  
Mailing Address:  
12 PORTER RD  
WESTFORD, MA 01886

---

Owner: PALMER DYLAN R  
Co-Owner:  
Prop ID: 022 0003 0111  
Prop Location: 10 PORTER RD Westford, MA  
Mailing Address:  
10 PORTER RD  
WESTFORD, MA 01886

---

Owner: STEPHENS JESSICA  
Co-Owner:  
Prop ID: 022 0003 0112  
Prop Location: 8 PORTER RD Westford, MA  
Mailing Address:  
8 PORTER RD  
WESTFORD, MA 01886

---

Owner: CAPRIO GIANNA

Co-Owner:  
Prop ID: 022 0003 0113  
Prop Location: 6 PORTER RD Westford, MA  
Mailing Address:  
6 PORTER RD  
WESTFORD, MA 01886

---

Owner: FOLGER STEPHANIE A  
Co-Owner:  
Prop ID: 022 0003 0114  
Prop Location: 4 PORTER RD Westford, MA  
Mailing Address:  
4 PORTER RD  
WESTFORD, MA 01886

---

Owner: PATEL PRAVINCHANDRA  
Co-Owner: PATEL VAISHALIBEN  
Prop ID: 022 0003 0115  
Prop Location: 2 PORTER RD Westford, MA  
Mailing Address:  
2 PORTER RD  
WESTFORD, MA 01886

---

Owner: SPANOS SHARON ELIZABETH  
Co-Owner:  
Prop ID: 022 0003 0116  
Prop Location: 1 PORTER RD Westford, MA  
Mailing Address:  
1 PORTER RD  
WESTFORD, MA 01886

---

Owner: GEORGE MAUREEN  
Co-Owner:  
Prop ID: 022 0003 0117  
Prop Location: 3 PORTER RD Westford, MA  
Mailing Address:  
3 PORTER RD  
WESTFORD, MA 01886

---

Owner: MANSOUR SUAD  
Co-Owner: ABDULHUSSIEN MAJID  
Prop ID: 022 0003 0118  
Prop Location: 6 ADELIN LN Westford, MA  
Mailing Address:  
6 ADELIN LANE  
WESTFORD, MA 01886

---

Owner: KAMEL MARK MORKOUS  
Co-Owner: KAMEL NANCY NABEEH  
Prop ID: 022 0003 0119  
Prop Location: 4 ADELIN LN Westford, MA  
Mailing Address:  
4 ADELIN LANE  
WESTFORD, MA 01886

---

Owner: DIBISCEGLIE ALEXANDER C  
Co-Owner:  
Prop ID: 022 0003 0120  
Prop Location: 2 ADELIN LN Westford, MA  
Mailing Address:  
2 ADELIN LN  
WESTFORD, MA 01886

---

Owner: WESTFORD GATEWAY, LLC  
Co-Owner:  
Prop ID: 022 0115 0000  
Prop Location: BOSTON RD Westford, MA  
Mailing Address:  
31 PROGRESS AVE  
TYNGSBOROUGH, MA 01879

---

Owner: WESTFORD GATEWAY, LLC  
Co-Owner:  
Prop ID: 022 0116 0000  
Prop Location: 66 BOSTON RD Westford, MA  
Mailing Address:  
31 PROGRESS AVE  
TYNGSBOROUGH, MA 01879

---



---

Owner: WINDEMERE II TRUST  
Co-Owner: PAUL A BRUNELLE  
Prop ID: 022 0117 0003  
Prop Location: BOSTON RD Westford, MA  
Mailing Address:  
13 DREWS CROSSING  
WESTFORD, MA 01886

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---

Owner: TOWN OF WESTFORD  
Co-Owner:  
Prop ID: 022 0117 0004  
Prop Location: DREW CROSSING Westford, MA  
Mailing Address:  
55 MAIN ST  
WESTFORD, MA 01886

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Owner: REALOGY CORPORATION  
Co-Owner: IOANNA HASAN FELL LEASE ADMINISTRATION  
Prop ID: 022 0118 0000  
Prop Location: 70 BOSTON RD Westford, MA  
Mailing Address:  
1415 WEST 22ND ST -SUITE 700E  
OAK BROOK, IL 60523

---

---

Owner: TOWN OF WESTFORD  
Co-Owner: CONSERVATION COMMISSION  
Prop ID: 022 0119 0000  
Prop Location: BOSTON RD Westford, MA  
Mailing Address:  
55 MAIN ST  
WESTFORD, MA 01886

---

**AFFIDAVIT OF SERVICE**

**Under the Massachusetts Wetlands Protection Act**

I, Thomas Quinlan, P.E. hereby certify under the

pains and penalties of perjury that on March 22, 2023 I gave notification to abutters  
date

in compliance with the second paragraph of the Massachusetts General Laws, Chapter 131, Section  
40 and the DEP Guide to Abutter Notification in connection with the following matter:

A(n) Notice of Intent application was filed under the Massachusetts

Wetlands Protection Act by The Town of Westford DPW with the Westford  
name

Conservation Commission on March 22, 2023 for a property located at  
date

Boston Road from Main Street to I-495

The form of notification and the list of abutters to whom it was given and their addresses are attached to this Affidavit of Service.



signature

3/22/2023

date

**Notification to Abutters Under the  
Massachusetts Wetlands Protection Act  
and  
Westford Non-Zoning Wetlands Bylaw**

In accordance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40 and the Westford Non-Zoning Wetlands Bylaw Ch. 171, you are hereby notified of the following.

- A. Applicant's name: Town of Westford Department of Public Works
- B. The applicant has filed with the Westford Conservation Commission:
- Request for Determination of Applicability (RDA) seeking a determination on whether a site or work (activity) will require the filing of a Notice of Intent, or whether the wetland boundary delineations are accurate.
  - Notice of Intent seeking permission to remove, fill, dredge, or alter an Area Subject to Protection under the Wetlands Protection Act (General Laws Chapter 131, Section 40) and Westford Non-Zoning Wetlands Bylaw Chapter 171.

**Summary of proposed project:**

The Town of Westford and the Massachusetts Department of Transportation (MassDOT) are proposing vehicular, bicycle, and pedestrian safety improvements along Boston Road from the intersection of Main Street to the I-495 Southbound off-ramps. The improvements include roadway widening, traffic signal improvements at the intersection of Boston Road and I-495 Southbound off-ramps, sidewalk construction, drainage and stormwater improvements. The project will be funded and constructed by MassDOT.

- C. The address of the proposed activity is: Boston Road from Main Street to I-495  
Assessors Map/Block/Lot: \_\_\_\_\_
- D. The application may be examined at the Westford Conservation Office at Town Hall, 55 Main St., between the hours of 8:00 A.M. and 4:00 P.M. from Monday through Friday. For more information call: 978-692-5524.
- E. Copies of the application may be obtained from either (check one): the applicant X or the applicant's representative \_\_\_\_\_ by calling (978 ) 399 - 2716 \_\_\_\_\_ between the hours of \_\_\_\_\_ and \_\_\_\_\_ on the following days of the week:
- F. **A Public Hearing will be held on:** April 12, 2023 **in the Second Floor Conference Room, Westford Town Hall, 55 Main St., Westford, MA, 01886.**

For more information call the Westford Conservation Commission at 978-692-5524, M - F between 8AM-4PM

NOTE: Notwithstanding the Governor's lifting of the COVID-19 face covering order, meeting attendees are strongly encouraged to wear face masks in Town Hall unless speaking at the microphone.

NOTE: Notice of the public hearing, including its date, time, and place, will be published at least five (5) days in advance in a newspaper of general circulation. (*Eagle Independent or Lowell Sun*)

NOTE: Notice of the public hearing, including its date, time, and place, will be posted at the Westford Town Hall not less than forty-eight (48) hours in advance.

NOTE: You may also contact your local Conservation Commission or the nearest Department of Environmental Protection Regional Office for more information about this application or the Wetland Protection Act. To contact DEP, call: Northeast Region (978) 694-3200.



# TOWN OF WESTFORD CONSERVATION COMMISSION

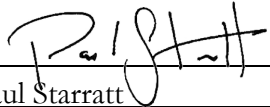
TOWN HALL  
55 Main Street  
WESTFORD, MA 01886  
[msalem@westfordma.gov](mailto:msalem@westfordma.gov)

Telephone (978) 692-5524 Fax (978) 399-2732

Date: March 22, 2023

GateHouse Media New England (Eagle - Independent)  
The Lowell Publishing Company (The Lowell Sun)  
Legal Notice Department

I hereby authorize the GateHouse Media / The Lowell Publishing Company (circle one) to bill me directly for the legal notice to be published in the Eagle - Independent for a public hearing with the Westford Conservation Commission.

Signed:   
Print Name: Paul Starratt  
Address: Westford Department of Public Works  
28 North Street  
Westford, MA 01886  
Phone/Cell Phone No.: 978-399-2716  
E-Mail: pstarratt@westfordma.gov

# MASSACHUSETTS DEPARTMENT OF TRANSPORTATION HIGHWAY DIVISION

PLAN AND PROFILE OF  
BOSTON ROAD

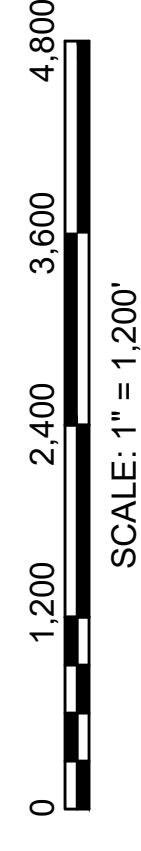
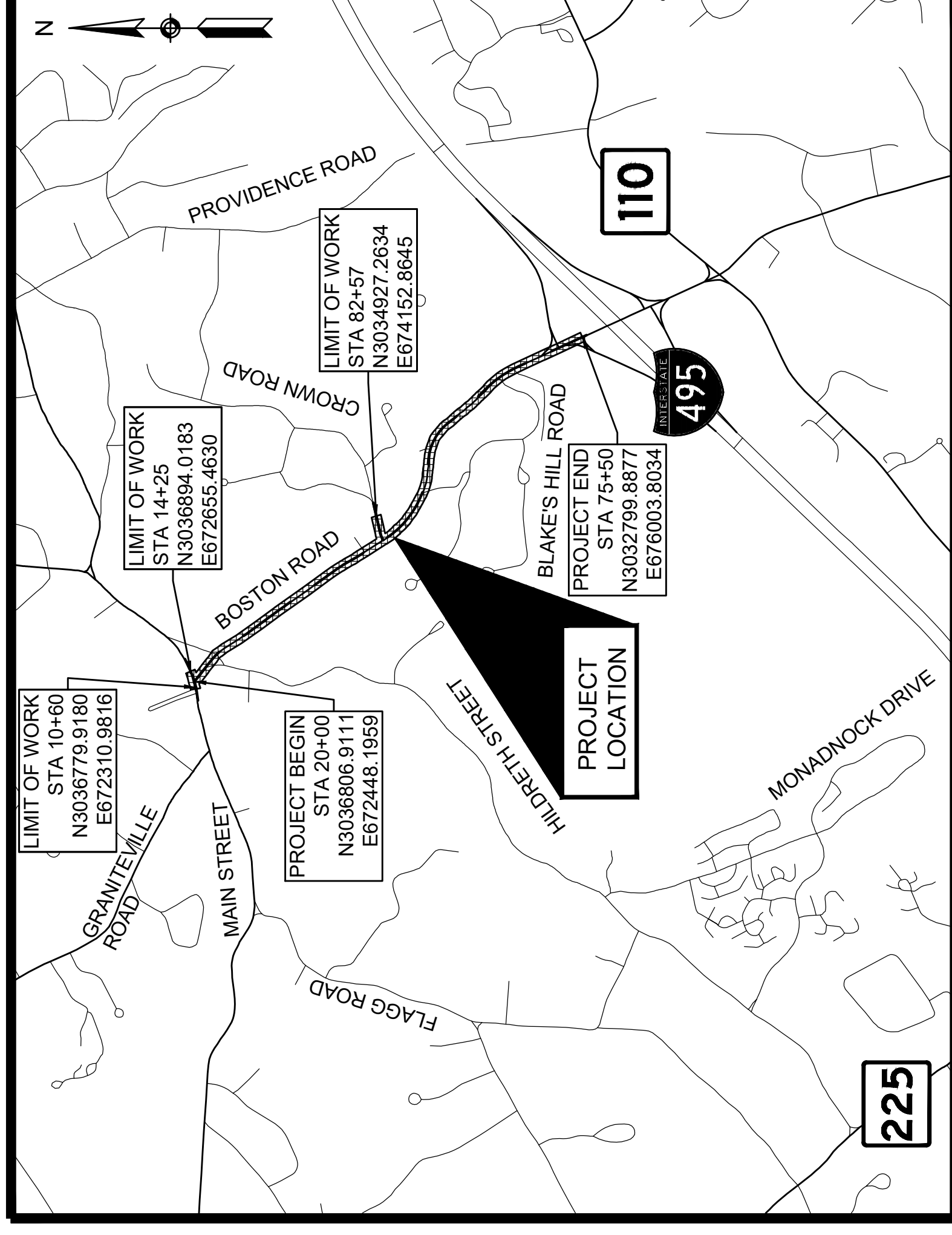
IN THE TOWN OF  
WESTFORD  
MIDDLESEX COUNTY

FEDERAL AID PROJECT NO. -

## NOI SUBMITTAL

SHEET NO.	DESCRIPTION
1	TITLE SHEET & INDEX
2	LEGEND, ABBREVIATIONS & DESCRIPTION OF WORK
3-13	CONSTRUCTION PLANS
14-24	UTILITY PLANS
25-30	CONSTRUCTION DETAILS

RESOURCE AREAS ON SHEETS 7, 13, 18, 24 & 29



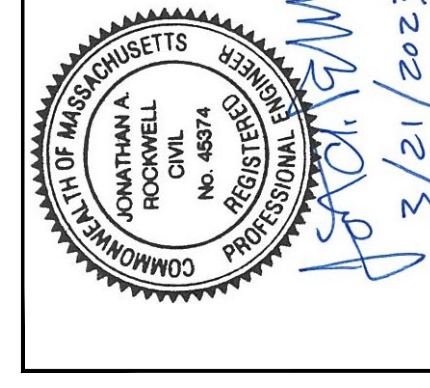
LENGTH OF PROJECT = 5.550 FEET = 1.051 MILES

THESE PLANS ARE SUPPLEMENTED BY THE OCTOBER 2017 CONSTRUCTION STANDARD DETAILS, THE 2015 OVERHEAD SIGNAL STRUCTURE AND FOUNDATION STANDARD DRAWINGS, MASSDOT TRAFFIC MANAGEMENT PLANS AND DETAIL DRAWINGS, THE 1980 STANDARD DRAWINGS FOR SIGNS AND SUPPORTS, THE 1968 STANDARD DRAWINGS FOR TRAFFIC SIGNALS AND HIGHWAY LIGHTING, AND THE LATEST EDITION OF THE AMERICAN STANDARD FOR NURSERY STOCK.

WESTFORD BOSTON ROAD		TOTAL SHEETS	
STATE	FED. AID PROJ. NO.	SHEET NO.	NO.
MA	-	1	30
PROJECT FILE NO. 609035			

### TITLE SHEET & INDEX

DATE	DESCRIPTION	REV #
3/22/2023	NOI SUBMITTAL	0



282 Merrimack St  
2nd Floor  
Lawrence, MA 01843  
978-794-1792

311 Main Street  
2nd Floor  
Worcester, MA 01608  
508-868-5104

169 Ocean Blvd, Unit 3  
Plymouth  
Hannock, MA 03842  
603-601-8154

www.TheEngineeringCorp.com

**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	2	30
PROJECT FILE NO.		609035	

**LEGEND, ABBREVIATIONS &  
DESCRIPTION OF WORK**

**ABBREVIATIONS**

GENERAL	DESCRIPTION
AADT	ANNUAL AVERAGE DAILY TRAFFIC
ABANDON	ABANDON
ADJ	ADJUST
APPROX.	APPROXIMATE
A.C.	ASPHALT CONCRETE
ACCM PIPE	ASPHALT COATED CORRUGATED METAL PIPE
AP	ANGLE POINT
BIT.	BITUMINOUS
BC	BOTTOM OF CURB
BD.	BOUND
BL	BASELINE
BLDG	BUILDING
BM	BENCHMARK
BO	BY OTHERS
BOS	BOTTOM OF SLOPE
BR.	BRIDGE
CB	CATCH BASIN
CBCI	CATCH BASIN WITH CURB INLET
CC	CEMENT CONCRETE
CCB	CAPE COD BERM
CCM	CEMENT CONCRETE MASONRY
CEM	CEMENT
CI	CURB INLET
CIP	CAST IRON PIPE
CLF	CHAIN LINK FENCE
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CSP	CORRUGATED STEEL PIPE
CO.	COUNTY
CONC	CONCRETE
CONT	CONTINUOUS
CONST	CONSTRUCTION
CR GR	CROWN GRADE
DHV	DESIGN HOURLY VOLUME
DI	DROP INLET
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
DW	STEADY DONT WALK - PORTLAND ORANGE
DWY	DRIVEWAY
ELEV (or EL.)	ELEVATION
EMB	EMBANKMENT
EOP (or EP)	EDGE OF PAVEMENT
EXIST (or EX)	EXISTING
EXC	EXCAVATION
F&C	FRAME AND COVER
F&G	FRAME AND GRATE
FDN.	FOUNDATION
FLDSTN	FIELDSTONE
GAR	GARAGE
GC	GRANITE CURB
GD	GROUND
GG	GAS GATE
GI	GUTTER INLET
GIP	GALVANIZED IRON PIPE
GRAN	GRANITE
GRAV	GRAVEL
GRD	GUARD
HDW	HEADWALL
HMA	HOT MIX ASPHALT
HOR	HORIZONTAL
HYD	HYDRANT
INV	INVERT
JCT	JUNCTION
L	LENGTH OF CURVE
LB	LEACH BASIN
LOG	LIMIT OF GRADING
LP	LIGHT POLE
L&S	LOAM AND SEED
LT	LEFT
MAX	MAXIMUM
MB	MAILBOX
MH	MANHOLE
MHB	MASSACHUSETTS HIGHWAY BOUND
MIN	MINIMUM
NIC	NOT IN CONTRACT
NO.	NUMBER
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
PERP	PERPENDICULAR
P.G.L.	PROFILE GRADE LINE
PI	POINT OF INTERSECTION
POC	POINT ON CURVE
POT	POINT ON TANGENT
PRC	POINT OF REVERSE CURVATURE
PROJ	PROJECT
PROB	PROPOSED
PSB	PLANTABLE SOIL BORROW

**ABBREVIATIONS (cont.)**

GENERAL	DESCRIPTION
PT	POINT OF TANGENCY
PUE	PROPOSED UTILITY EASEMENT
PVC	POINT OF VERTICAL CURVATURE
PVI	POINT OF VERTICAL INTERSECTION
PVT	POINT OF VERTICAL TANGENCY
PVMT	PAVEMENT
PWW	PAVED WATERWAY
R	RADIUS OF CURVATURE
R&D	REMOVE AND DISPOSE
RCP	REINFORCED CONCRETE PIPE
RD	ROAD
RDWY	ROADWAY
REM	REMOVE
RET	RETAIN
RET WALL	RETAINING WALL
ROW	RIGHT OF WAY
RR	RAILROAD
RRFB	RECTANGULAR RAPID FLASHING BEACON
R&R	REMOVE AND RESET
R&S	REMOVE AND STACK
RT	RIGHT
SB	STONE BOUND
SHLD	SHOULDER
SMH	SEWER MANHOLE
ST	STREET
STA	STATION
SSD	STOPPING SIGHT DISTANCE
SW	STATE HIGHWAY LAYOUT LINE
SHW	SIDEWALK
T	TANGENT DISTANCE OF CURVE/TRUCK %
TAN	TANGENT
TEMP	TEMPORARY
TC	TOP OF CURB
TOS	TOP OF SLOPE
TYP	TYPICAL
UP	UTILITY POLE
VAR	VARIES
VERT	VERTICAL
VC	VERTICAL CURVE
WCR	WHEEL CHAIR RAMP
WG	WATER GATE
WIP	WROUGHT IRON PIPE
WM	WATER METER/WATER MAIN
X-SECT	CROSS SECTION

**TRAFFIC SIGNAL ABBREVIATIONS**

TRAFFIC SIGNAL ABBREVIATIONS	DESCRIPTION
CAB.	CABINET
CCVE	CLOSED CIRCUIT VIDEO EQUIPMENT
DW	STEADY DONT WALK
FDW	FLASHING DONT WALK
FR	FLASHING CIRCULAR RED
FRL	FLASHING RED LEFT ARROW
FRR	FLASHING RED RIGHT ARROW
FY	FLASHING CIRCULAR YELLOW
FYL	FLASHING YELLOW LEFT ARROW
FYR	FLASHING YELLOW RIGHT ARROW
G	STEADY CIRCULAR GREEN
GL	STEADY GREEN LEFT ARROW
GR	STEADY GREEN RIGHT ARROW
GSL	STEADY GREEN SLASH LEFT ARROW
GSR	STEADY GREEN SLASH RIGHT ARROW
GV	STEADY GREEN VERTICAL ARROW
OL	OVERLAP
PED	PEDESTRIAN
PAN, TILT, ZOOM	PAN, TILT, ZOOM
PTZ	STEADY CIRCULAR RED
R	STEADY RED LEFT ARROW
RL	STEADY RED RIGHT ARROW
RR	TRAFFIC SIGNAL
TR SIG	TRAFFIC SIGNAL CONDUIT
TSC	STEADY WALKING PERSON
W	STEADY CIRCULAR YELLOW
Y	PROJECT
YL	STEADY YELLOW LEFT ARROW

**TRAFFIC SYMBOLS**

EXISTING	PROPOSED	DESCRIPTION
		CONTROLLER CABINET, FOUNDATION
		MAST ARM FOUNDATION (SCALE OF BLOCK = DIAMETER IN INCHES)
		MAST ARM (LENGTH NOTED)
		EMERGENCY PREEMPTION CONFIRMATION STROBE LIGHT
		VEHICULAR SIGNAL HEAD
		PEDESTRIAN SIGNAL HEAD
		MAST ARM OR TS POLE MOUNTED SIGN
		EMERGENCY PRE-EMPTION RECEIVER
		EMERGENCY PRE-EMPTION CONFIRMATION STROBE
		PEDESTRIAN PUSH BUTTON
		YAGI ANTENNA
		BICYCLE WIRE LOOP DETECTOR (SIZE AS NOTED)
		WIRE LOOP DETECTOR (SIZE AND TYPE NOTED)
		TRAFFIC SIGN (1 POST)
		TRAFFIC SIGN (2 POST)
		PULL BOX 12"x12" (OR AS NOTED)
		ELECTRIC HANDHOLE 12"x24" (OR AS NOTED)
		TRAFFIC SIGNAL CONDUIT

**PAVEMENT MARKINGS SYMBOLS**

EXISTING	PROPOSED	DESCRIPTION
		PAVEMENT ARROW - WHITE
		LEGEND "ONLY" - WHITE
		BIKE LANE LEGEND - WHITE
		STOP LINE
		CROSSWALK
		SOLID WHITE LINE
		SOLID YELLOW LINE
		BROKEN WHITE LINE
		BROKEN YELLOW LINE
		6" DOTTED WHITE LINE (3' LINE W/ 9' GAP)
		6" DOTTED YELLOW LINE (3' LINE W/ 9' GAP)
		6" DOTTED WHITE LINE EXTENSION (2' LINE W/ 6' GAP)
		6" DOTTED YELLOW LINE EXTENSION (2' LINE W/ 6' GAP)
		DOUBLE WHITE LINE
		DOUBLE YELLOW LINE
		12" YELLOW GORE LINE (3:1, 10' O.C.)

**PROJECT DESCRIPTION:**

THE PROPOSED TRANSPORTATION IMPROVEMENT PROJECT CONSISTS OF TRAFFIC SIGNAL IMPROVEMENTS, ADDITION OF PEDESTRIAN AND BICYCLE ACCOMMODATIONS, AND INSTALLATION OF A NEW DRAINAGE & PUBLIC WATER SYSTEM BETWEEN MAIN STREET AND I-495. IMPROVEMENTS WILL ALSO INCLUDE ADA COMPLIANT CURB RAMPS, FULL DEPTH PAVEMENT RECLAMATION, PAVEMENT MARKINGS, AND SIGNS.

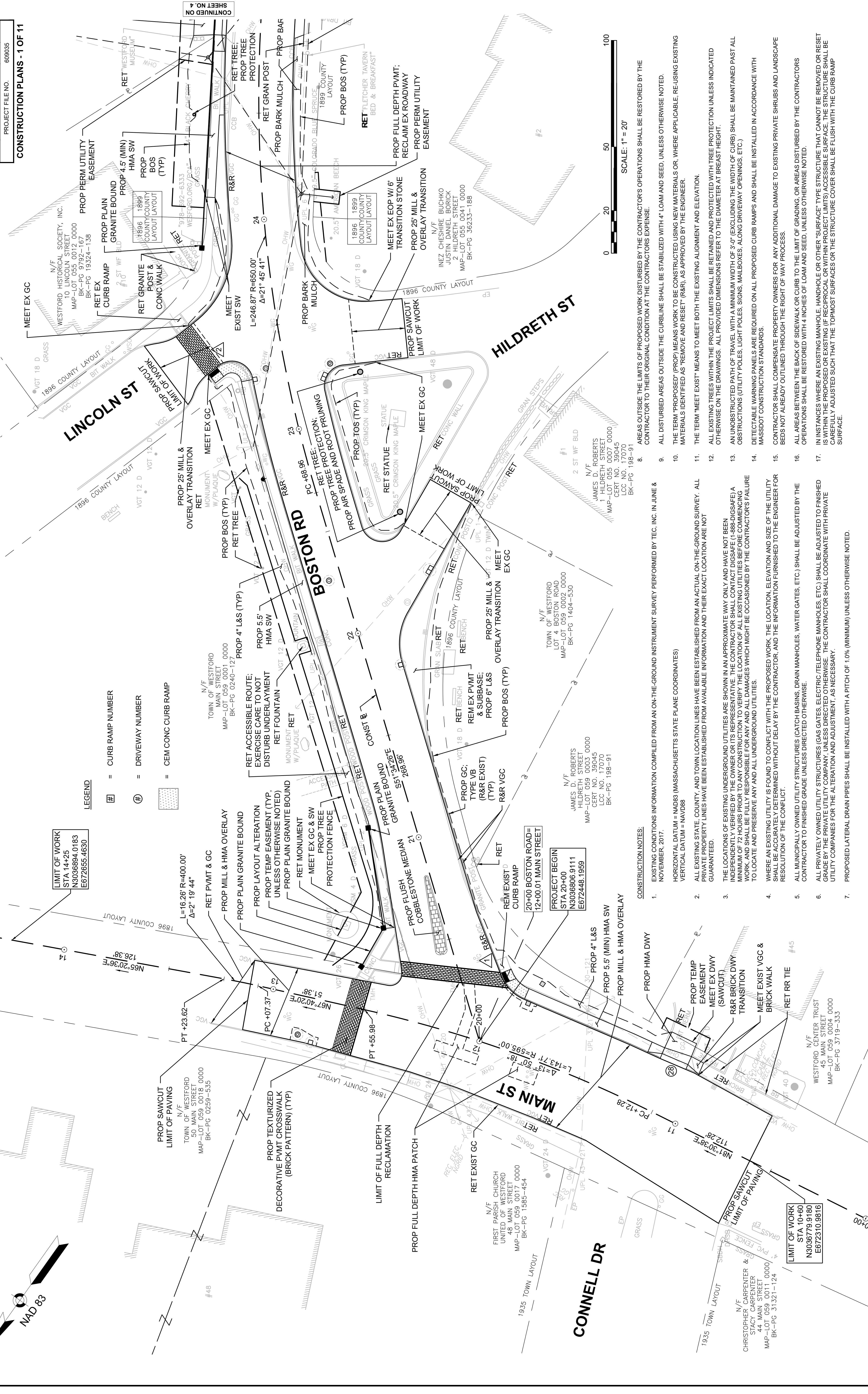
THE WORK INCLUDES EARTH EXCAVATION, SUPERPAVE ASPHALT PAVEMENT, HOT MIX ASPHALT SIDEWALKS, GRANITE CURB, DRAINAGE STRUCTURES & PIPE, PUBLIC WATER PIPE & FITTINGS, TRAFFIC SIGNALS, SLOPE GRADING, AND OTHER INCIDENTAL WORK.

**GENERAL SYMBOLS**

EXISTING	PROPOSED	DESCRIPTION
		JERSEY BARRIER
		CATCH BASIN OR GUTTER INLET
		CATCH BASIN OR GUTTER INLET W/ CURB INLET
		FLAG POLE
		GAS PUMP
		MAIL BOX
		POST SQUARE
		POST CIRCULAR
		WELL
		ELECTRIC HANDHOLE
		FENCE GATE POST
		GAS GATE
		BORING HOLE
		MONITORING WELL
		TEST PIT
		HYDRANT
		LIGHT POLE
		COUNTY BOUND
		GPS POINT
		CABLE MANHOLE
		DRAINAGE MANHOLE
		ELECTRIC MANHOLE
		GAS MANHOLE
		MISC MANHOLE
		SEWER MANHOLE
		TELEPHONE MANHOLE
		WATER MANHOLE
		MASSACHUSETTS HIGHWAY BOUND
		MONUMENT
		STONE BOUND
		TOWN OR CITY BOUND
		TRAVERSE OR TRIANGULATION STATION
		TROLLEY POLE OR GUY POLE
		TRANSMISSION POLE
		UTILITY POLE W/ FIREBOX
		UTILITY POLE WITH DOUBLE LIGHT
		UTILITY POLE W/ 1 LIGHT
		UTILITY POLE
		BUSH
		TREE
		SWAMP / MARSH
		WATER GATE
		WATER SHUTOFF/CURB STOP
		PARKING METER
		OVERHEAD CABLE/WIRE
		CURBING
		CONTOURS (ON-THE-GROUND SURVEY DATA)
		CONTOURS (PHOTOGAMMETRIC DATA)
		UNDERGROUND DRAIN PIPE (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND ELECTRIC DUCT (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND GAS MAIN (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND SEWER MAIN (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND TELEPHONE DUCT (DOUBLE LINE 24 INCH AND OVER)
		UNDERGROUND WATER MAIN (DOUBLE LINE 24 INCH AND OVER)
		BALANCED STONE WALL
		GUARD RAIL - STEEL POSTS
		GUARD RAIL - WOOD POSTS
		CHAIN LINK OR METAL FENCE
		WOOD FENCE
		SEDIMENT CONTROL BARRIER
		TREE LINE
		EDGE OF PAVEMENT
		SAWCUT LINE
		TOP OR BOTTOM OF SLOPE
		LIMIT OF EDGE OF MICROMILLING AND OVERLAY
		BANK OF RIVER OR STREAM
		BORDER OF WETLAND
		100 FT WETLAND BUFFER
		200 FT RIVERFRONT BUFFER
		STATE HIGHWAY LAYOUT
		TOWN OR CITY LAYOUT
		COUNTY LAYOUT
		RAILROAD SIDELINE
		TOWN OR CITY BOUNDARY LINE
		PROPERTY LINE OR APPROXIMATE PROPERTY LINE
		EASEMENT

STATE	MA	FED. AID PROJ. NO.	
SHEET NO.	3	TOTAL SHEETS	30
PROJECT FILE NO.	609035		

CONSTRUCTION PLANS - 1 OF 11



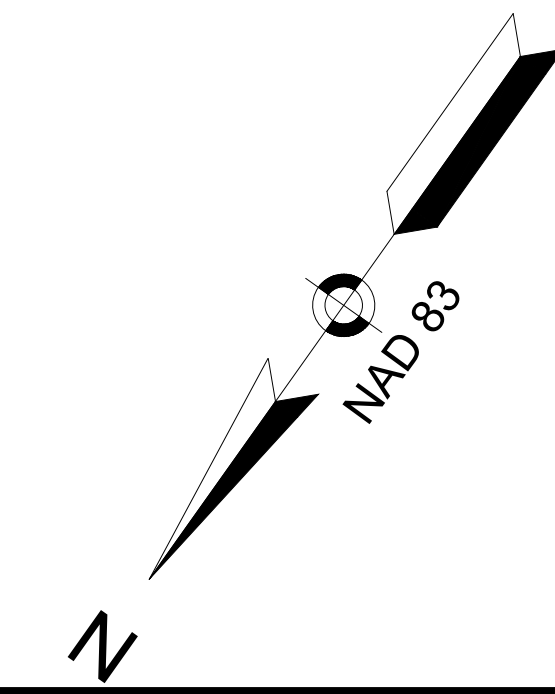
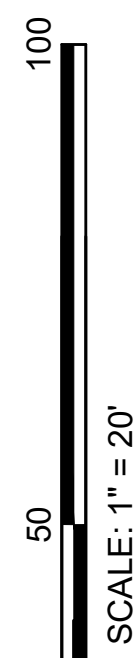
- LEGEND**
- [Symbol] = CURB RAMP NUMBER
  - [Symbol] = DRIVEWAY NUMBER
  - [Symbol] = CEM CONC CURB RAMP

LIMIT OF WORK  
STA 14+25  
N3036894.0183  
E672655.4630

LIMIT OF WORK  
STA 10+60  
N3036779.9180  
E672310.9816

CONSTRUCTION NOTES:

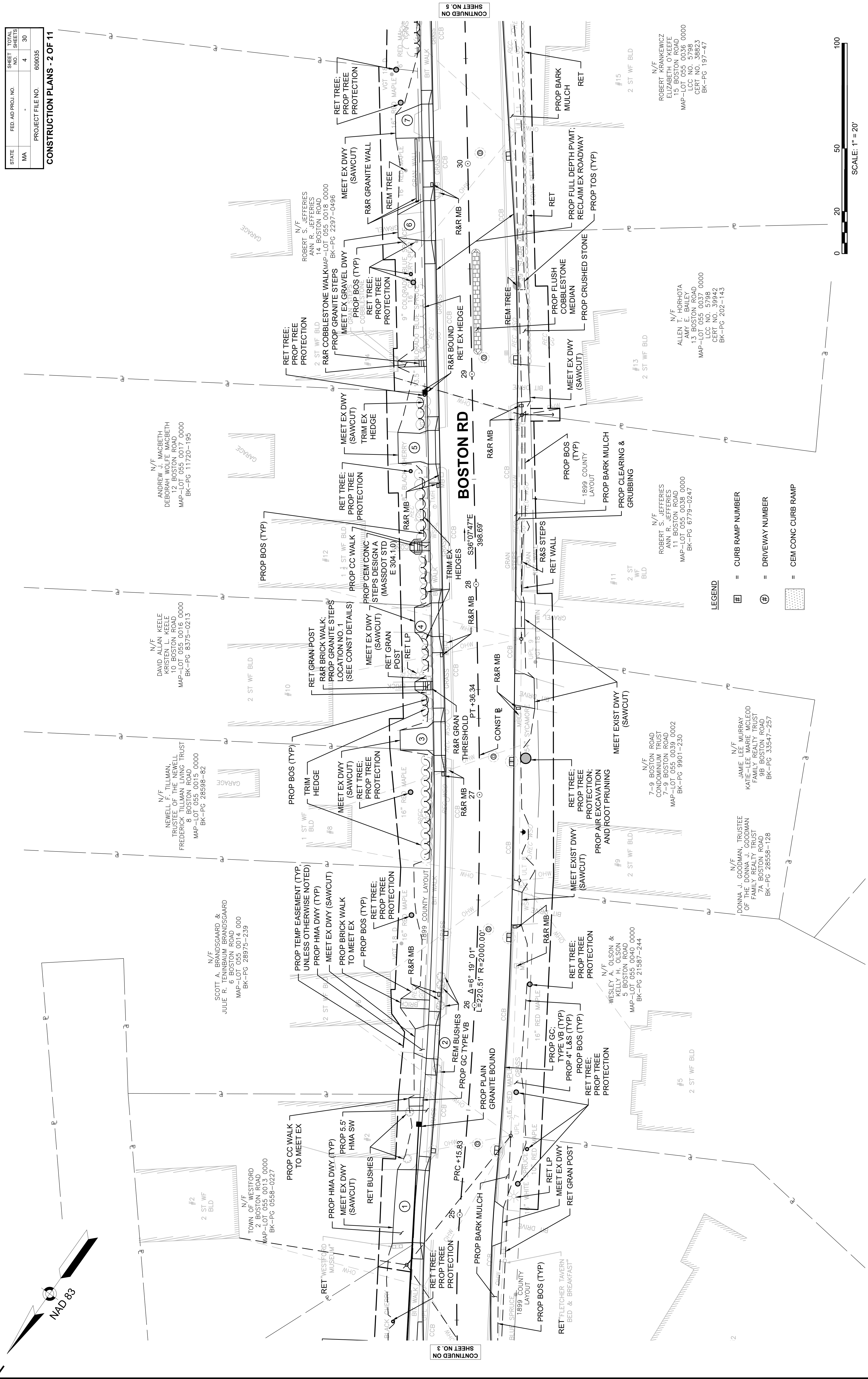
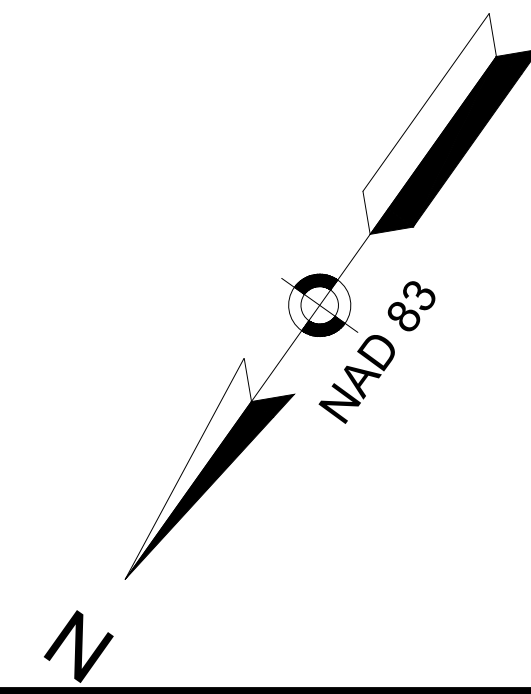
- EXISTING CONDITIONS INFORMATION COMPILED FROM AN ON-THE-GROUND INSTRUMENT SURVEY PERFORMED BY TEC, INC. IN JUNE & NOVEMBER, 2017.
- HORIZONTAL DATUM = NAD83 (MASSACHUSETTS STATE PLANE COORDINATES)  
VERTICAL DATUM = NAVD83
- ALL EXISTING STATE, COUNTY, AND TOWN LOCATION LINES HAVE BEEN ESTABLISHED FROM AN ACTUAL ON-THE-GROUND SURVEY. ALL PRIVATE PROPERTY LINES HAVE BEEN ESTABLISHED FROM AVAILABLE INFORMATION AND THEIR EXACT LOCATION ARE NOT GUARANTEED.
- THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL CONTACT DIGSAFE (1-888-DIGSAFE) A MINIMUM OF 72 HOURS PRIOR TO ANY CONSTRUCTION TO VERIFY THE LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.
- WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, THE LOCATION, ELEVATION AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR, AND THE INFORMATION FURNISHED TO THE ENGINEER FOR RESOLUTION OF THE CONFLICT.
- ALL MUNICIPALLY OWNED UTILITY STRUCTURES (CATCH BASINS, DRAIN MANHOLES, WATER GATES, ETC.) SHALL BE ADJUSTED BY THE CONTRACTOR TO FINISHED GRADE UNLESS DIRECTED OTHERWISE.
- ALL PRIVATELY OWNED UTILITY STRUCTURES (GAS GATES, ELECTRIC TELEPHONE MANHOLES, ETC.) SHALL BE ADJUSTED TO FINISHED GRADE BY THE PRIVATE UTILITY COMPANY, UNLESS DIRECTED OTHERWISE. THE CONTRACTOR SHALL COORDINATE WITH PRIVATE UTILITY COMPANIES FOR THE ALTERATION AND ADJUSTMENT, AS NECESSARY.
- PROPOSED LATERAL DRAIN PIPES SHALL BE INSTALLED WITH A PITCH OF 1.0% (MINIMUM) UNLESS OTHERWISE NOTED.
- AREAS OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE.
- ALL DISTURBED AREAS OUTSIDE THE CURBLINE SHALL BE STABILIZED WITH 4" LOAM AND SEED, UNLESS OTHERWISE NOTED.
- THE TERM "PROPOSED" (PROP) MEANS WORK TO BE CONSTRUCTED USING NEW MATERIALS OR, WHERE APPLICABLE, RE-USING EXISTING MATERIALS IDENTIFIED AS "REMOVE AND RESET" (R&R), AS APPROVED BY THE ENGINEER.
- THE TERM "MEET EXIST" MEANS TO MEET BOTH THE EXISTING ALIGNMENT AND ELEVATION.
- ALL EXISTING TREES WITHIN THE PROJECT LIMITS SHALL BE RETAINED AND PROTECTED WITH TREE PROTECTION UNLESS INDICATED OTHERWISE ON THE DRAWINGS. ALL PROVIDED DIMENSIONS REFER TO THE DIAMETER AT BREAST HEIGHT.
- AN UNOBSTRUCTED PATH OF TRAVEL WITH A MINIMUM WIDTH OF 3'-0" (EXCLUDING THE WIDTH OF CURB) SHALL BE MAINTAINED PAST ALL OBSTRUCTIONS (UTILITY POLES, LIGHT POLES, SIGNS, MAILBOXES, ALONG DRIVEWAY OPENINGS, ETC.)
- DETECTABLE WARNING PANELS ARE REQUIRED ON ALL PROPOSED CURB RAMPS AND SHALL BE INSTALLED IN ACCORDANCE WITH MASSDOT CONSTRUCTION STANDARDS.
- CONTRACTOR SHALL COMPENSATE PROPERTY OWNERS FOR ANY ADDITIONAL DAMAGE TO EXISTING PRIVATE SHRUBS AND LANDSCAPE BEDS NOT ALREADY OUTLINED THROUGH THE RIGHT OF WAY PROCESS.
- ALL AREAS BETWEEN THE BACK OF SIDEWALK OR CURB TO THE LIMIT OF GRADING, OR AREAS DISTURBED BY THE CONTRACTORS OPERATIONS SHALL BE RESTORED WITH 4 INCHES OF LOAM AND SEED, UNLESS OTHERWISE NOTED.
- IN INSTANCES WHERE AN EXISTING MANHOLE, HANDHOLE OR OTHER "SURFACE" TYPE STRUCTURE THAT CANNOT BE REMOVED OR RESET IS WITHIN THE PROPOSED OR EXISTING (IF RECIPROCAL OR WITHIN PROJECT LIMITS) ACCESSIBLE SURFACE, THE STRUCTURE SHALL BE CAREFULLY ADJUSTED SUCH THAT THE TOPMOST SURFACES OR THE STRUCTURE COVER SHALL BE FLUSH WITH THE CURB RAMP SURFACE.



**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		4	30
PROJECT FILE NO. 609035			

**CONSTRUCTION PLANS - 2 OF 11**



N/F  
ROBERT KRANKIEWICZ  
ELIZABETH O'KEEFE  
15 BOSTON ROAD  
MAP-LOT 055 0036 0000  
LCC NO. 5788  
CERT NO. 38823  
BK-PG 197-47

N/F  
ALLEN L. HORHOTA  
13 BOSTON ROAD  
MAP-LOT 055 0037 0000  
LCC NO. 5798  
CERT NO. 39942  
BK-PG 202-143

N/F  
ROBERT S. JEFFERIES  
ANN R. JEFFERIES  
11 BOSTON ROAD  
MAP-LOT 055 0038 0000  
BK-PG 6779-0247

N/F  
7-9 BOSTON ROAD  
CONDOMINIUM TRUST  
7-9 BOSTON ROAD  
MAP-LOT 055 0039 0002  
BK-PG 9901-230

N/F  
DONNA J. GOODMAN, TRUSTEE  
OF THE DONNA J. GOODMAN  
FAMILY REALTY TRUST  
9B BOSTON ROAD  
BK-PG 28558-128

N/F  
WESLEY A. OLSON &  
KELLY H. OLSON  
5 BOSTON ROAD  
MAP-LOT 055 0040 0000  
BK-PG 21587-244

N/F  
TOWN OF WESTFORD  
2 BOSTON ROAD  
MAP-LOT 055 0013 0000  
BK-PG 0558-0227

N/F  
SCOTT A. BRANDSGAARD &  
JULIE R. TENINBAUM BRANDSGAARD  
6 BOSTON ROAD  
MAP-LOT 055 0014 0000  
BK-PG 28979-239

N/F  
ANDREW J. MACBETH  
DEBORAH WOLFE MACBETH  
14 BOSTON ROAD  
MAP-LOT 055 0017 0000  
BK-PG 11720-195

N/F  
DAVID ALLAN KEELE  
ROBERTA KEELE  
10 BOSTON ROAD  
MAP-LOT 055 0016 0000  
BK-PG 8375-0213

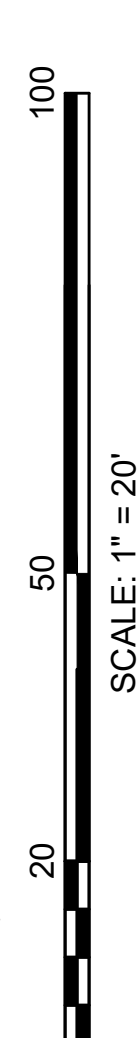
N/F  
NEWELL F. TILLMAN,  
TRUSTEE OF THE NEWELL  
FREDERICK TILLMAN TRUST  
8 BOSTON ROAD  
MAP-LOT 055 0015 0000  
BK-PG 28598-82

N/F  
ROBERT S. JEFFERIES  
ANN R. JEFFERIES  
11 BOSTON ROAD  
MAP-LOT 055 0038 0000  
BK-PG 6779-0247

N/F  
ALLEN L. HORHOTA  
13 BOSTON ROAD  
MAP-LOT 055 0037 0000  
LCC NO. 5798  
CERT NO. 39942  
BK-PG 202-143

N/F  
ROBERT KRANKIEWICZ  
ELIZABETH O'KEEFE  
15 BOSTON ROAD  
MAP-LOT 055 0036 0000  
LCC NO. 5788  
CERT NO. 38823  
BK-PG 197-47

- LEGEND**
- = CURB RAMP NUMBER
  - = DRIVEWAY NUMBER
  - = CEM CONC CURB RAMP



SCALE: 1" = 20'

CONTINUED ON SHEET NO. 3

CONTINUED ON SHEET NO. 5



**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		5	30
PROJECT FILE NO. 609035			

**CONSTRUCTION PLANS - 3 OF 11**

N/F  
ROBERT J. WASKIEWICZ  
24 BOSTON ROAD  
MAP-LOT 055 0023 0000  
BK-PG 31571-155

N/F  
BRIAN C. McDONALD  
NICOLE A. McDONALD  
22 BOSTON ROAD  
MAP-LOT 055 0022 0000  
BK-PG 30208-17

N/F  
WILLIAM MORGAN STAIR  
CYNTHIA JO. BEELER  
20 BOSTON ROAD  
MAP-LOT 055 0021 0000  
BK-PG 11162-215

N/F  
BRIAN G. ALGORN  
ANDREA REID GRAHAM  
18 BOSTON ROAD  
MAP-LOT 055 0020 0000  
BK-PG 25798-151

N/F  
DANIEL H. DRINKWATER  
MARIA A. MARTIN  
16 BOSTON ROAD  
MAP-LOT 055 0019 0000  
BK-PG 10894-042

N/F  
ROBERT KRANKIEWICZ  
ELIZABETH O'KEEFE  
15 BOSTON ROAD  
MAP-LOT 055 0018 0000  
BK-PG 197-47

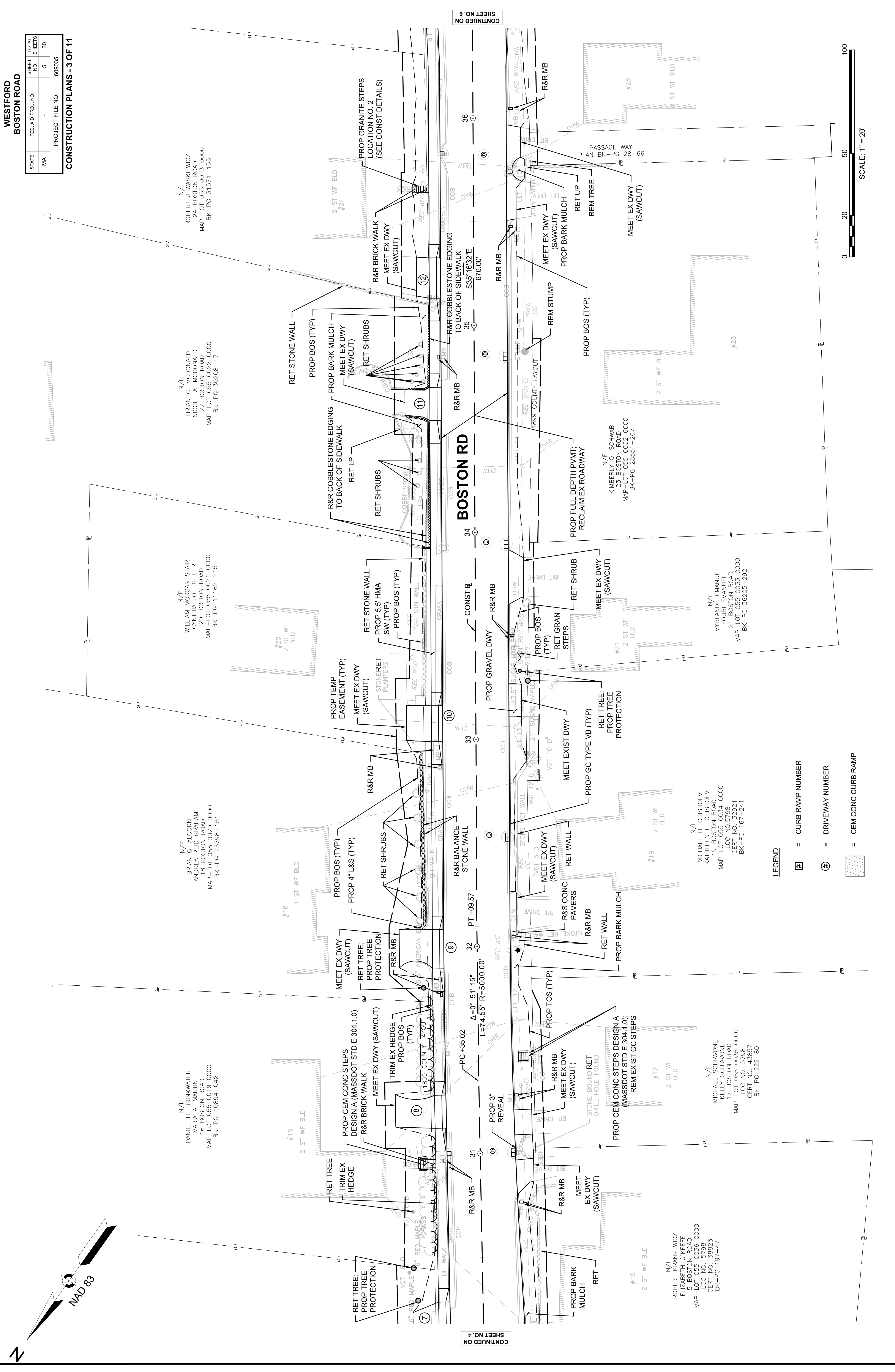
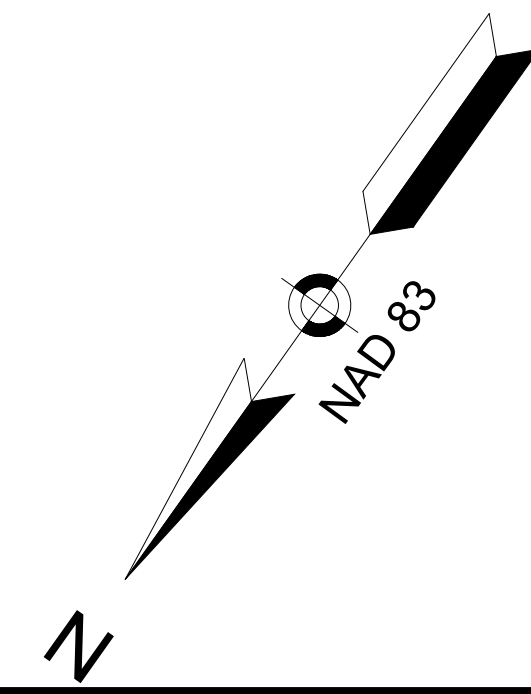
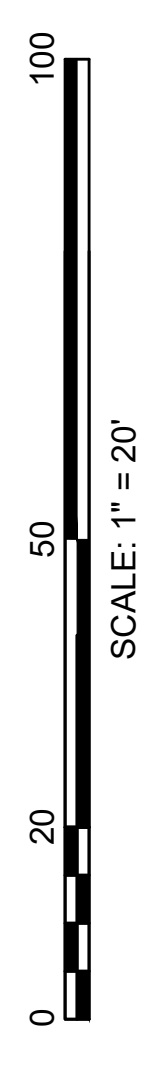
N/F  
MICHAEL SCHIAVONE  
KELLY SCHIAVONE  
17 BOSTON ROAD  
MAP-LOT 055 0017 0000  
BK-PG 222-80

N/F  
MICHAEL B. CHISHOLM  
KATHLEEN L. CHISHOLM  
19 BOSTON ROAD  
MAP-LOT 055 0034 0000  
BK-PG 167-241

N/F  
MYRLANDE EMANUEL  
YOURI EMANUEL  
21 BOSTON ROAD  
MAP-LOT 055 0033 0000  
BK-PG 36205-292

N/F  
KIMBERLY O. SCHWAB  
23 BOSTON ROAD  
MAP-LOT 055 0032 0000  
BK-PG 28651-267

- LEGEND**
- = CURB RAMP NUMBER
  - = DRIVEWAY NUMBER
  - = CEM CONG CURB RAMP



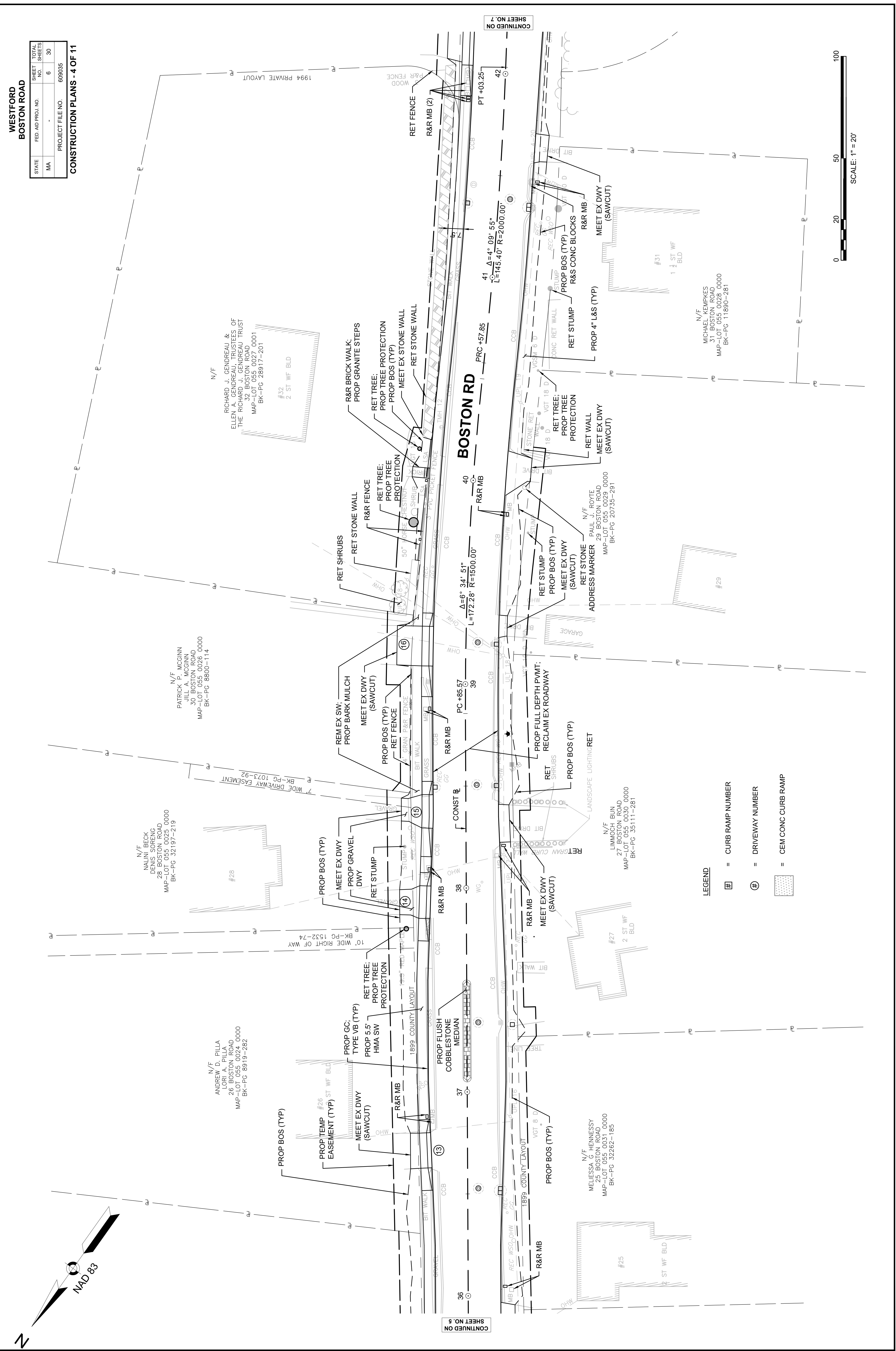
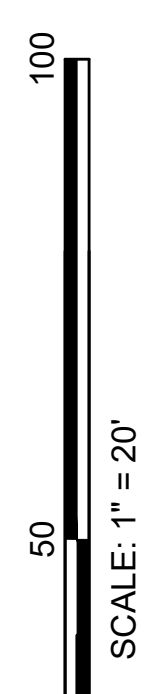
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**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		6	30
PROJECT FILE NO. 609035			

**CONSTRUCTION PLANS - 4 OF 11**

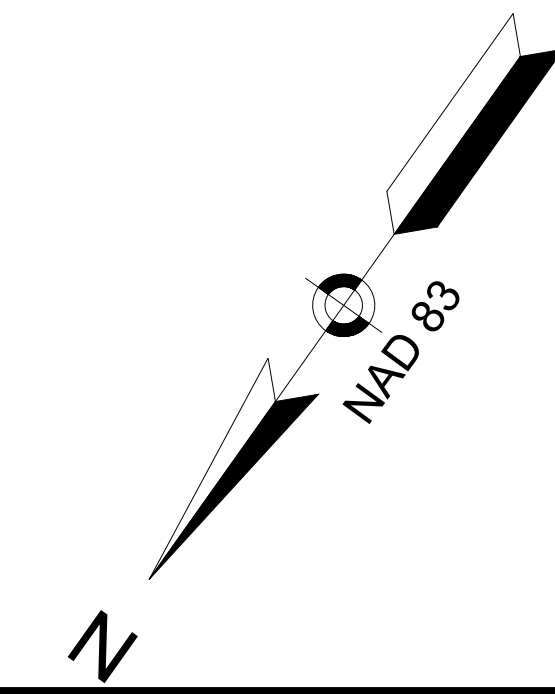


**LEGEND**

	= CURB RAMP NUMBER
	= DRIVEWAY NUMBER
	= CEM CONC CURB RAMP

CONTINUED ON SHEET NO. 5

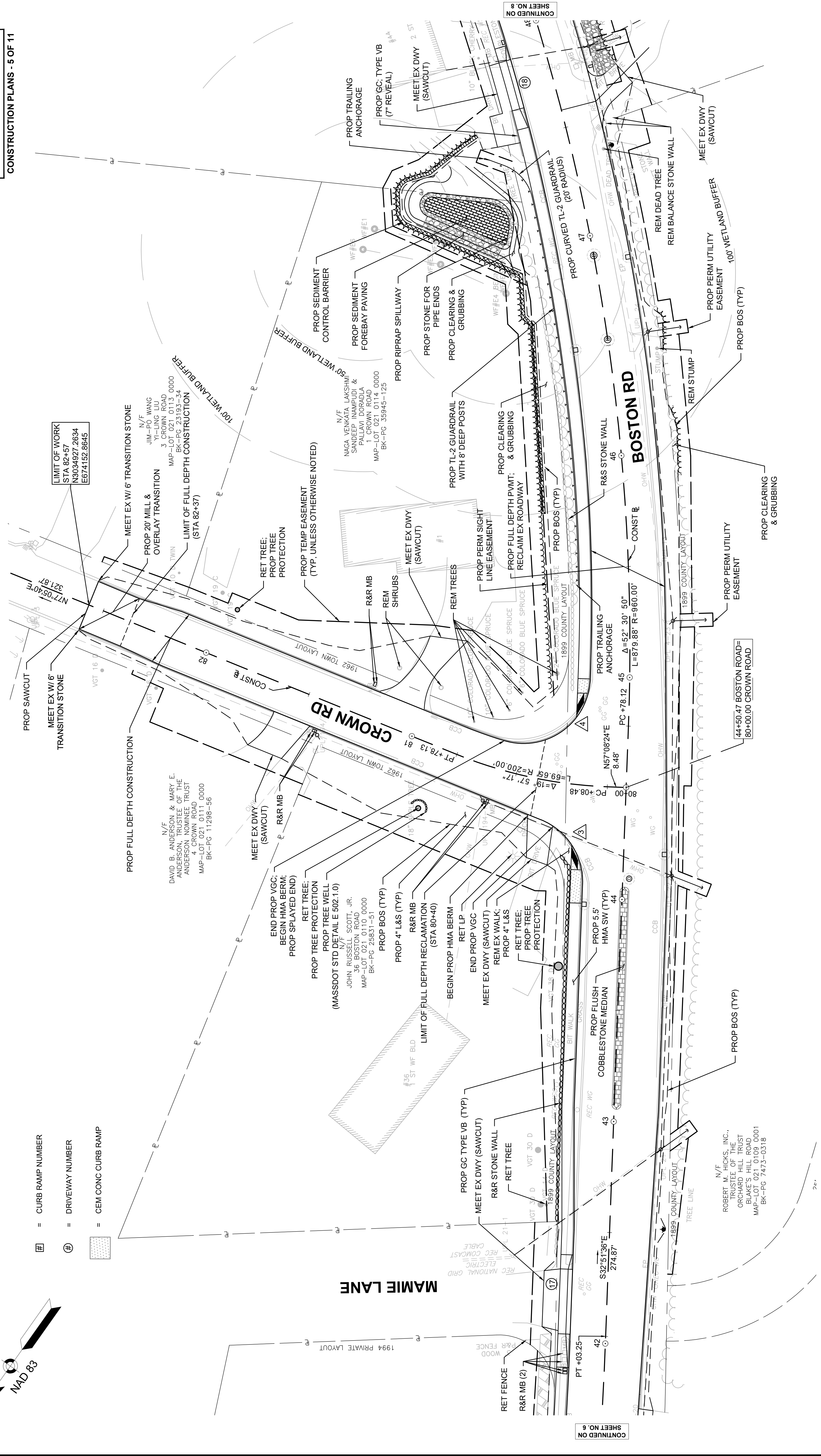
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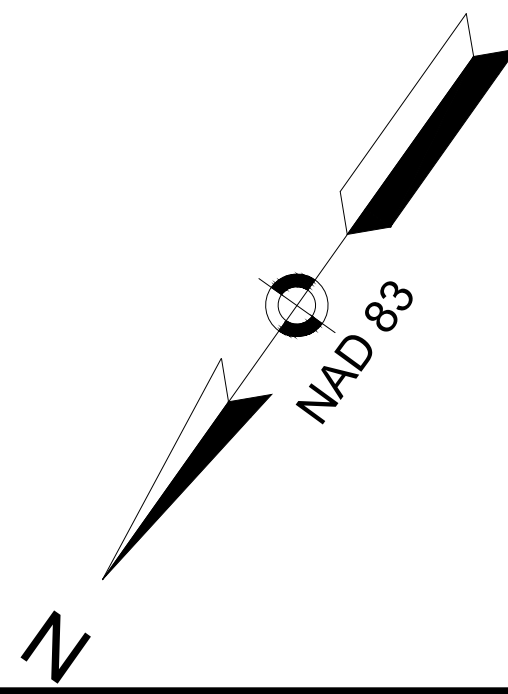
**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		7	30
PROJECT FILE NO. 609035			

**CONSTRUCTION PLANS - 5 OF 11**



- = CURB RAMP NUMBER
- = DRIVEWAY NUMBER
- = CEM CONC CURB RAMP



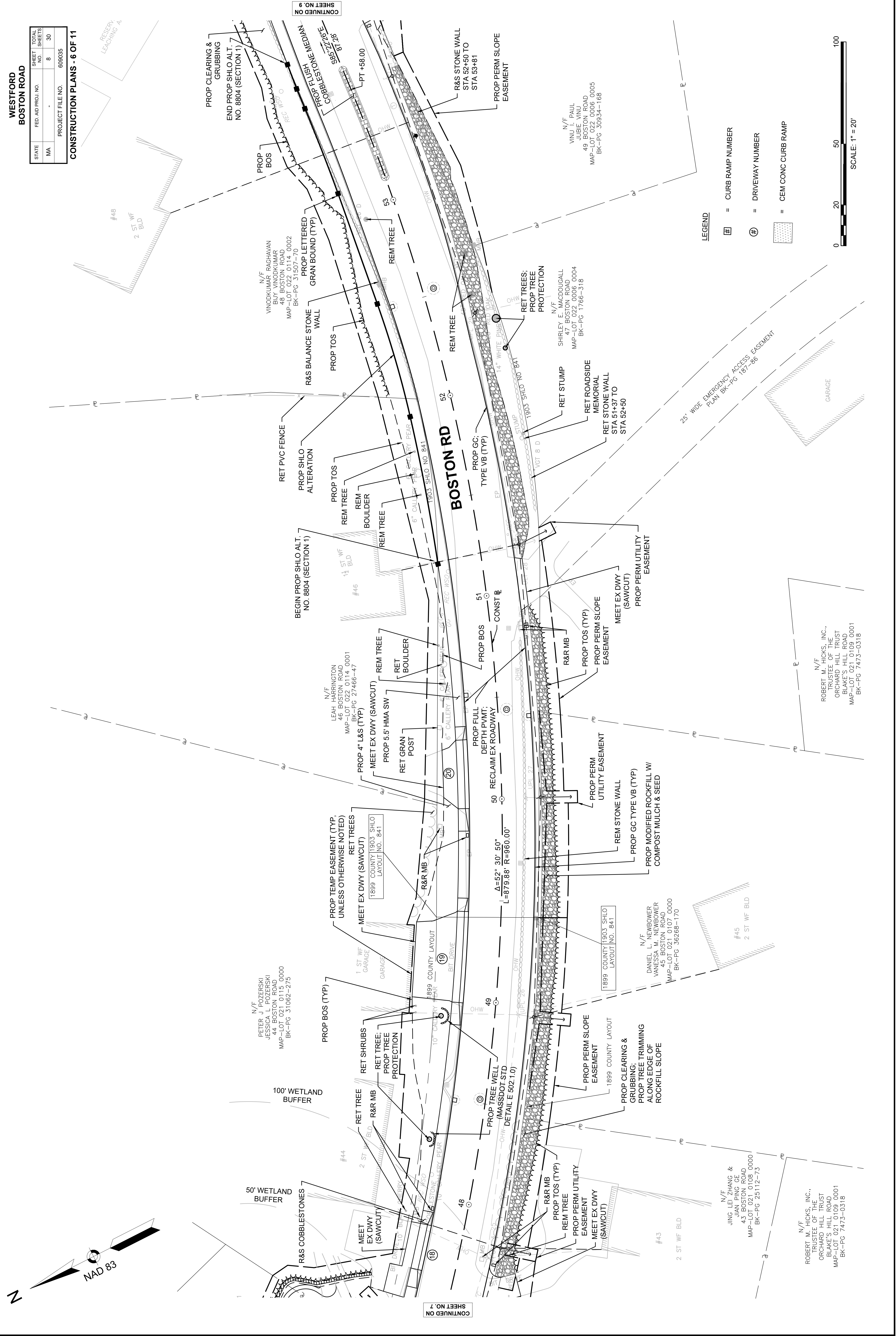
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CONTINUED ON SHEET NO. 8

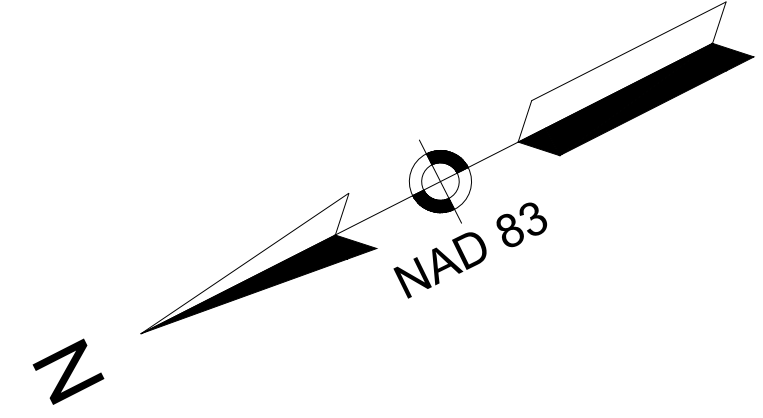
WESTFORD  
BOSTON ROAD

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		8	30
PROJECT FILE NO. 609035			

CONSTRUCTION PLANS - 6 OF 11



- LEGEND**
- [Symbol] = CURB RAMP NUMBER
  - [Symbol] = DRIVEWAY NUMBER
  - [Symbol] = CEM CONC CURB RAMP



CONTINUED ON SHEET NO. 7

CONTINUED ON SHEET NO. 9

N/F  
PETER J POZERSKI  
JESSICA L POZERSKI  
44 BOSTON ROAD  
MAP-LOT 021 0115 0000  
BK-PG 31062-275

N/F  
LEAH HARRINGTON  
46 BOSTON ROAD  
MAP-LOT 022 0114 0001  
BK-PG 27466-47

N/F  
DANIEL L. NEWBOWER  
VANESSA M. NEWBOWER  
45 BOSTON ROAD  
MAP-LOT 021 0107 0000  
BK-PG 36268-170

N/F  
VINU I. PAUL  
JUBIE VINU  
49 BOSTON ROAD  
MAP-LOT 022 0006 0005  
BK-PG 30934-165

N/F  
SHIRLEY E. MACDOUGALL  
47 BOSTON ROAD  
MAP-LOT 022 0006 0004  
BK-PG 1766-318

N/F  
VINU I. PAUL  
JUBIE VINU  
49 BOSTON ROAD  
MAP-LOT 022 0006 0005  
BK-PG 30934-165

N/F  
JING LEI ZHANG &  
JIAN ZHANG  
43 BOSTON ROAD  
MAP-LOT 021 0108 0000  
BK-PG 25112-73

N/F  
ROBERT M. HICKS, INC.,  
TRUSTEE OF THE  
ORCHARD HILL TRUST  
BLAKE'S HILL ROAD  
MAP-LOT 021 0109 0001  
BK-PG 7473-0318

N/F  
ROBERT M. HICKS, INC.,  
TRUSTEE OF THE  
ORCHARD HILL TRUST  
BLAKE'S HILL ROAD  
MAP-LOT 021 0109 0001  
BK-PG 7473-0318

N/F  
VINU I. PAUL  
JUBIE VINU  
49 BOSTON ROAD  
MAP-LOT 022 0006 0005  
BK-PG 30934-165






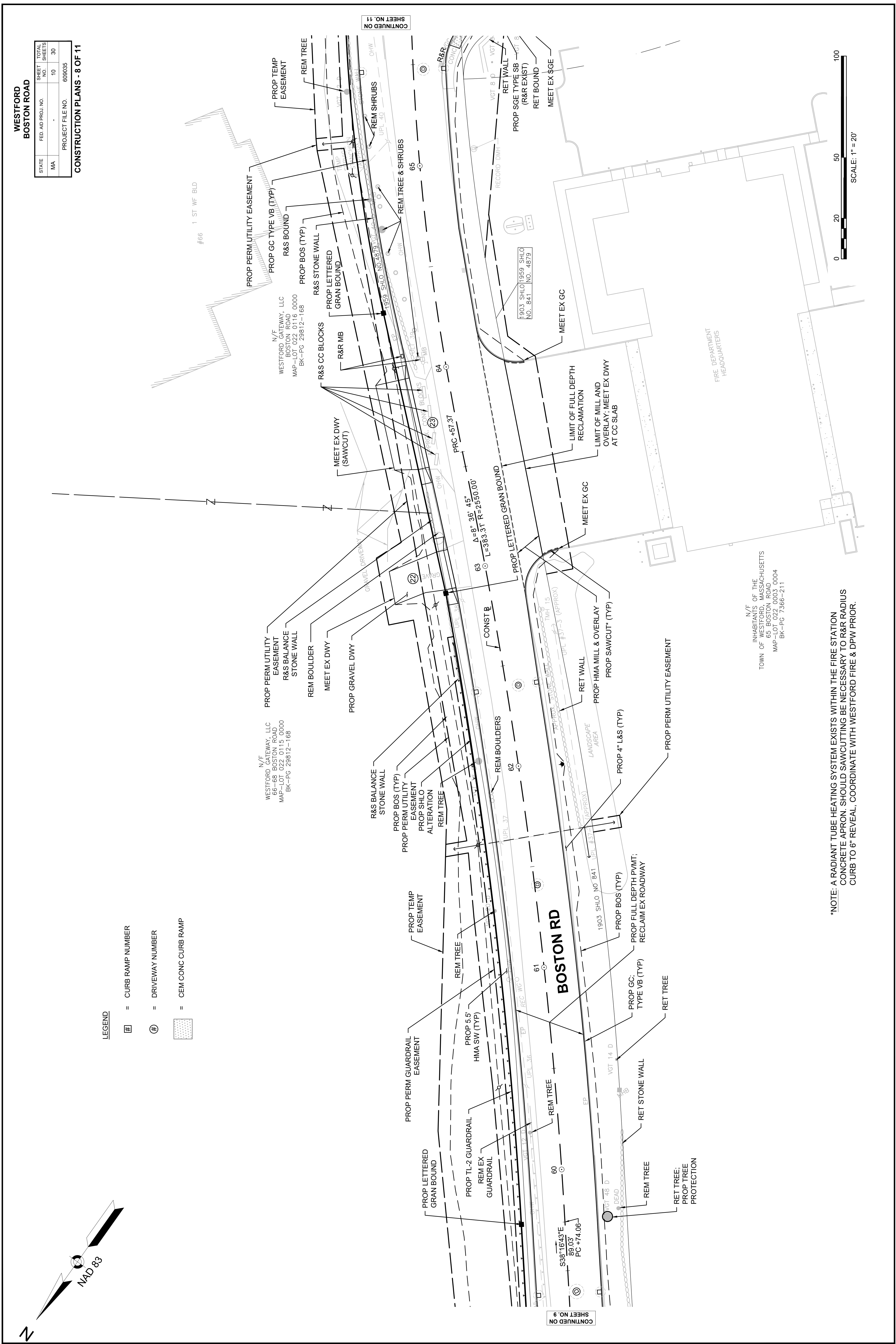
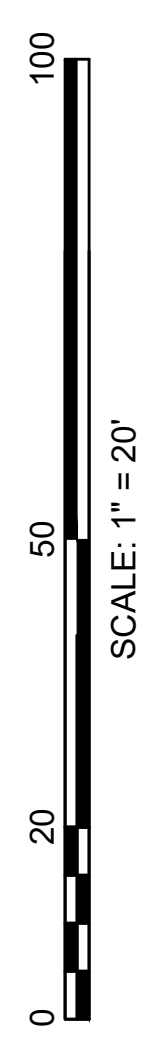
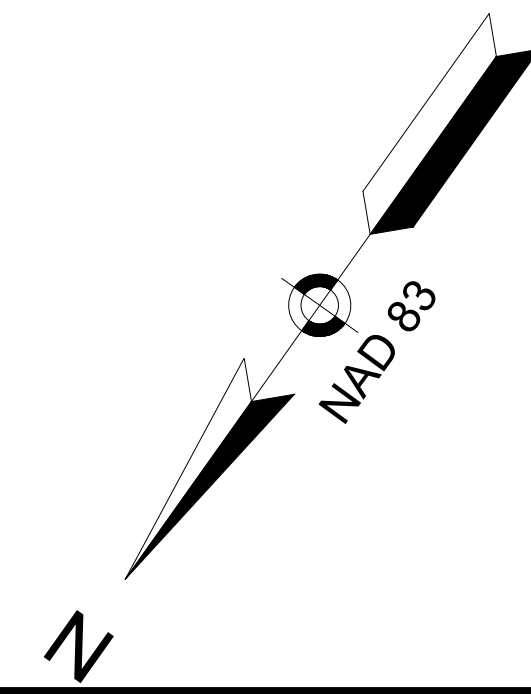
**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		10	30

PROJECT FILE NO. 609035

**CONSTRUCTION PLANS - 8 OF 11**

- LEGEND**
-  = CURB RAMP NUMBER
  -  = DRIVEWAY NUMBER
  -  = CEM CONG CURB RAMP



SHEET NO. 11  
CONTINUED ON

SHEET NO. 9  
CONTINUED ON

\*NOTE: A RADIANT TUBE HEATING SYSTEM EXISTS WITHIN THE FIRE STATION CONCRETE APRON. SHOULD SAWCUTTING BE NECESSARY TO R&R RADIUS CURB TO 6" REVEAL, COORDINATE WITH WESTFORD FIRE & DPW PRIOR.

N/F  
INHABITANTS OF THE  
TOWN OF WESTFORD, MASSACHUSETTS  
66 BOSTON ROAD  
WESTFORD, MA 02786  
MAP L-10-0004  
BK-PC 7366-211

N/F  
WESTFORD GATEWAY, LLC  
66-68 BOSTON ROAD  
MAP L-10-0000  
BK-PC 29812-168

N/F  
WESTFORD GATEWAY, LLC  
BOSTON ROAD  
MAP-L-10-022 0116 0000  
BK-PC 29812-168

SHEET NO. 11  
CONTINUED ON

**WESTFORD BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		11	30
PROJECT FILE NO. 609035			

**CONSTRUCTION PLANS - 9 OF 11**

N/F INHABITANTS OF THE TOWN OF WESTFORD BOSTON ROAD MAP-LOT 022 0117 0002 BK-PG 4446-0226

N/F THE DEWOLFE COMPANY, INC. 70 BOSTON ROAD MAP-LOT 022 0118 0000 BK-PG 7048-0249

N/F WESTFORD GATEWAY, LLC BOSTON ROAD MAP-LOT 022 0116 0000 BK-PG 29812-168

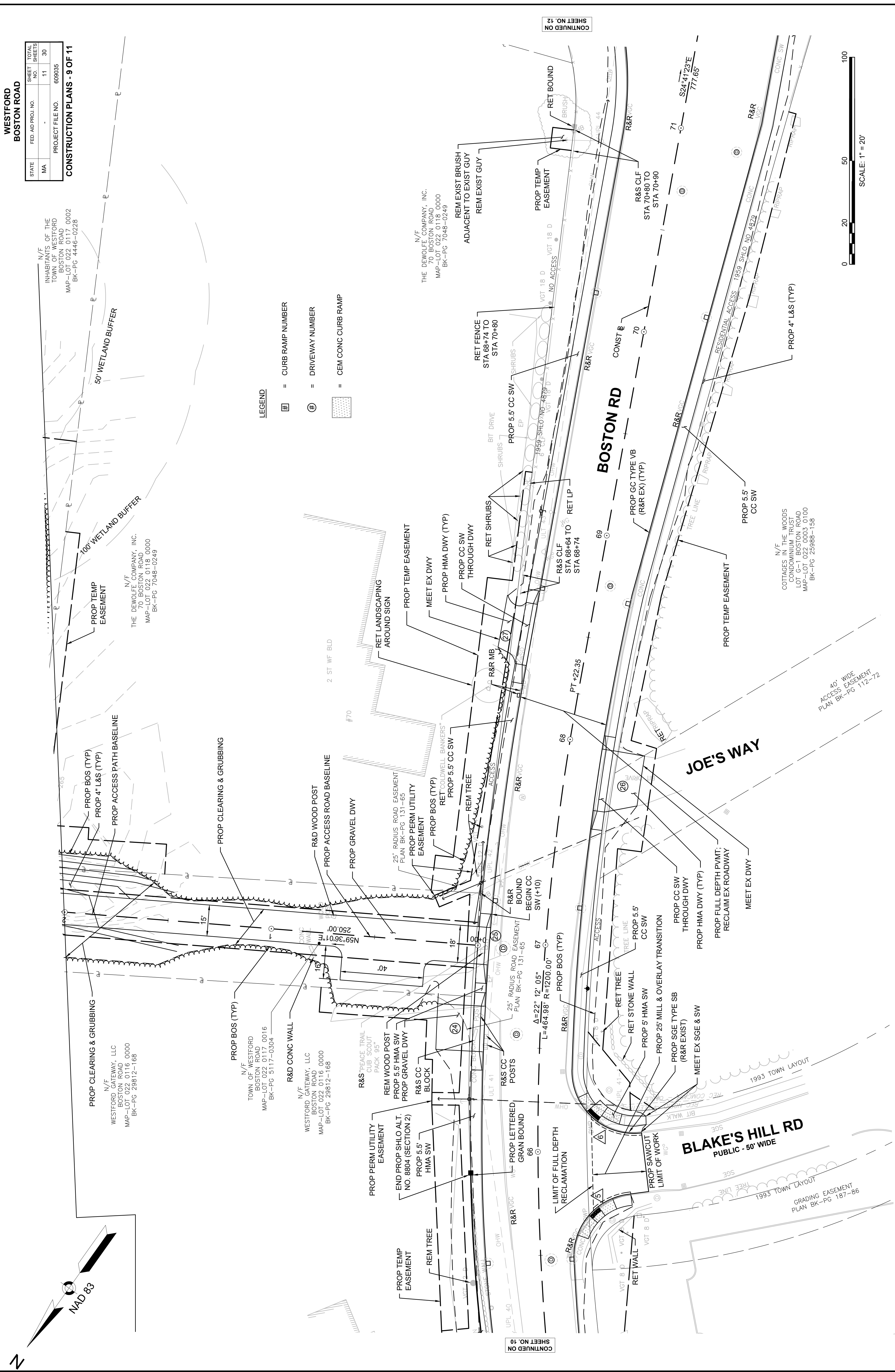
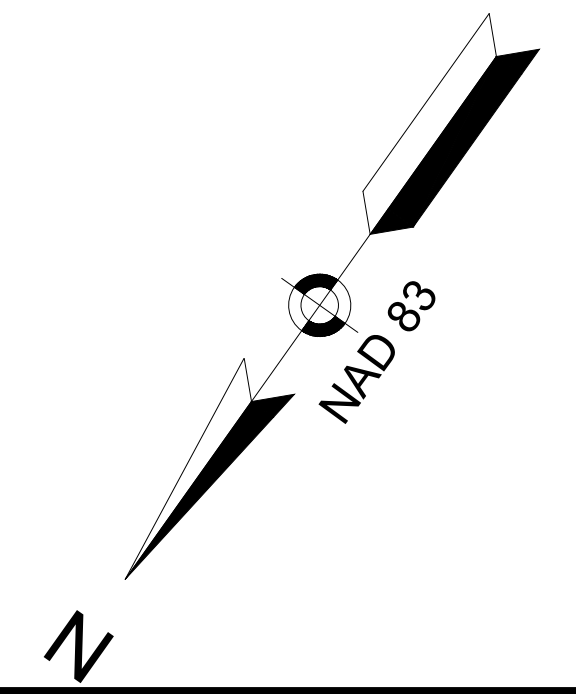
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N/F WESTFORD GATEWAY, LLC BOSTON ROAD MAP-LOT 022 0116 0000 BK-PG 29812-168

N/F THE DEWOLFE COMPANY, INC. 70 BOSTON ROAD MAP-LOT 022 0118 0000 BK-PG 7048-0249

N/F COTTAGES IN THE WOODS CONDOMINIUM TRUST LLC 67 BOSTON ROAD MAP-LOT 022 0100 BK-PG 25988-158

- LEGEND**
- = CURB RAMP NUMBER
  - = DRIVEWAY NUMBER
  - = CEM CONC CURB RAMP



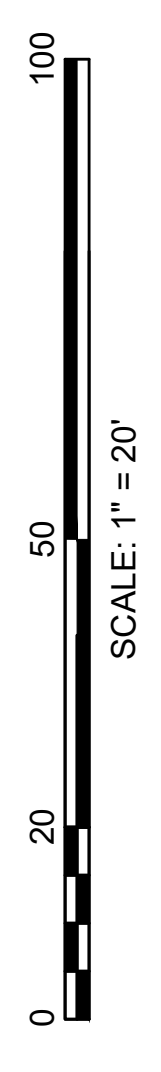
CONTINUED ON SHEET NO. 10

CONTINUED ON SHEET NO. 12

WESTFORD  
BOSTON ROAD

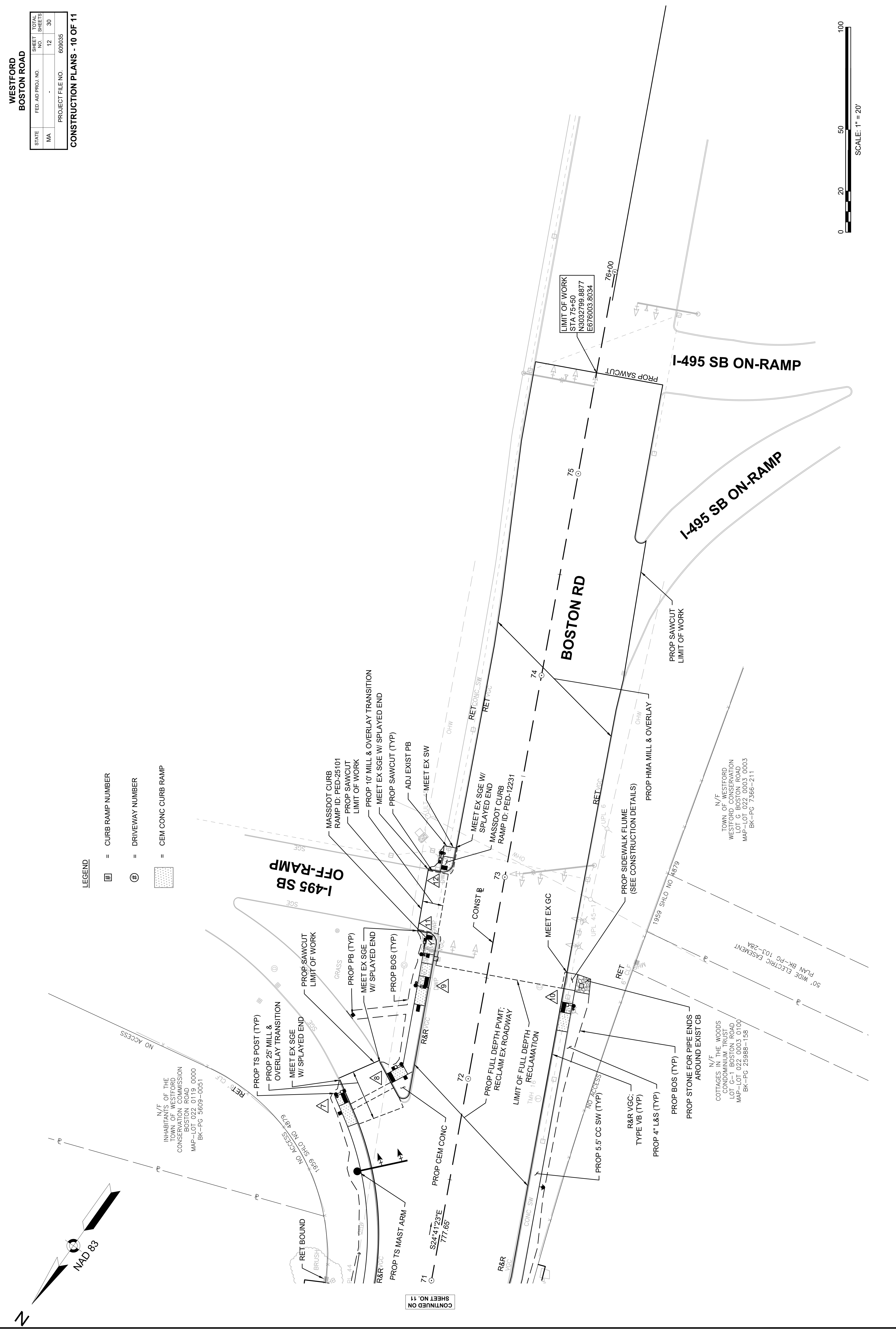
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MA		12	30
PROJECT FILE NO. 609035			

CONSTRUCTION PLANS - 10 OF 11



LEGEND

- = CURB RAMP NUMBER
- = DRIVEWAY NUMBER
- = CEM CONC CURB RAMP

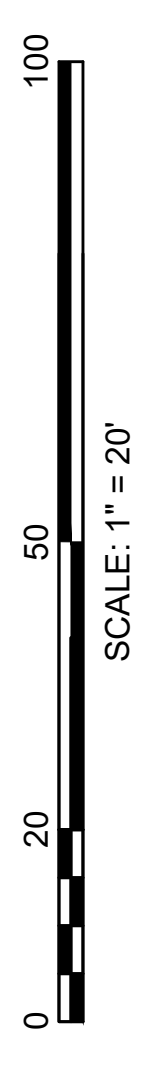
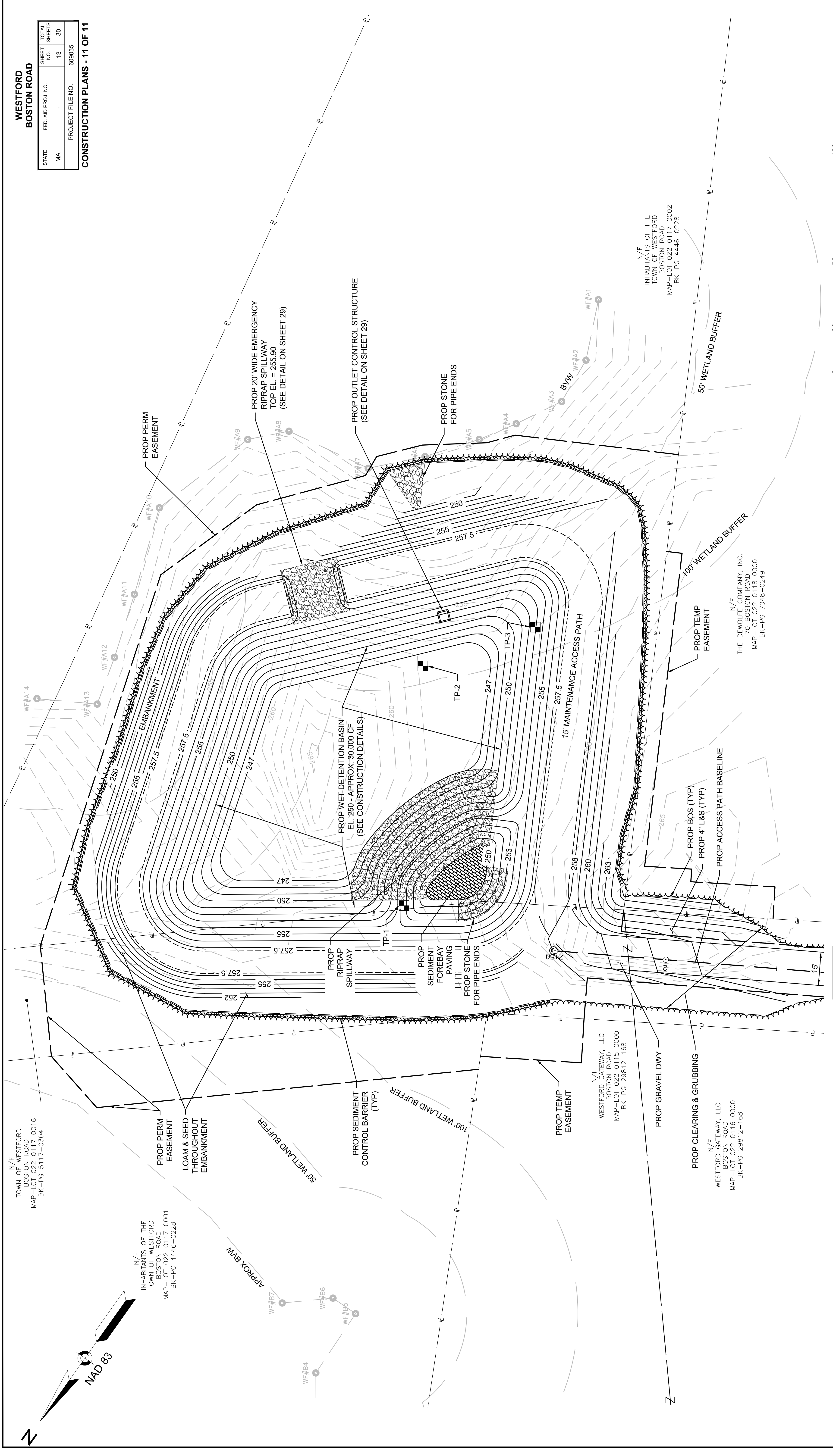


CONTINUED ON SHEET NO. 11



WESTFORD BOSTON ROAD		SHEET NO. 13		TOTAL SHEETS 30	
STATE	FED. AID PROJ. NO.	PROJECT FILE NO. 609035			
MA					

CONSTRUCTION PLANS - 11 OF 11



CONTINUED ON SHEET NO. 11

N/F  
TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0016  
BK-PG 5117-0304

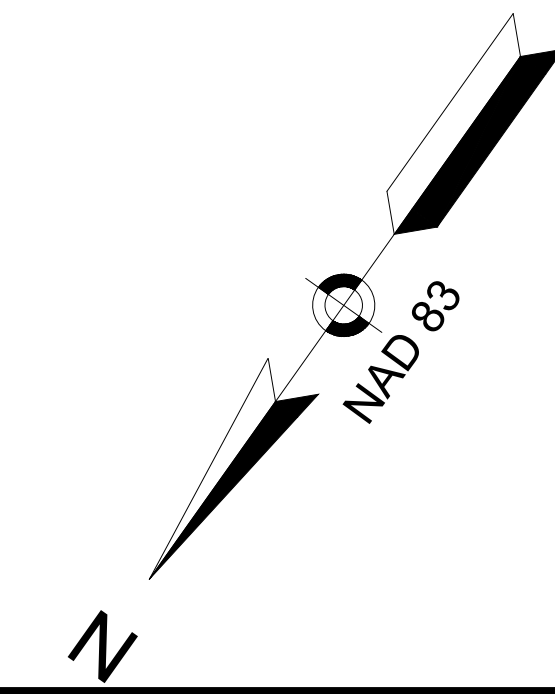
N/F  
INHABITANTS OF THE  
TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0001  
BK-PG 4446-0228

N/F  
WESTFORD GATEWAY, LLC  
BOSTON ROAD  
MAP-LOT 022 0118 0000  
BK-PG 29812-168

N/F  
WESTFORD GATEWAY, LLC  
BOSTON ROAD  
MAP-LOT 022 0118 0000  
BK-PG 29812-168

N/F  
THE DEWOLFE COMPANY, INC.  
70 BOSTON ROAD  
MAP-LOT 022 0118 0000  
BK-PG 7048-0249

N/F  
INHABITANTS OF THE  
TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0002  
BK-PG 4446-0228



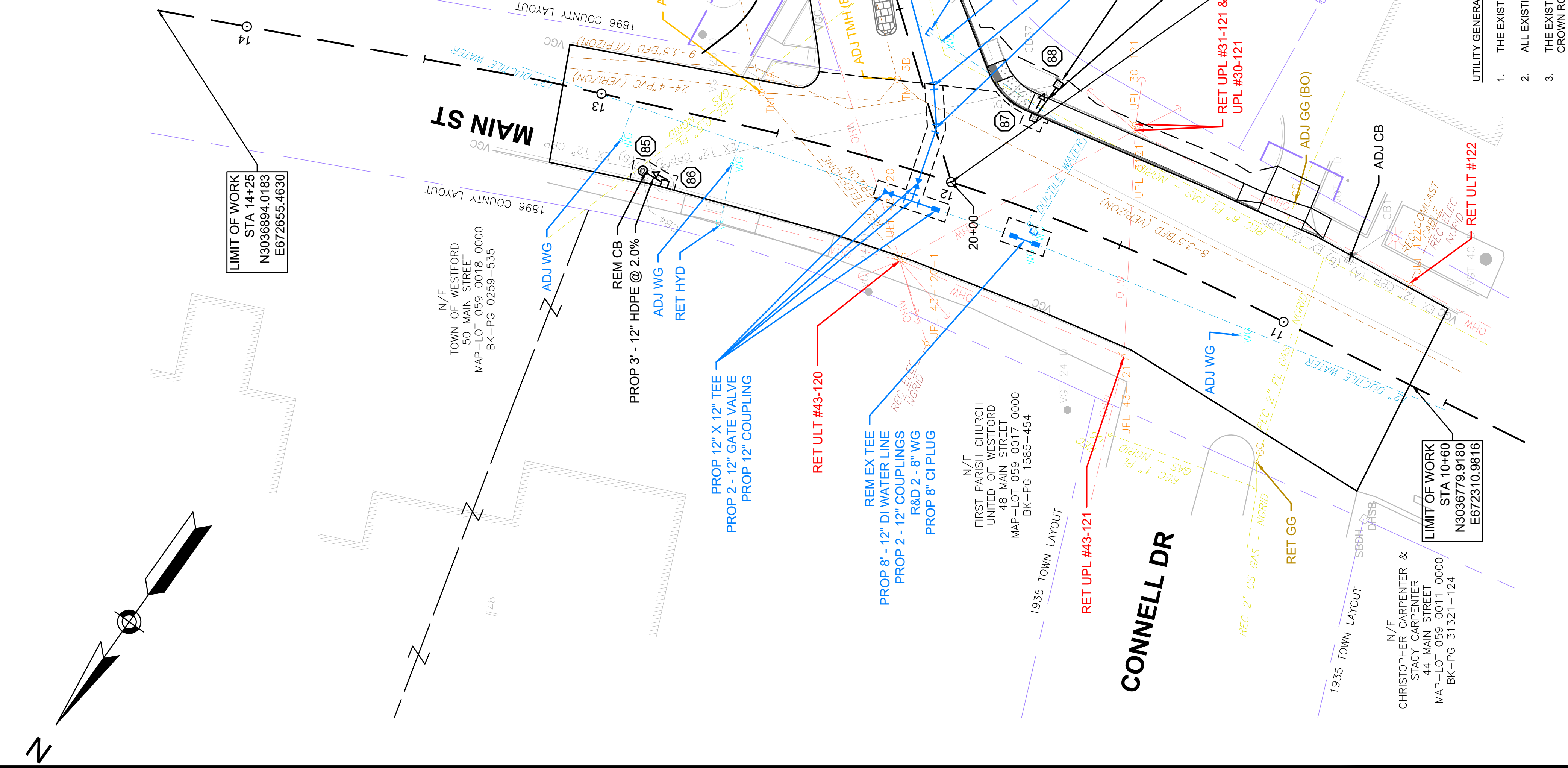
**WESTFORD BOSTON ROAD**

STATE	MA
FED. AID PROJ. NO.	
PROJECT FILE NO.	609035
SHEET NO.	14
TOTAL SHEETS	30

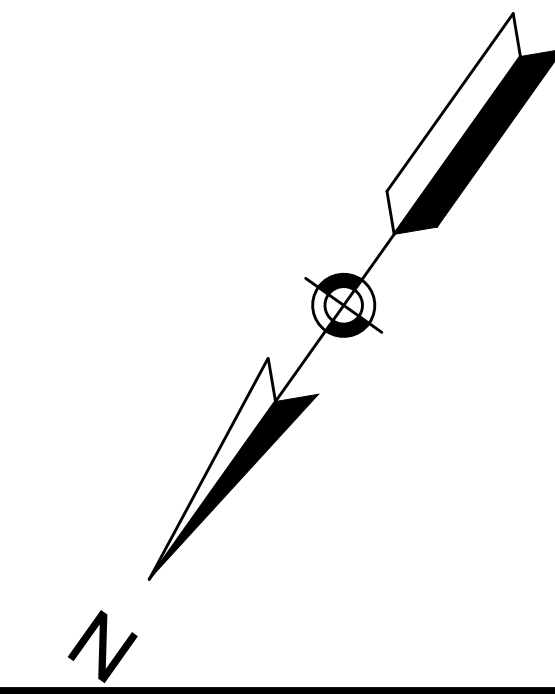
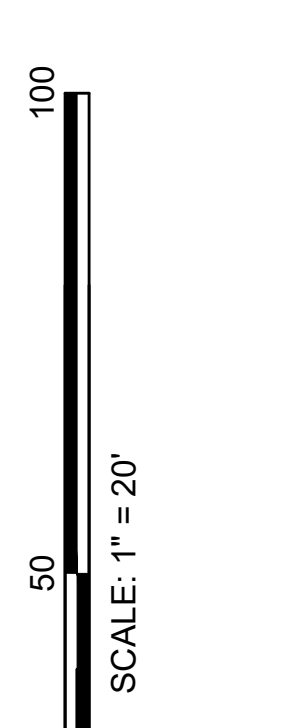
**UTILITY PLANS - 1 OF 11**

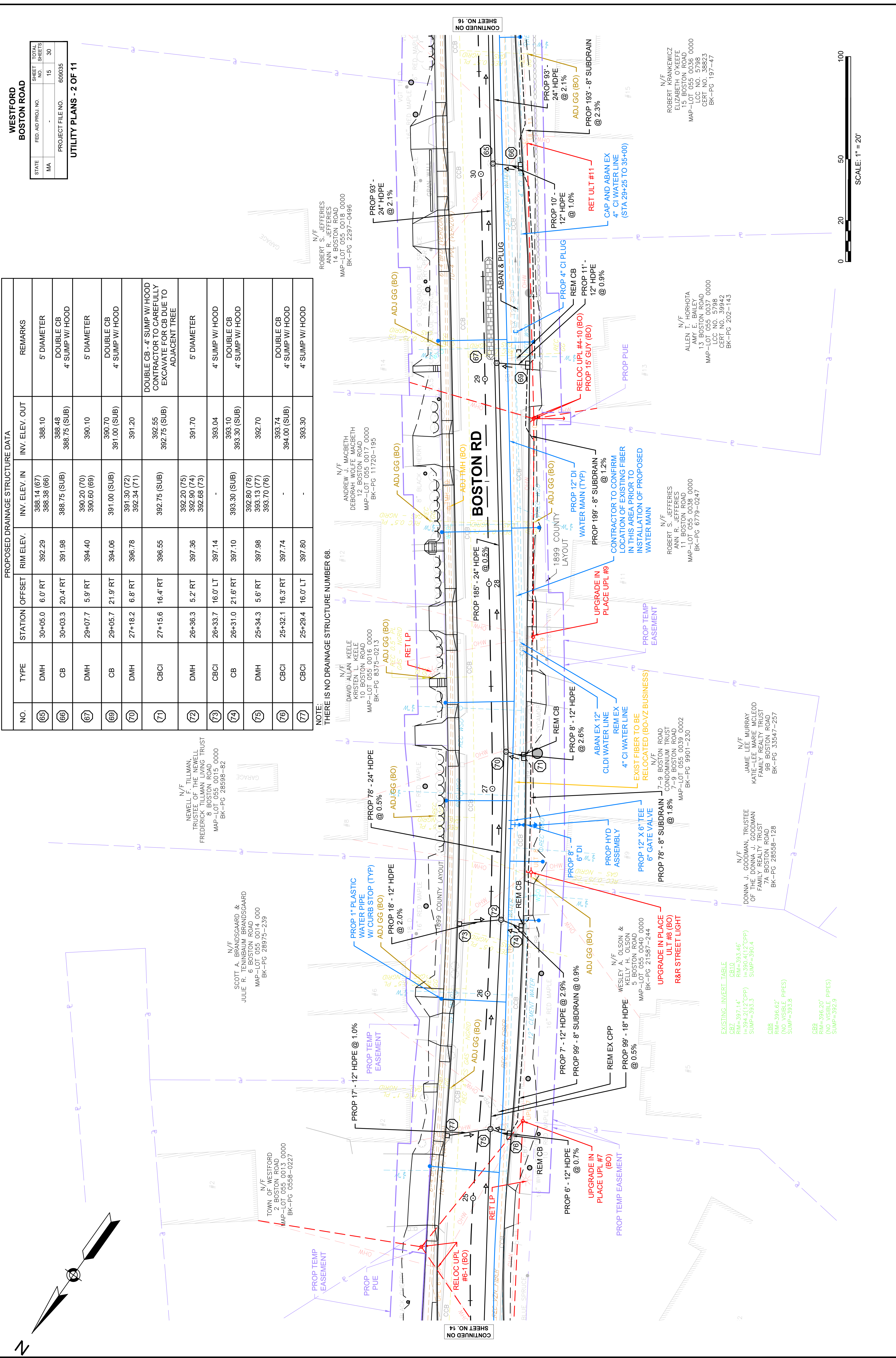
**PROPOSED DRAINAGE STRUCTURE DATA**

NO.	TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
78	DMH	23+31.0	9.0' LT	398.98	394.40 (82) 394.40 (80) 394.90 (79)	393.90	5" DIAMETER
79	CB	23+27.0	16.0' RT	398.87	-	394.98	4' SUMP W/ HOOD
80	DMH	23+27.3	21.0' LT	398.92	395.00 (EXIST) 395.90 (81)	394.90	CIT EXIST CB TO DMH CONTRACTOR TO VERIFY ELEV
81	CBCI	23+20.0	17.3' RT	398.85	-	396.00	DOUBLE CB
82	DMH	22+27.7	6.0' LT	399.57	395.25 (83) 395.25 (84)	395.15	4' SUMP W/ HOOD
83	CBCI	21+26.0	16.0' RT	399.55	-	395.55	DOUBLE CB
84	CBCI	22+19.0	40.7' RT	399.80	-	395.80	4' SUMP W/ HOOD
85	DMH	12+84.2	17.7' LT	398.98	395.20 (86)	395.20 (EXIST)	REM EXIST CB CONTRACTOR TO VERIFY ELEV
86	CBCI	12+77.6	20.0' LT	399.04	-	395.26	4' SUMP W/ HOOD
87	REMOD CB	11+84.4	24.2' RT	400.89	-	397.33	
88	EXIST CB	11+80.4	34.5' RT	401.07	397.25 (87)	387.10 (EXIST)	CONTRACTOR TO VERIFY ELEV



- UTILITY GENERAL NOTES:**
1. THE EXIST 12" WATER LINE TO BE ABANDONED SHALL BE FILLED WITH CONTROLLED DENSITY FILL.
  2. ALL EXISTING WATER SERVICES SHALL BE ABANDONED AND ALL EXISTING CURB STOPS SHALL BE REMOVED.
  3. THE EXISTING VERIZON-OWNED DIRECT BURIED COPPER CABLE ALONG THE NORTHEAST SIDE OF BOSTON ROAD BETWEEN CONNELL STREET AND HILDRETH STREET SHALL BE REMOVED BY THE CONTRACTOR. THE CONTRACTOR IS ALLOWED TO REMOVE THE CABLE AS NECESSARY.





**PROPOSED DRAINAGE STRUCTURE DATA**

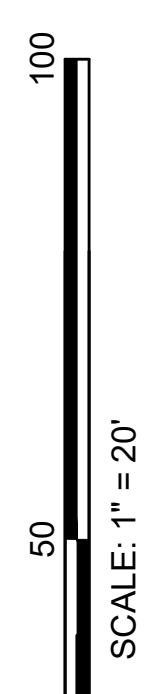
NO.	TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
65	DMH	30+05.0	6.0' RT	392.29	388.14 (67)	388.10	5" DIAMETER
66	CB	30+03.3	20.4' RT	391.98	388.75 (SUB)	388.48	DOUBLE CB 4' SUMP W/ HOOD
67	DMH	29+07.7	5.9' RT	394.40	390.20 (70)	390.10	5" DIAMETER
69	CB	29+05.7	21.9' RT	394.06	391.00 (SUB)	390.70	DOUBLE CB 4' SUMP W/ HOOD
70	DMH	27+18.2	6.8' RT	396.78	391.30 (72)	391.20	5" DIAMETER
71	CBCI	27+15.6	16.4' RT	396.55	392.75 (SUB)	392.55	DOUBLE CB - 4' SUMP W/ HOOD CONTRACTOR TO CAREFULLY EXCAVATE FOR CB DUE TO ADJACENT TREE
72	DMH	26+36.3	5.2' RT	397.36	392.20 (75)	391.70	5" DIAMETER
73	CBCI	26+33.7	16.0' LT	397.14	393.30 (SUB)	393.04	4' SUMP W/ HOOD
74	CB	26+31.0	21.6' RT	397.10	393.30 (SUB)	393.10	DOUBLE CB 4' SUMP W/ HOOD
75	DMH	25+34.3	5.6' RT	397.98	392.80 (78)	392.70	5" DIAMETER
76	CBCI	25+32.1	16.3' RT	397.74	393.13 (77)	393.74	DOUBLE CB 4' SUMP W/ HOOD
77	CBCI	25+29.4	16.0' LT	397.80	393.70 (76)	393.30	4' SUMP W/ HOOD

NOTE: THERE IS NO DRAINAGE STRUCTURE NUMBER 68.

**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		15	30
PROJECT FILE NO. 609035		UTILITY PLANS - 2 OF 11	

CONTINUED ON  
SHEET NO. 14



N/F  
ROBERT S. JEFFERIES  
ANN R. JEFFERIES  
14 BOSTON ROAD  
MAP-LOT 055 0018 0000  
BK-PG 2297-0496

N/F  
ALLEN L. HORHOTA  
ANN R. JEFFERIES  
13 BOSTON ROAD  
MAP-LOT 055 0037 0000  
LCC NO. 5798  
CERT NO. 38823  
BK-PG 197-47

N/F  
ROBERT S. JEFFERIES  
ANN R. JEFFERIES  
11 BOSTON ROAD  
MAP-LOT 055 0038 0000  
BK-PG 6779-0247

N/F  
JAMIE LEE MURRAY  
KATIE-LEE MARIE MCLEOD  
FAMILY REALTY TRUST  
9B BOSTON ROAD  
BK-PG 33547-257

N/F  
DONNA J. GOODMAN, TRUSTEE  
OF THE DONNA J. GOODMAN  
FAMILY REALTY TRUST  
7A BOSTON ROAD  
BK-PG 28558-128

N/F  
WESLEY A. OLSON &  
KELLY H. OLSON  
5 BOSTON ROAD  
MAP-LOT 055 0040 0000  
BK-PG 21587-244

N/F  
SCOTT A. BRANDSGAARD &  
JULIE R. TENINBAUM BRANDSGAARD  
6 BOSTON ROAD  
MAP-LOT 055 0014 000  
BK-PG 28973-239

N/F  
TOWN OF WESTFORD  
2 BOSTON ROAD  
MAP-LOT 055 0013 0000  
BK-PG 0558-0227

EXISTING INVERT TABLE  
CB7  
RM=397.14'  
I=394.2(12'CPP)  
SUMP=393.3  
CB8  
RM=396.62'  
(NO VISIBLE PIPES)  
SUMP=393.8  
CB9  
RM=396.20'  
(NO VISIBLE PIPES)  
SUMP=392.9

CONTINUED ON  
SHEET NO. 16

**WESTFORD BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	16	30
PROJECT FILE NO. 609035		UTILITY PLANS - 3 OF 11	

N/F  
ROBERT J WASKIEWICZ  
24 BOSTON ROAD  
MAP-LOT 055 0023 0000  
BK-PG 31571-155

N/F  
BRIAN C. McDONALD  
NICOLE A. McDONALD  
22 BOSTON ROAD  
MAP-LOT 055 0022 0000  
BK-PG 30208-17

N/F  
WILLIAM MORGAN STAIR  
CYNTHIA JO. BEELER  
20 BOSTON ROAD  
MAP-LOT 055 0021 0000  
BK-PG 11162-215

N/F  
DANIEL H. DRINKWATER  
MARIA A. MARTIN  
15 BOSTON ROAD  
MAP-LOT 055 0019 0000  
BK-PG 10894-042

N/F  
BRIAN C. ALCORN  
ANDREA REID GRAHAM  
18 BOSTON ROAD  
MAP-LOT 055 0020 0000  
BK-PG 25798-151

N/F  
ROBERT KRANKIEWICZ  
ELIZABETH O'KEEFE  
15 BOSTON ROAD  
MAP-LOT 055 0019 0000  
CERT NO. 38823  
BK-PG 197-47

N/F  
MICHAEL B. CHISHOLM  
KATHLEEN L. CHISHOLM  
19 BOSTON ROAD  
MAP-LOT 055 0034 0000  
CERT NO. 32921  
BK-PG 167-241

N/F  
MICHAEL SCHIAVONE  
KELLY SCHIAVONE  
17 BOSTON ROAD  
MAP-LOT 055 0038 0000  
CERT NO. 43857  
BK-PG 222-80

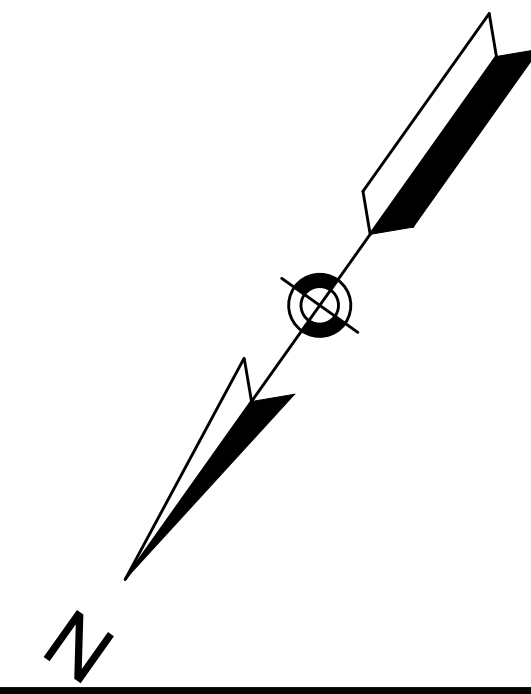
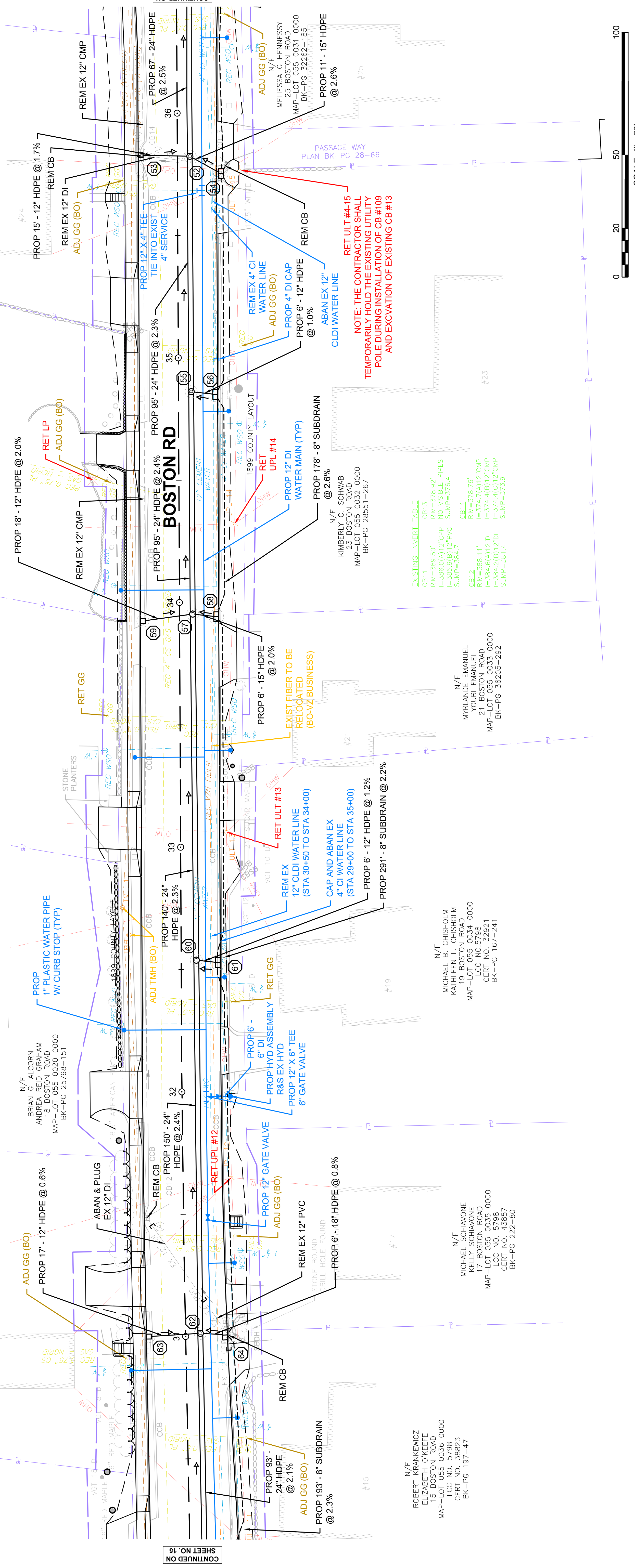
N/F  
MYRLANDE EMANUEL  
YOURI EMANUEL  
21 BOSTON ROAD  
MAP-LOT 055 0033 0000  
BK-PG 36205-292

N/F  
KIMBERLY SCHIMAB  
23 BOSTON ROAD  
MAP-LOT 055 0032 0000  
BK-PG 28651-267

N/F  
MELESSA G HENNESSY  
25 BOSTON ROAD  
MAP-LOT 055 0031 0000  
BK-PG 32264-185

**PROPOSED DRAINAGE STRUCTURE DATA**

NO.	TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
52	DMH	35+82.4	5.1' RT	379.58	374.50 (55)	374.40	5" DIAMETER
53	CBCI	35+82.9	16.0' LT	379.35	374.40 (54)	374.65	4" SUMP W/ HOOD OFFSET TOP
54	CB	35+75.3	17.6' RT	379.95	374.95 (SUB)	374.68	DOUBLE CB
55	DMH	34+86.2	5.2' RT	381.70	376.77 (57)	376.70	5" DIAMETER
56	CB	34+85.0	16.0' RT	381.46	377.40 (56)	377.46	DOUBLE CB
57	DMH	33+95.3	5.4' RT	383.70	379.15 (60)	379.05	5" DIAMETER
58	CB	33+94.1	16.0' RT	383.46	379.17 (59)	379.29	DOUBLE CB
59	CBCI	33+92.5	16.0' LT	383.54	379.55 (SUB)	379.54	4" SUMP W/ HOOD
60	DMH	32+53.7	6.1' RT	386.80	382.50 (61)	382.35	5" DIAMETER
61	CB	32+52.8	16.0' RT	386.57	382.40 (62)	382.57	DOUBLE CB
62	DMH	31+01.6	6.2' RT	390.16	386.10 (66)	386.00	5" DIAMETER
63	CB	31+00.3	16.0' LT	389.71	386.10 (63)	386.20	DOUBLE CB
64	CB	31+00.3	16.0' RT	389.91	386.30 (SUB)	386.15	DOUBLE CB

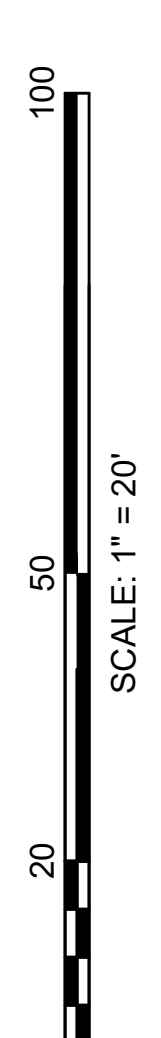
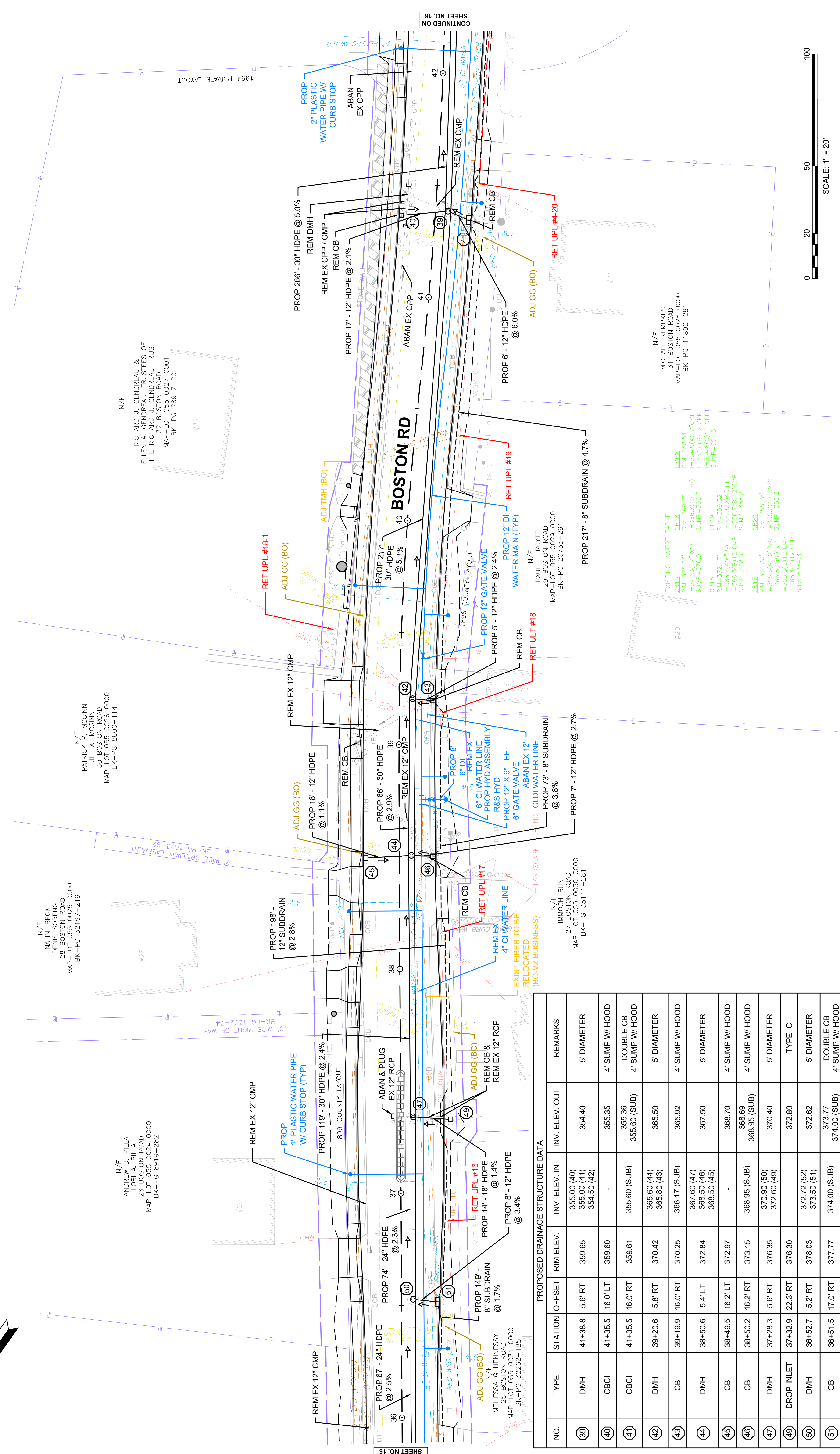


CONTINUED ON SHEET NO. 15

CONTINUED ON SHEET NO. 17

**WESTFORD BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		17	30
PROJECT FILE NO. 609035		UTILITY PLANS - 4 OF 11	



**PROPOSED DRAINAGE STRUCTURE DATA**

NO.	TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
39	DMH	41+38.8	5.6' RT	359.65	355.00 (40) 355.00 (41) 354.50 (42)	354.40	5' DIAMETER
40	CBCI	41+35.5	16.0' LT	359.60	-	355.35	4' SUMP W/ HOOD
41	CBCI	41+35.5	16.0' RT	359.61	355.60 (SUB)	355.36 355.60 (SUB)	DOUBLE CB 4' SUMP W/ HOOD
42	DMH	39+20.6	5.8' RT	370.42	365.60 (44) 365.80 (43)	365.50	5' DIAMETER
43	CB	39+19.9	16.0' RT	370.25	366.17 (SUB)	365.92	4' SUMP W/ HOOD
44	DMH	38+50.6	5.4' LT	372.84	367.60 (47) 368.50 (46) 368.50 (45)	367.50	5' DIAMETER
45	CB	38+49.5	16.2' LT	372.97	-	368.70	4' SUMP W/ HOOD
46	CB	38+50.2	16.2' RT	373.15	368.95 (SUB)	368.69 368.95 (SUB)	4' SUMP W/ HOOD
47	DMH	37+28.3	5.6' RT	376.35	370.00 (50) 372.60 (49)	370.40	5' DIAMETER
48	DROP INLET	37+32.9	22.3' RT	376.30	-	372.80	TYPE C
49	DMH	36+52.7	5.2' RT	378.03	372.72 (52) 373.50 (51)	372.62	5' DIAMETER
51	CB	36+51.5	17.0' RT	377.77	374.00 (SUB)	373.77 374.00 (SUB)	DOUBLE CB 4' SUMP W/ HOOD

NOTE: THERE IS NO DRAINAGE STRUCTURE NUMBER 48.

N/F  
RICHARD J. GENDREAU &  
ELLEN A. GENDREAU, TRUSTEES OF  
THE RICHARD J. GENDREAU TRUST  
1899 BOSTON ROAD  
BOSTON, MA 02124  
MAP-LOT 055 0027-0001  
BK-PG 28917-201

N/F  
PATRICK P. MCGINN  
1715 BOSTON ROAD  
30 BOSTON ROAD  
MAP-LOT 055 0026 0000  
BK-PG 8800-114

N/F  
MALINI BECK  
DENIS SORENG  
28 BOSTON ROAD  
MAP-LOT 055 0025 0000  
BK-PG 32197-219

N/F  
ANDREW D. PILLA  
26 BOSTON ROAD  
MAP-LOT 055 0024 0000  
BK-PG 8919-282

N/F  
PAUL ROYCE  
28 BOSTON ROAD  
MAP-LOT 055 0029 0000  
BK-PG 20735-291

N/F  
MICHAEL KEMPKES  
31 BOSTON ROAD  
MAP-LOT 055 0028 0000  
BK-PG 11890-281

N/F  
LIMMOCH BUN  
27 BOSTON ROAD  
MAP-LOT 055 0030 0000  
BK-PG 35111-281

**EXISTING INVERT TABLE**

CB15	RM=375.33'	I=372.3(12'RCF)	SUMP=370.5
DMH2	RM=358.51'	I=354.9(A)12'CMP	I=354.8(B)12'CPP
CB18	RM=369.76'	I=366.8(12'CPP)	SUMP=366.7
CB19	RM=359.82'	I=356.5(C)12'CPP	SUMP=354.9
CB16	RM=372.17'	I=368.7(A)6'PVC	I=357.5(A)4'CPP
		I=368.3(B)12'CMP	SUMP=368.0
CB20	RM=358.78'	I=355.2(12'CMP)	SUMP=355.8
CB17	RM=370.30'	I=366.6(A)12'PVC	I=355.2(12'CMP)
		I=366.6(B)8'CMP	SUMP=355.2
		I=365.5(C)12'CMP	SUMP=364.6

CONTINUED ON SHEET NO. 16

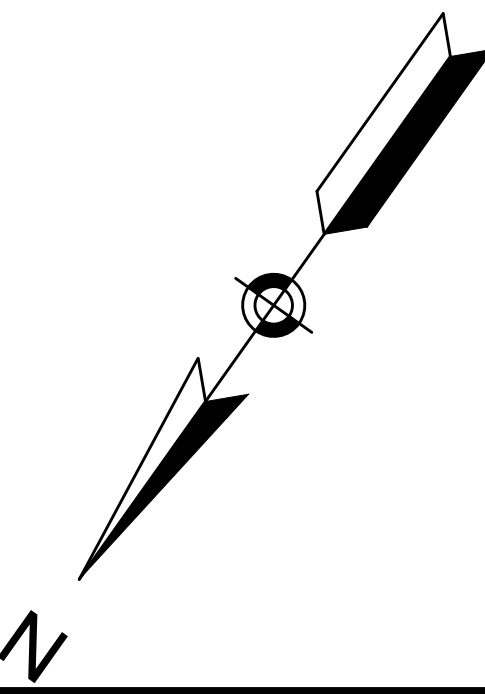
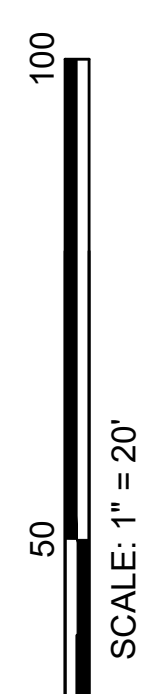
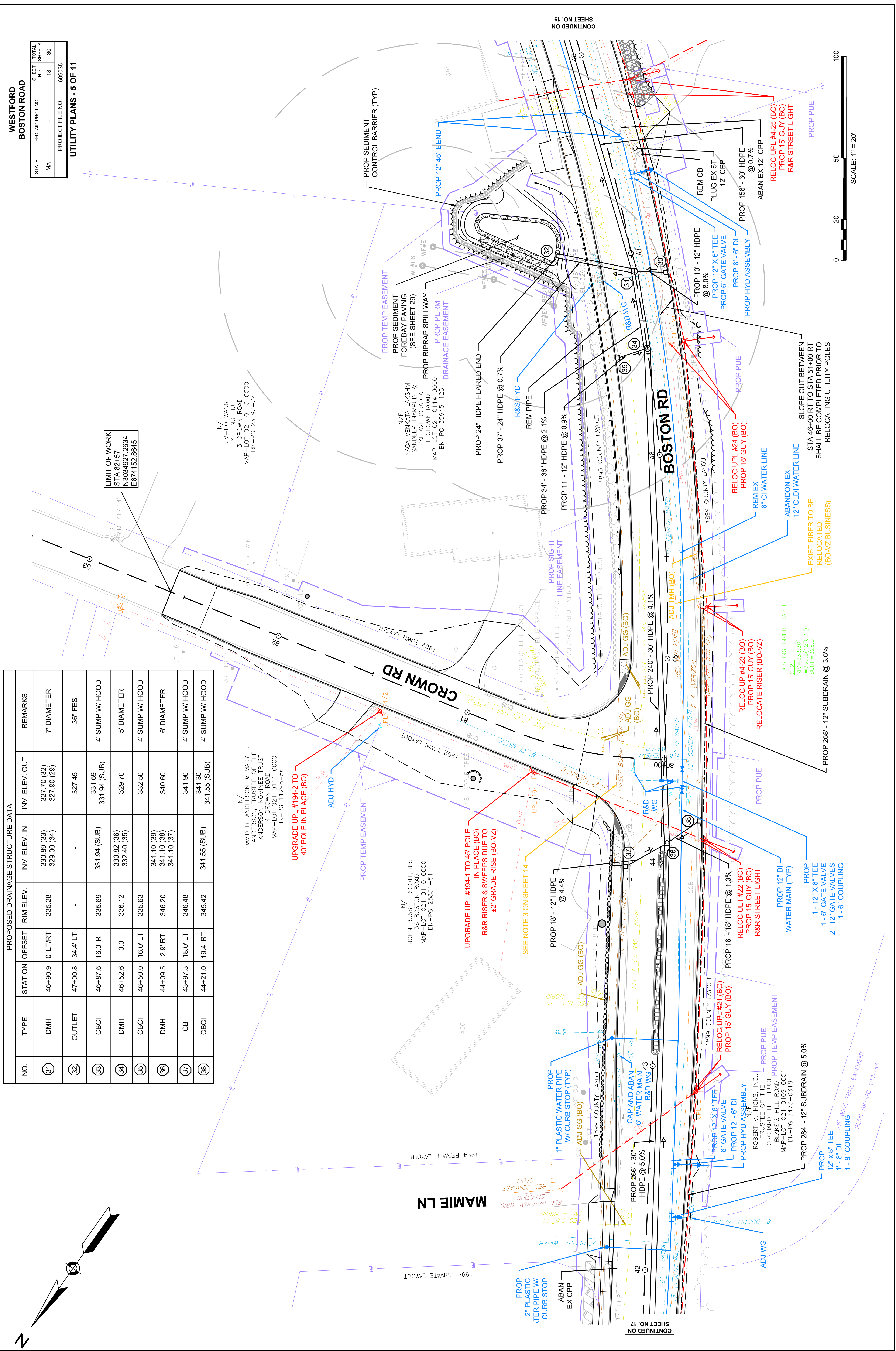
CONTINUED ON SHEET NO. 18

**WESTFORD BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	18	30
PROJECT FILE NO. 609035		UTILITY PLANS - 5 OF 11	

**PROPOSED DRAINAGE STRUCTURE DATA**

NO.	TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
31	DMH	46+90.9	0' LT/RT	335.28	330.89 (33) 329.00 (34)	327.70 (32) 327.90 (29)	7" DIAMETER
32	OUTLET	47+00.8	34.4' LT	-	-	327.45	36" FES
33	CBCI	46+87.6	16.0' RT	335.69	331.94 (SUB)	331.69 331.94 (SUB)	4" SUMP W/ HOOD
34	DMH	46+52.6	0.0'	336.12	330.82 (36) 332.40 (35)	329.70	5" DIAMETER
35	CBCI	46+50.0	16.0' LT	335.63	-	332.50	4" SUMP W/ HOOD
36	DMH	44+09.5	2.9' RT	346.20	341.10 (39) 341.10 (38) 341.10 (37)	340.60	6" DIAMETER
37	CB	43+97.3	18.0' LT	346.48	-	341.90	4" SUMP W/ HOOD
38	CBCI	44+21.0	19.4' RT	345.42	341.55 (SUB)	341.30 341.55 (SUB)	4" SUMP W/ HOOD



CONTINUED ON SHEET NO. 19

CONTINUED ON SHEET NO. 17







**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		21	30
PROJECT FILE NO. 609035		UTILITY PLANS - 8 OF 11	

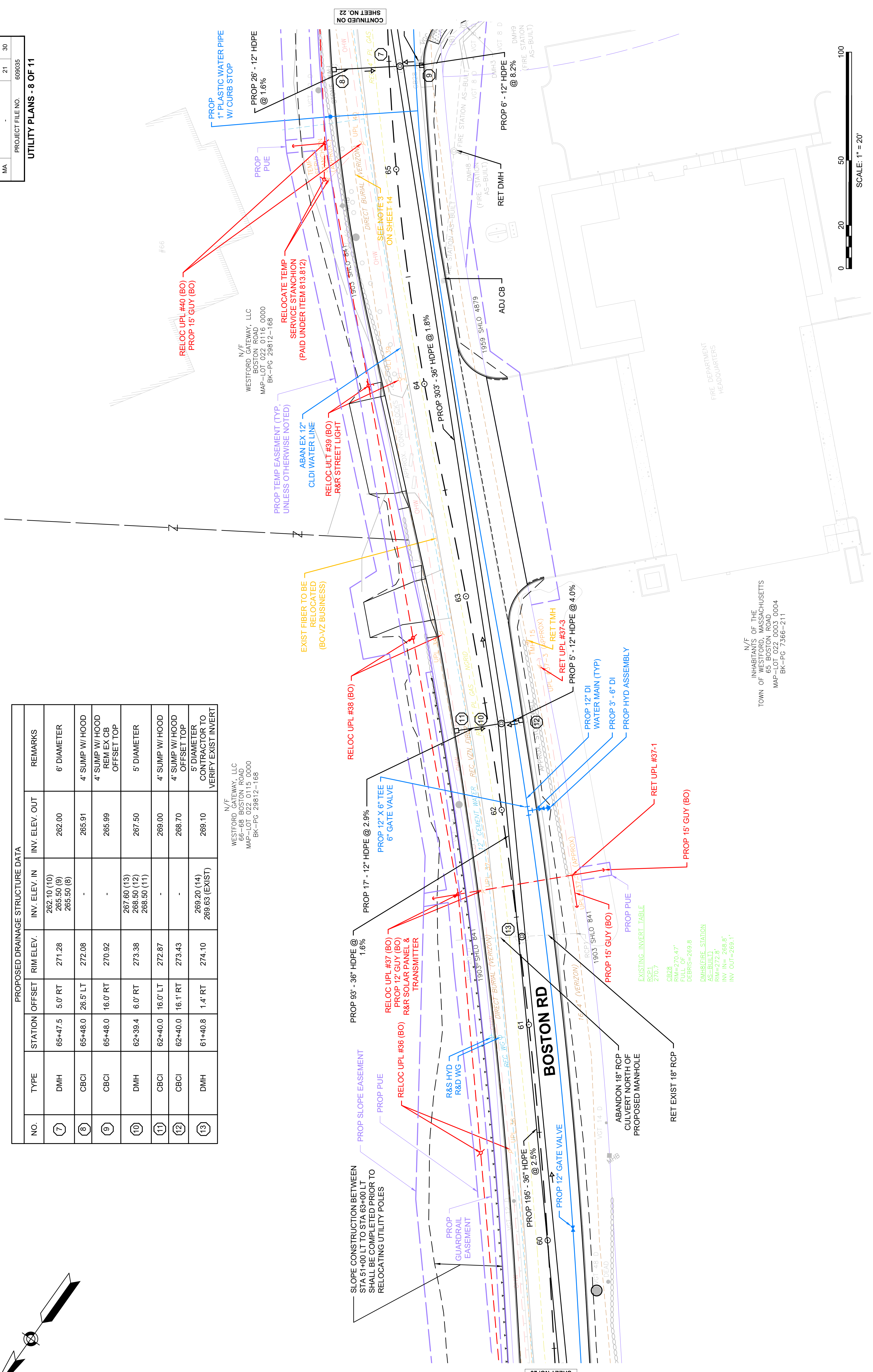
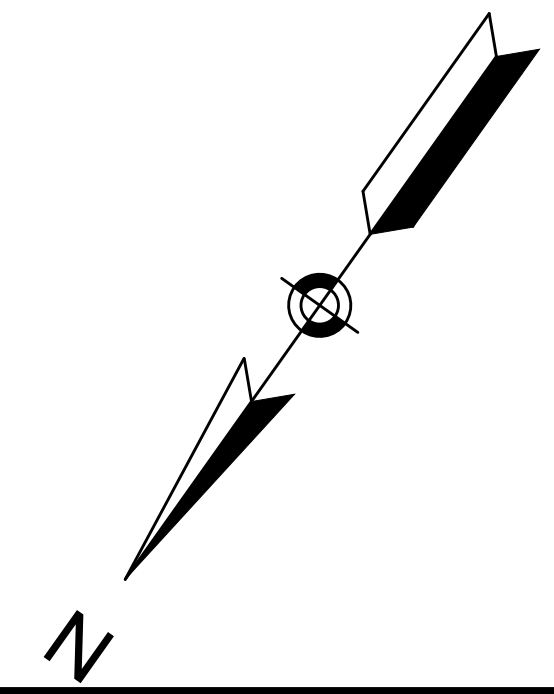
PROPOSED DRAINAGE STRUCTURE DATA

NO.	TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
7	DMH	65+47.5	5.0' RT	271.28	262.10 (10) 265.50 (9) 265.50 (8)	262.00	6" DIAMETER
8	CBCI	65+48.0	26.5' LT	272.08	-	265.91	4" SUMP W/ HOOD
9	CBCI	65+48.0	16.0' RT	270.92	-	265.99	4" SUMP W/ HOOD REM EX CB OFFSET TOP
10	DMH	62+39.4	6.0' RT	273.38	267.60 (13) 268.50 (12) 268.50 (11)	267.50	5" DIAMETER
11	CBCI	62+40.0	16.0' LT	272.87	-	269.00	4" SUMP W/ HOOD
12	CBCI	62+40.0	16.1' RT	273.43	-	268.70	4" SUMP W/ HOOD OFFSET TOP
13	DMH	61+40.8	1.4' RT	274.10	269.20 (14) 269.63 (EXIST)	269.10	5" DIAMETER CONTRACTOR TO VERIFY EXIST INVERT

N/F  
WESTFORD GATEWAY, LLC  
66-68 BOSTON ROAD  
MAP LOT 22, 01116, 00000  
BK-PC 239812-168

N/F  
WESTFORD GATEWAY, LLC  
66-68 BOSTON ROAD  
MAP LOT 22, 01116, 00000  
BK-PC 239812-168

N/F  
INHABITANTS OF THE  
TOWN OF WESTFORD, MASSACHUSETTS  
66 BOSTON ROAD  
MAP LOT 22, 01116, 0004  
BK-PC 7366-211



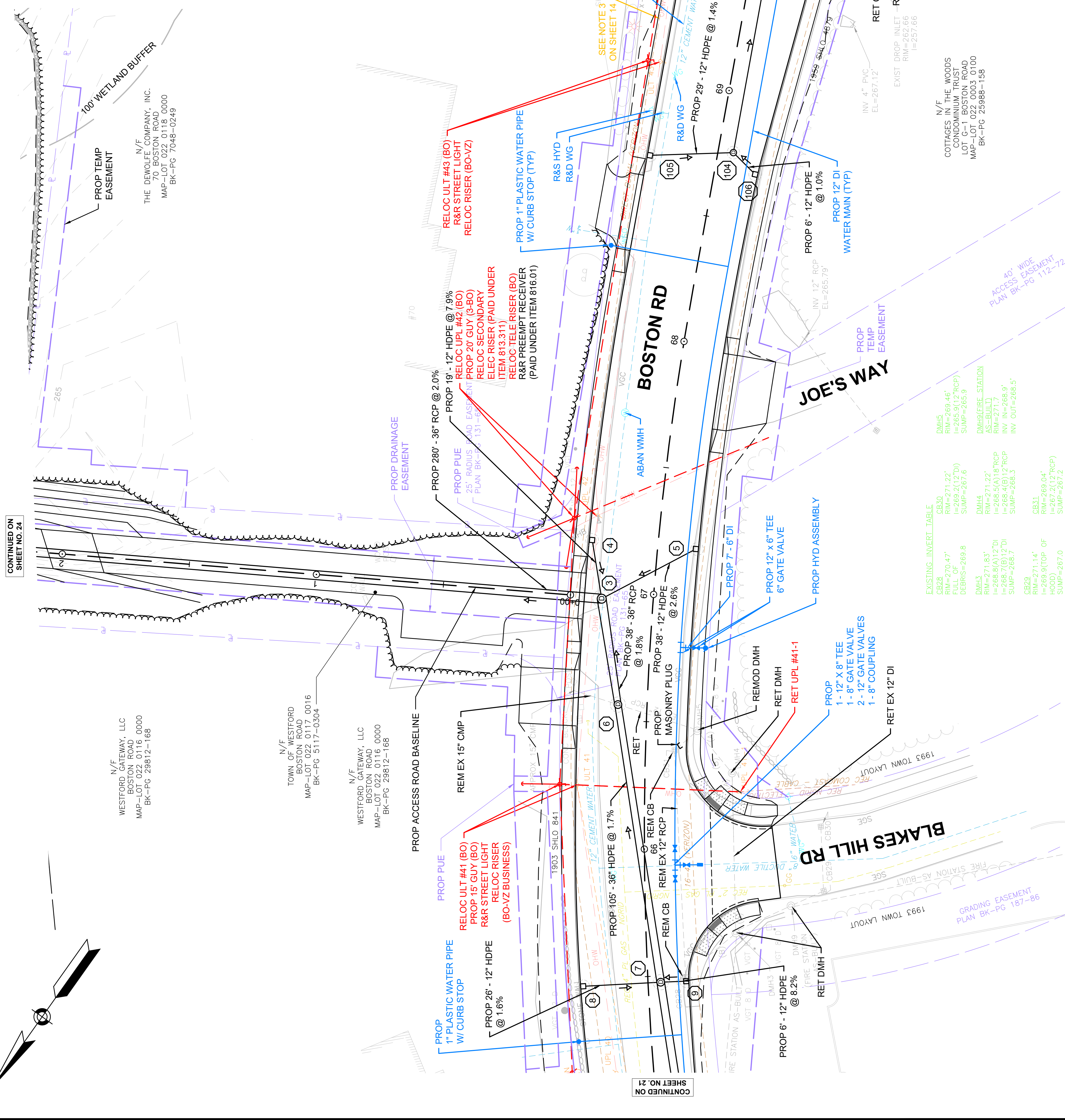
CONTINUED ON  
SHEET NO. 20

CONTINUED ON  
SHEET NO. 22

**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	22	30
PROJECT FILE NO. 609035		UTILITY PLANS - 9 OF 11	

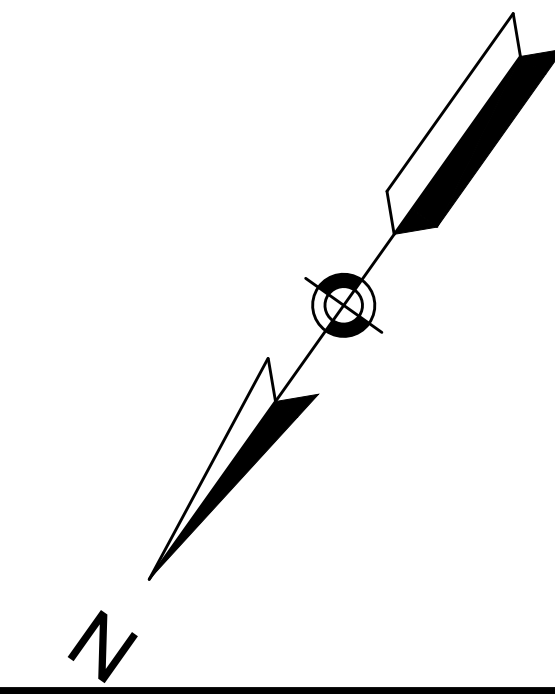
PROPOSED DRAINAGE STRUCTURE DATA							
NO.	TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
100	DMH	70+78.5	28.8' RT	261.94	256.50 (EXIST) 257.00 (101)	256.50 (EXIST)	CONTRACTOR TO VERIFY EXISTING ELEVATION
101	DMH	70+20.8	6.0' RT	262.54	258.70 (104) 258.70 (103) 258.70 (102)	258.50	
102	CBCI	70+14.4	27.0' LT	263.07	-	259.57	4' SUMP W/ HOOD
103	CBCI	70+14.4	23.9' RT	263.13	-	259.63	4' SUMP W/ HOOD
104	DMH	68+76.3	6.0' RT	265.84	262.18 (106) 262.18 (105)	262.08	
105	CB	68+70.0	27.0' LT	266.08	-	262.58	4' SUMP W/ HOOD
106	CBCI	68+69.4	16.9' RT	265.74	-	262.24	4' SUMP W/ HOOD
3	DMH	66+97.4	20.2' LT	269.66	259.40 (6) 263.50 (5) 263.50 (4)	259.30	7" DIAMETER
4	CB	67+19.1	25.9' LT	269.29	-	265.00	4' SUMP W/ HOOD
5	CBCI	67+19.3	15.0' RT	268.12	-	264.50	4' SUMP W/ HOOD OFFSET TOP
6	DMH	66+56.1	11.4' LT	270.06	265.6 (EXIST) 260.20 (7)	260.10	5" DIAMETER CONTRACTOR TO VERIFY EXIST ELEV
7	DMH	65+47.5	5.0' RT	271.28	262.10 (10) 265.50 (9) 265.50 (8)	262.00	6" DIAMETER
8	CBCI	65+48.0	26.5' LT	272.08	-	265.91	4' SUMP W/ HOOD
9	CBCI	65+48.0	16.0' RT	270.92	-	265.99	4' SUMP W/ HOOD REM EX CB OFFSET TOP



CONTINUED ON SHEET NO. 24

CONTINUED ON SHEET NO. 21

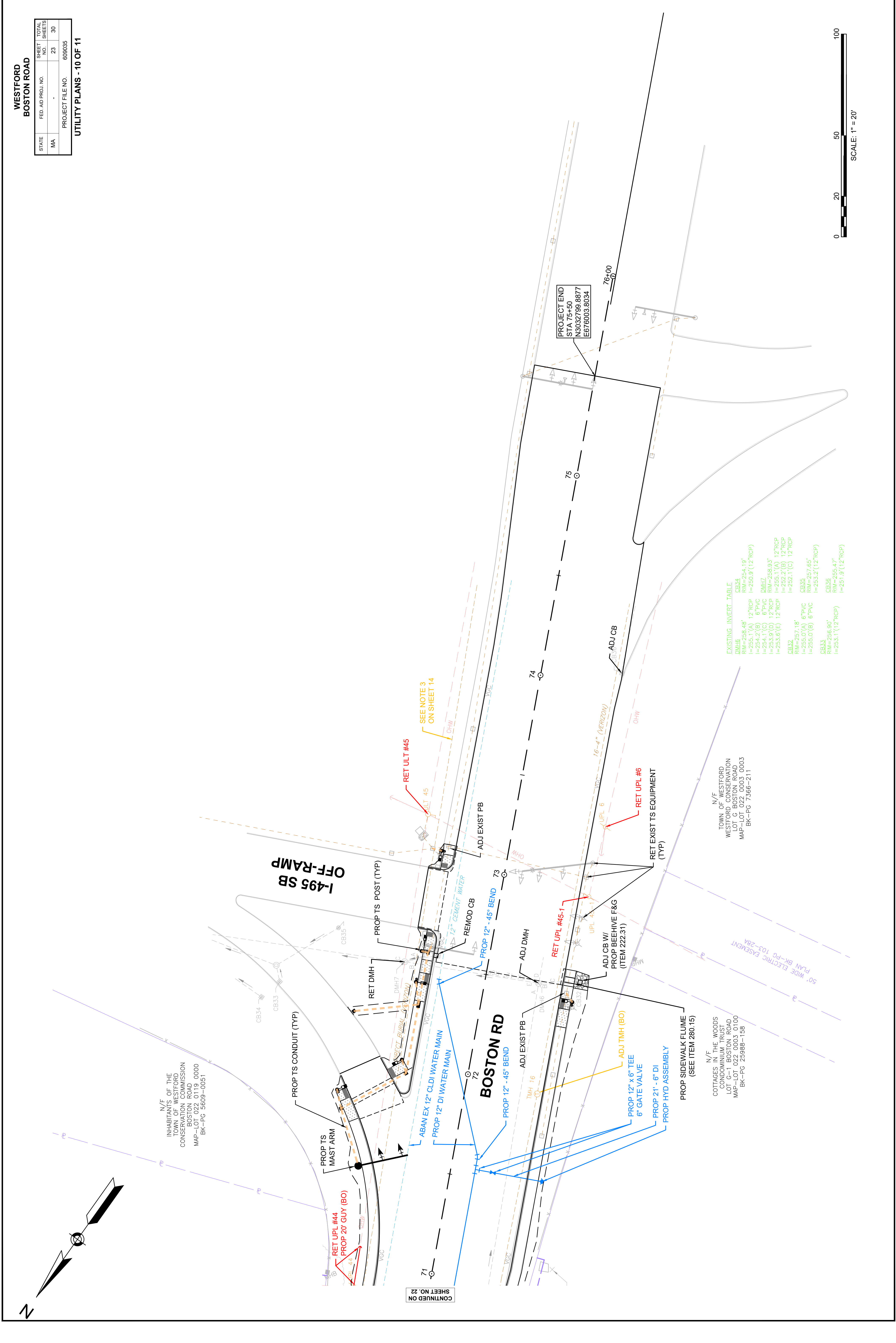
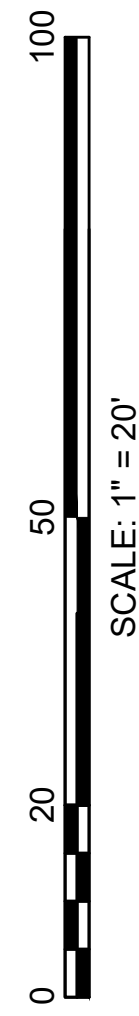
CONTINUED ON SHEET NO. 23



WESTFORD  
BOSTON ROAD

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA		23	30
PROJECT FILE NO. 609035			

UTILITY PLANS - 10 OF 11



EXISTING INVERT TABLE

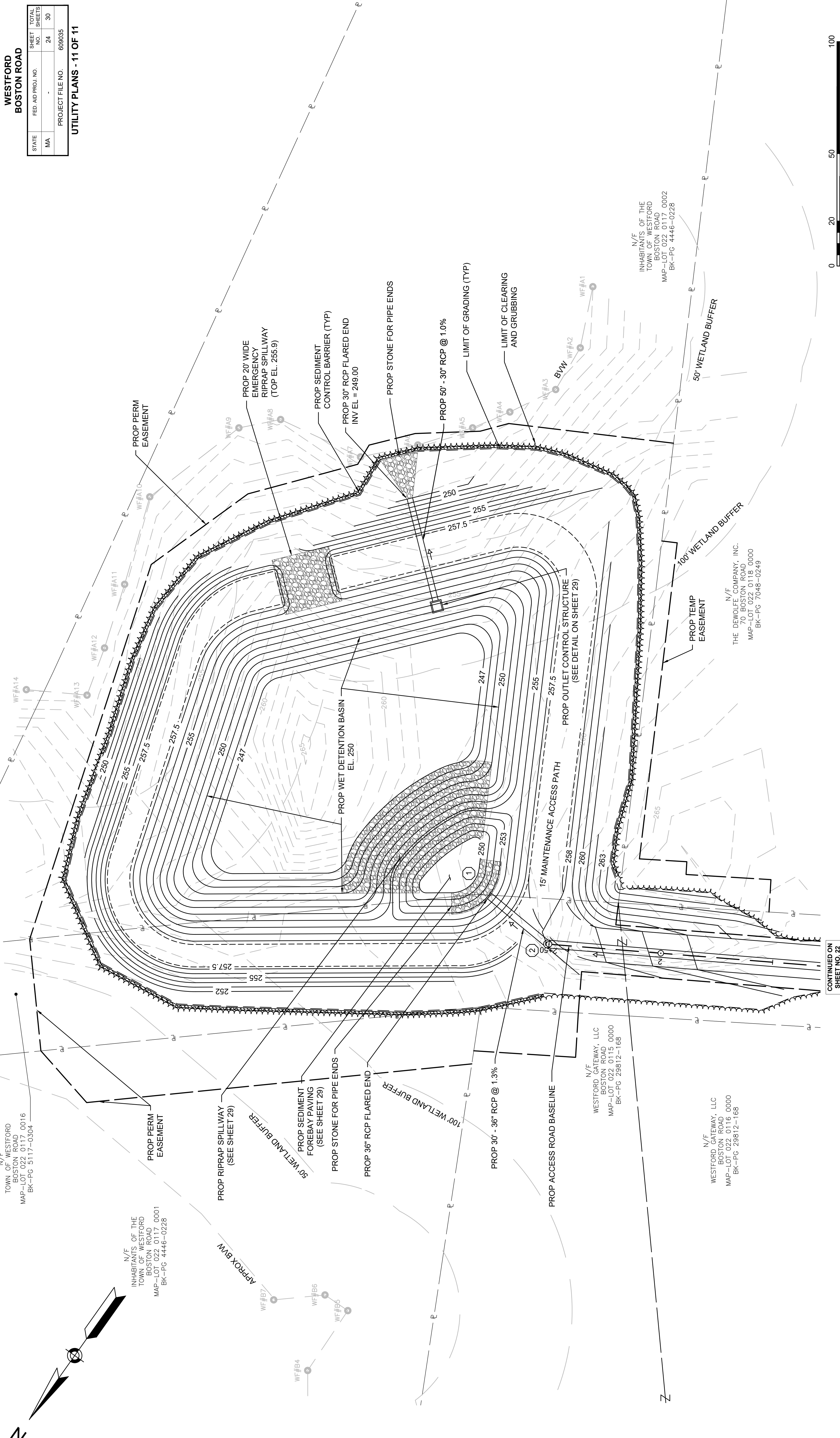
DMH#	CE#	RM	DI
258.48'	254.19'	250.9'	12" RCP
255.1'	254.1'	254.2'	6" PVC
254.2'	253.9'	253.6'	12" RCP
255.1'	255.1'	252.2'	12" RCP
257.18'	255.0'	255.0'	6" PVC
256.90'	253.1'	251.9'	12" RCP

N/F  
TOWN OF WESTFORD  
WESTFORD CONSERVATION  
LOT G BOSTON ROAD  
MAP-LOT 022 0003 0003  
BK-PG 7366-211

N/F  
COTTAGES OF THE WOODS  
CONSERVATION TRUST  
LOT C-1 BOSTON ROAD  
MAP-LOT 022 0003 0100  
BK-PG 25988-158

N/F  
INHABITANTS OF THE  
TOWN OF WESTFORD  
CONSERVATION COMMISSION  
LOT 022 0119 0000  
MAP-LOT 022 0119 0000  
BK-PG 5609-0051

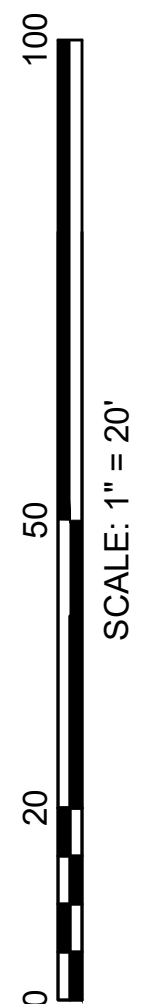
CONTINUED ON  
SHEET NO. 22



**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	24	30
PROJECT FILE NO. 609035			

UTILITY PLANS - 11 OF 11



PROPOSED DRAINAGE STRUCTURE DATA

NO.	TYPE	STATION	OFFSET	RIM ELEV.	INV. ELEV. IN	INV. ELEV. OUT	REMARKS
①	OUTLET	67+12.8	301.9' LT	-	253.20	253.20	36" FES
②	DMH	66+98.3	283.2' LT	258.00	253.70 (9)	253.60	6' DIAMETER

CONTINUED ON  
SHEET NO. 22

N/F  
TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0016  
BK-PG 5117-0304

N/F  
INHABITANTS OF THE  
TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0001  
BK-PG 4446-0228

PROX B/W

N/F  
WESTFORD GATEWAY, LLC  
BOSTON ROAD  
MAP-LOT 022 0118 0000  
BK-PG 7048-0249

N/F  
WESTFORD GATEWAY, LLC  
BOSTON ROAD  
MAP-LOT 022 0118 0000  
BK-PG 7048-0249

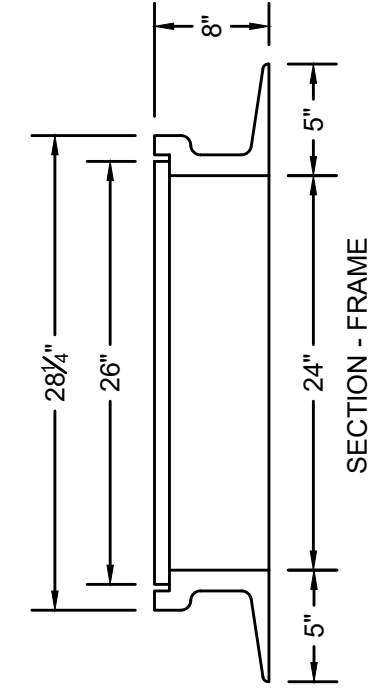
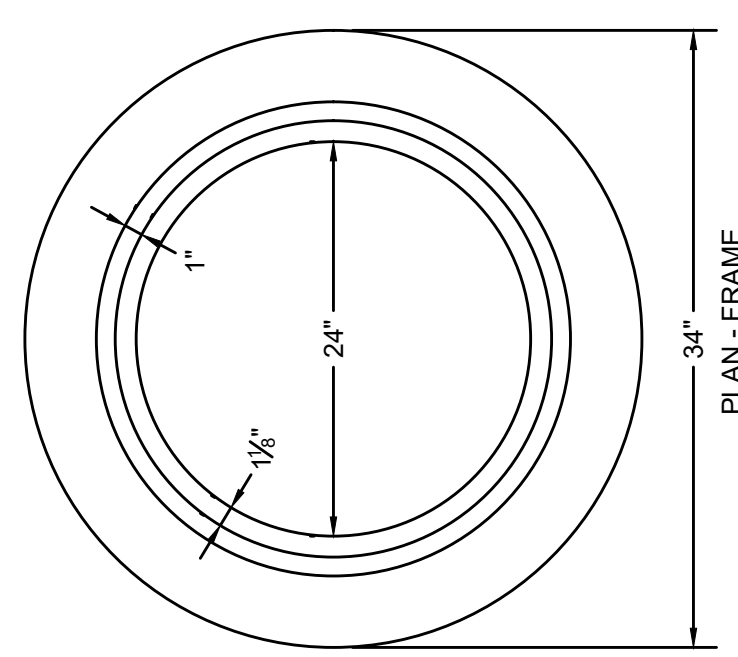
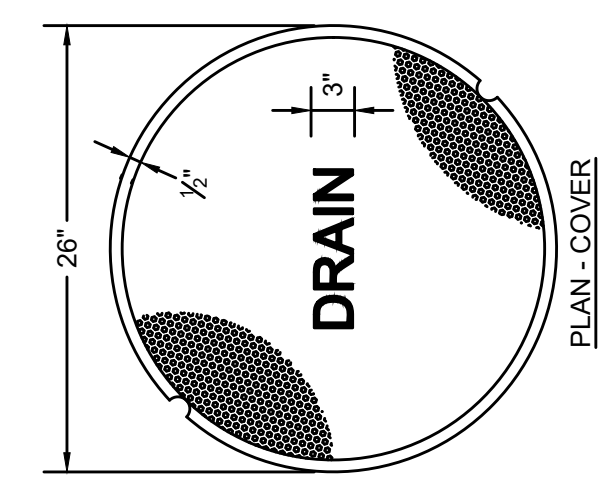
N/F  
WESTFORD GATEWAY, LLC  
BOSTON ROAD  
MAP-LOT 022 0118 0000  
BK-PG 7048-0249

N/F  
INHABITANTS OF THE  
TOWN OF WESTFORD  
BOSTON ROAD  
MAP-LOT 022 0117 0002  
BK-PG 4446-0228

**WESTFORD BOSTON ROAD**

STATE	FED AD PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	25	30
PROJECT FILE NO.		609035	

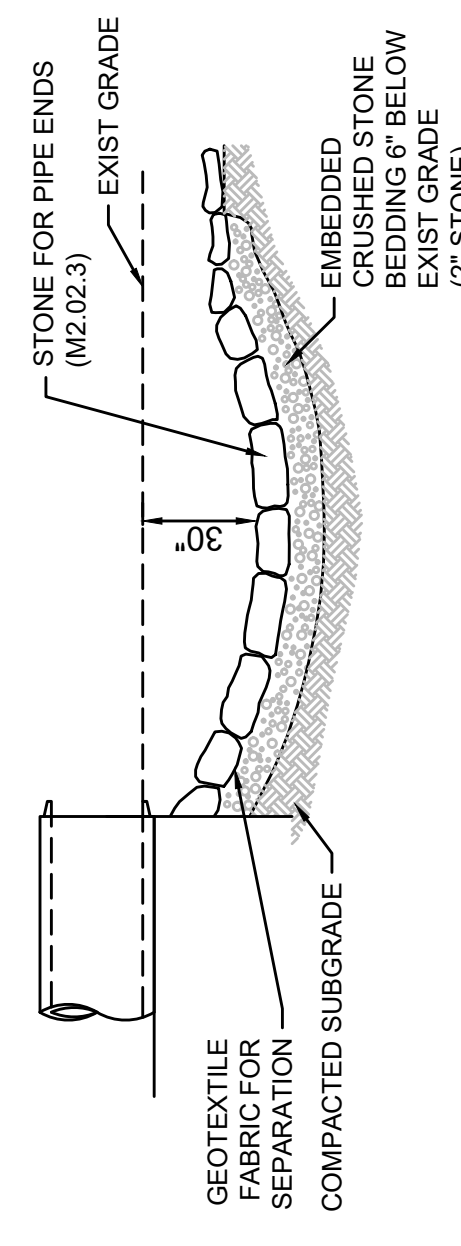
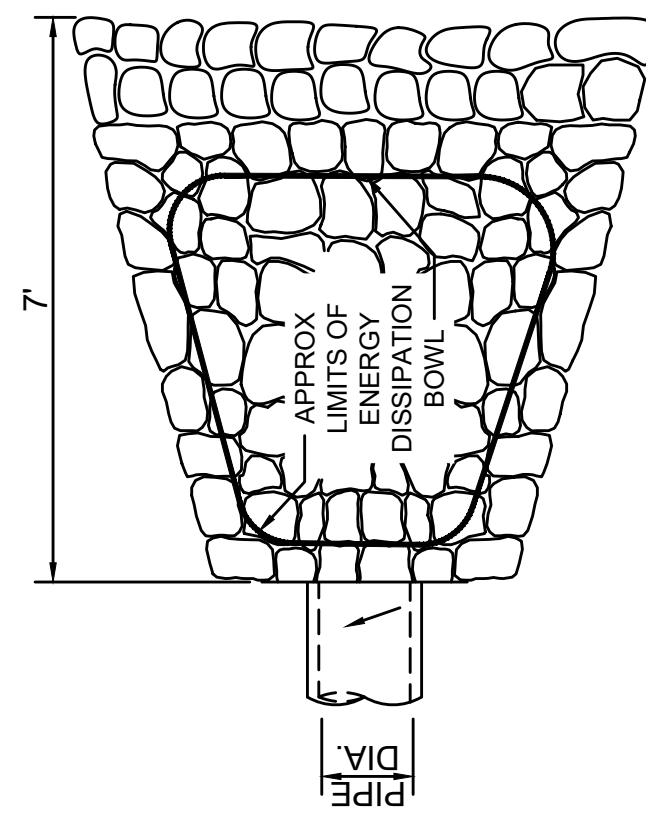
**CONSTRUCTION DETAILS - 1 OF 6**



- NOTES:**
1. FRAME AND COVER SHALL BE RATED FOR HL-93 LOADING.
  2. MATERIAL - CAST IRON.
  3. MINIMUM MASS - 265 LBS.
  4. ALL MH FRAMES AND COVERS SHALL BE ADA AND A48 COMPLIANT.
  5. MANHOLE COVERS SHALL HAVE A DIAMOND PATTERN, PICK HOLES, AND THE WORD "DRAIN" OR "SEWER" CAST IN 3-INCH LETTERS.
  6. MANHOLE COVERS WITHIN SHOULDER SHALL COMPLY WITH CONSTRUCTION STANDARD E202.6.0.

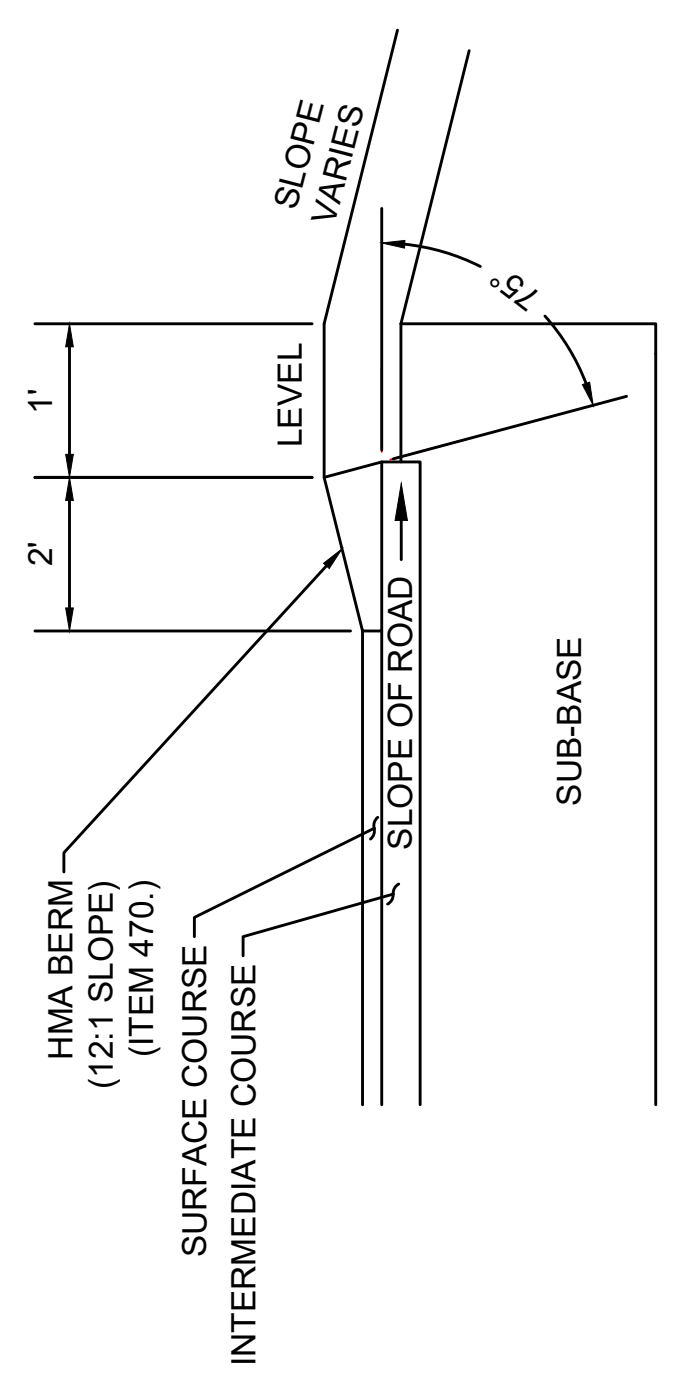
**MANHOLE FRAME & COVER (MUNICIPAL STANDARD)**

N.T.S.



**STONE FOR PIPE ENDS**

N.T.S.

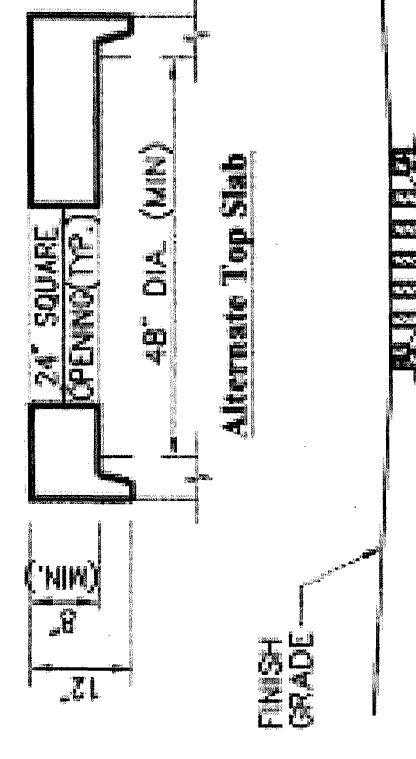


**HOT MIX ASPHALT BERM**

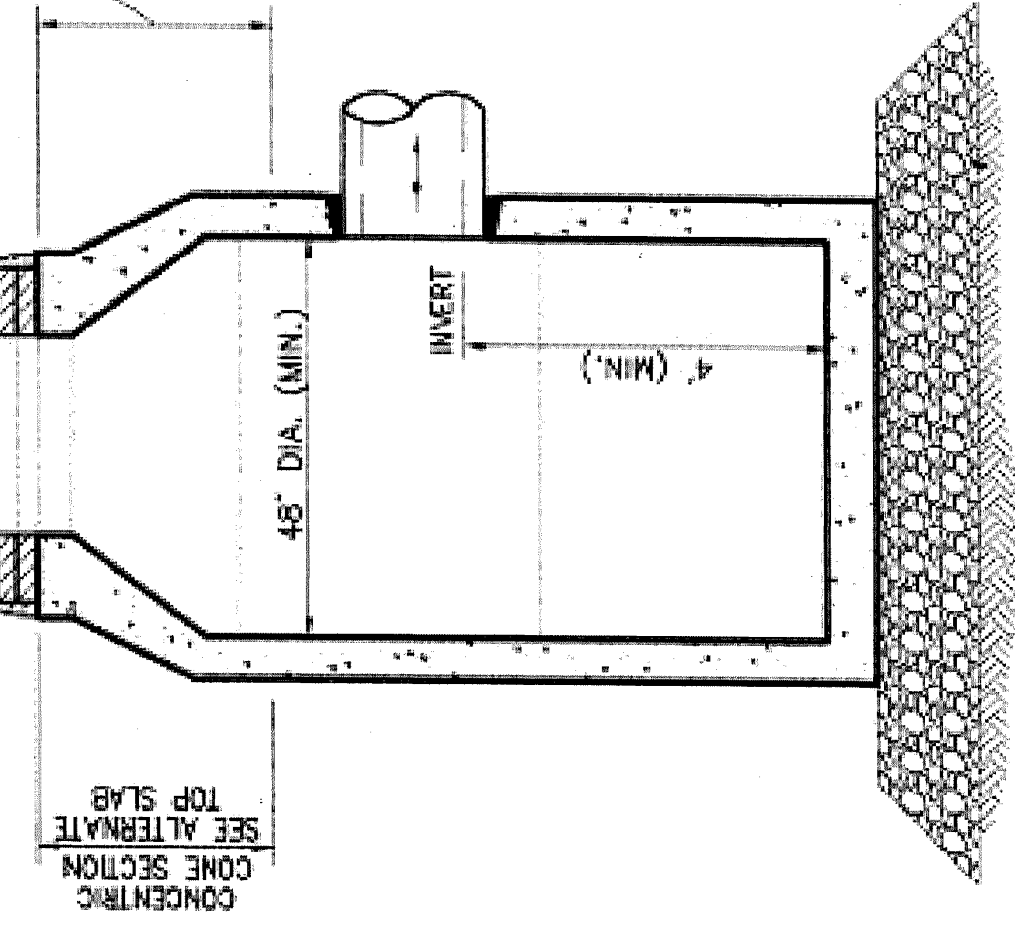
N.T.S.

- Notes:**
1. BASED ON ACTUAL FIELD CONDITIONS; THE CONTRACTOR SHALL DETERMINE WHICH STYLE OF TOP SECTION SHOULD BE USED.

**Alternate Eccentric Conc. Section**



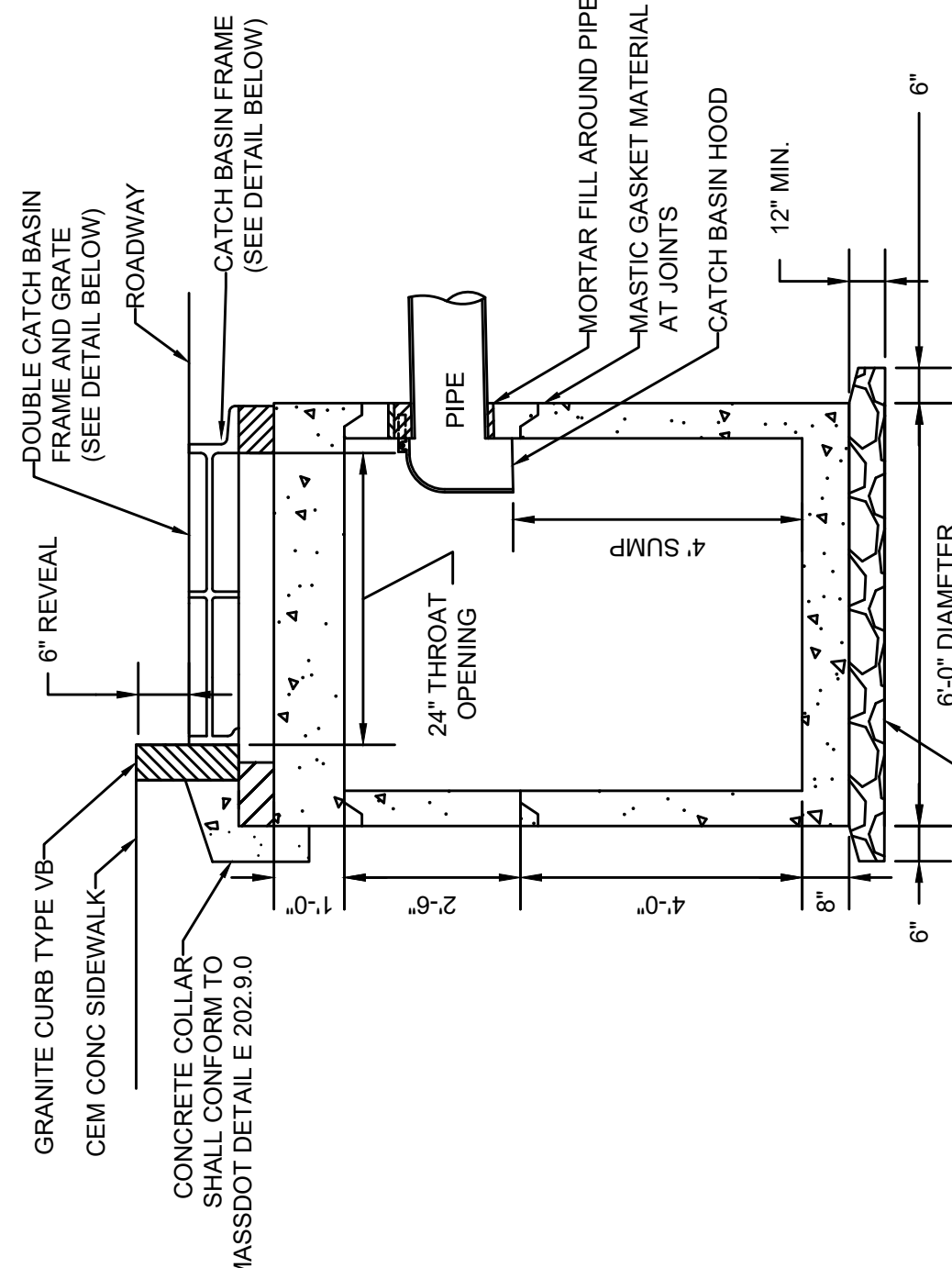
- NOTES:**
1. BASED ON ACTUAL FIELD CONDITIONS; THE CONTRACTOR SHALL DETERMINE WHICH STYLE OF TOP SECTION SHOULD BE USED.



**OFFSET CATCH BASIN**

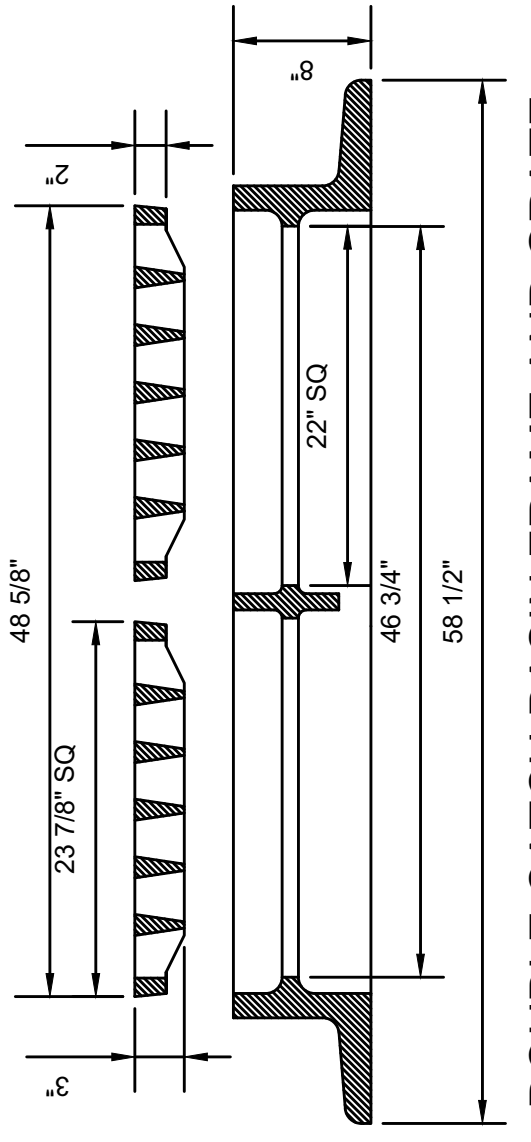
N.T.S.

- NOTES:**
1. PLAY LIMITS IN ROCK EXCAVATION SHALL BE 6\"/>
  - 2. INSTALL CB FRAME AND GRATE WITH 48\"/>



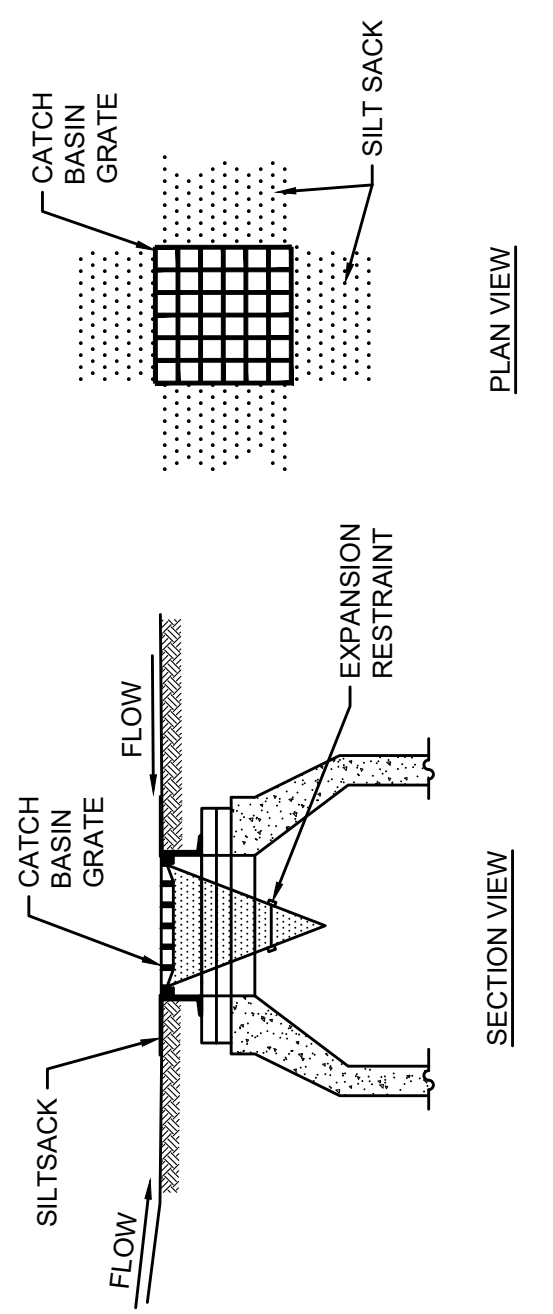
**DOUBLE CATCH BASIN (ITEM 201.1)**

N.T.S.



**DOUBLE CATCH BASIN FRAME AND GRATE**

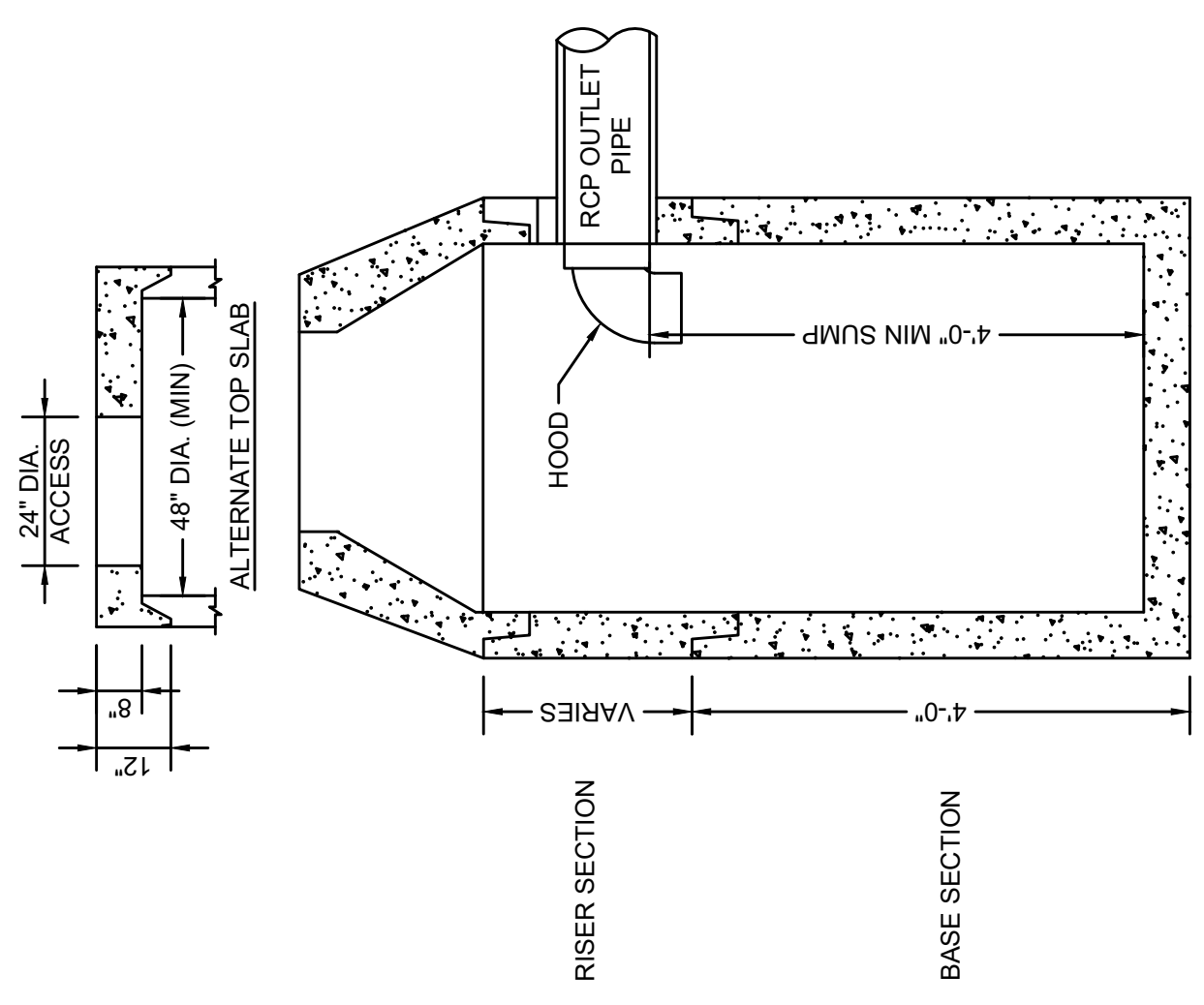
N.T.S.



- NOTES:**
1. INSTALL SILT SACK IN EXISTING CATCH BASINS BEFORE COMMENCING WORK, AND IN NEW CATCH BASINS IMMEDIATELY AFTER INSTALLATION OF STRUCTURE. SILT SACKS SHOULD BE PLACED IN THE PAVING IS COMPLETE OR A PERMANENT STAND OF GRASS HAS BEEN ESTABLISHED.
  2. GRATE TO BE PLACED OVER SILT SACK
  3. SILT SACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED PROMPTLY AS NEEDED.

**INLET PROTECTION SILT SACK IN CATCH BASIN**

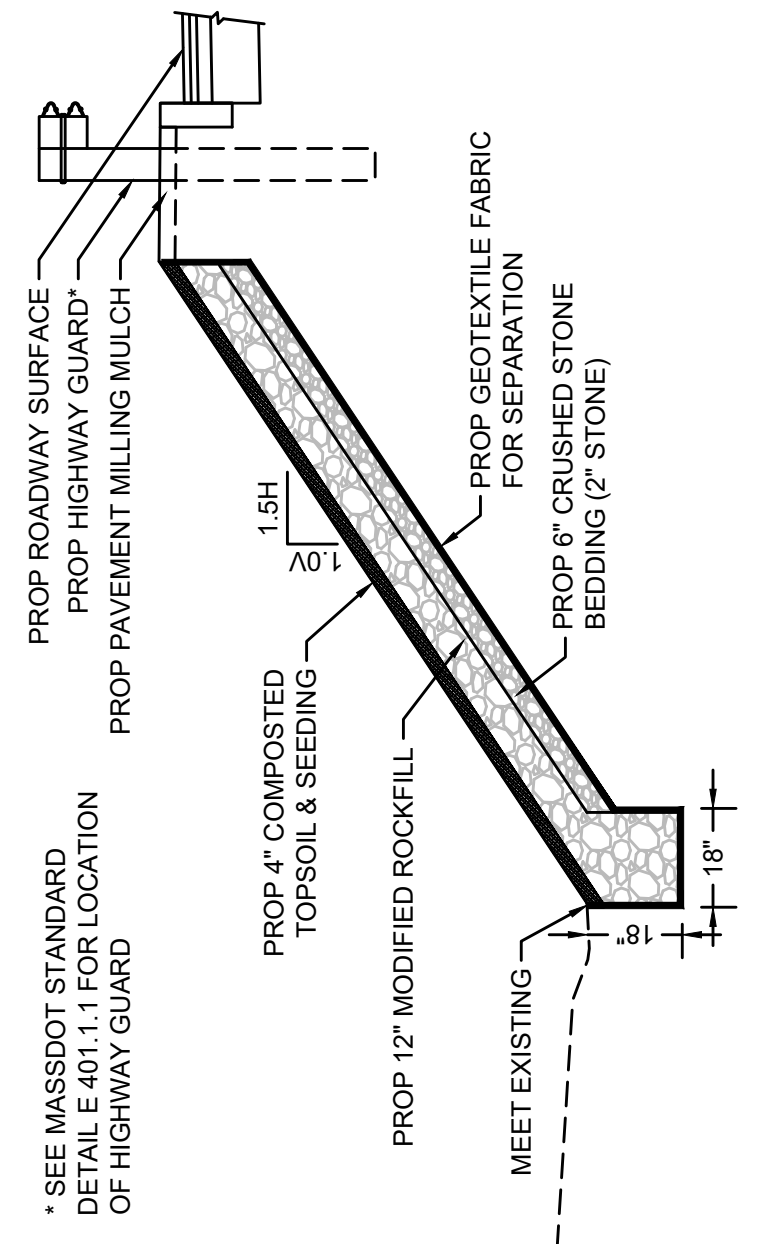
N.T.S.



- NOTE:**
- ALL CATCH BASINS SHALL CONFORM TO MASSDOT CONSTRUCTION STANDARD E 201.4.0 EXCEPT FOR 4\"/>

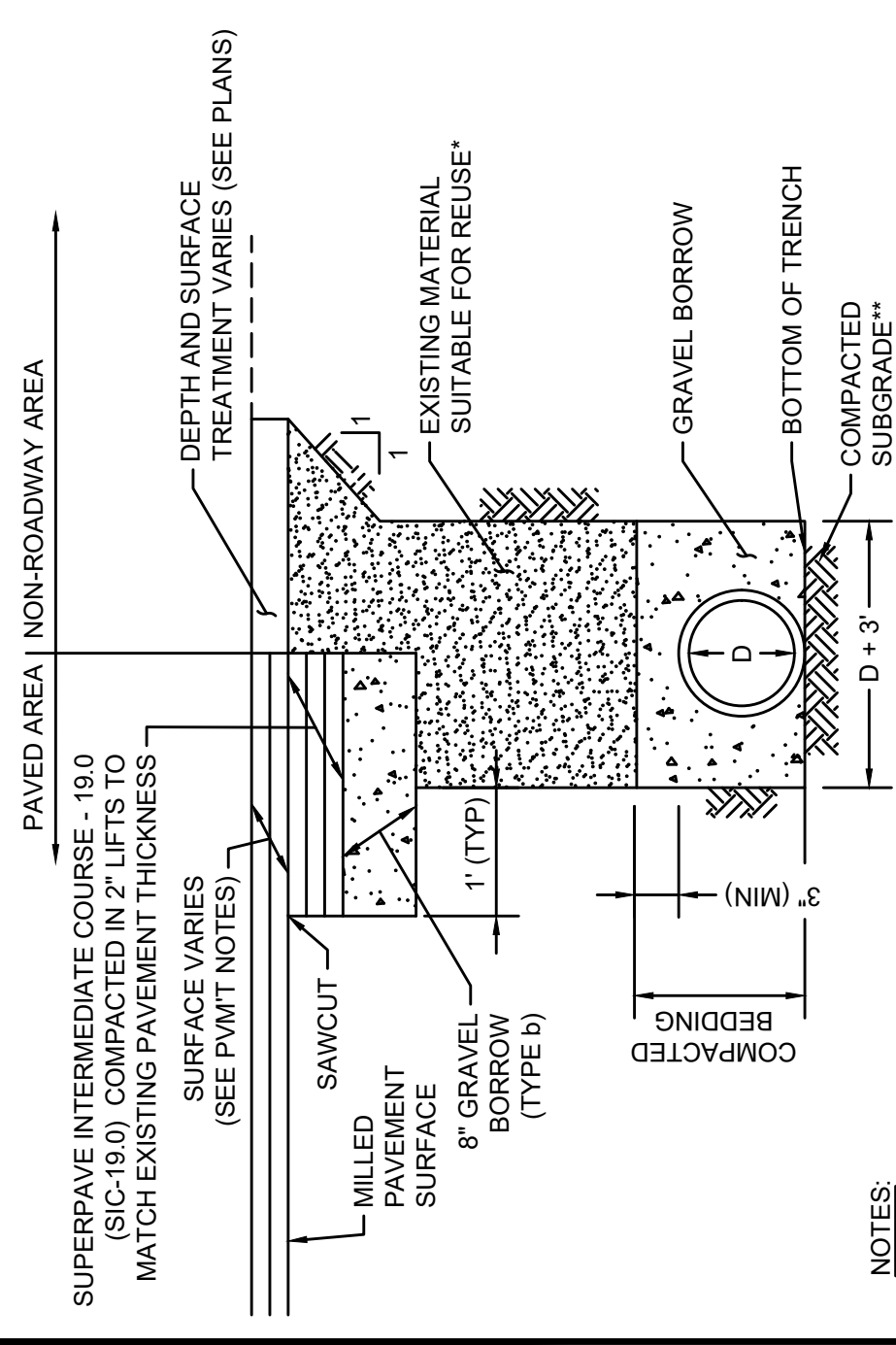
**DEEP SUMP CATCH BASIN WITH HOOD**

N.T.S.



**MODIFIED ROCKFILL SLOPE STABILIZATION**

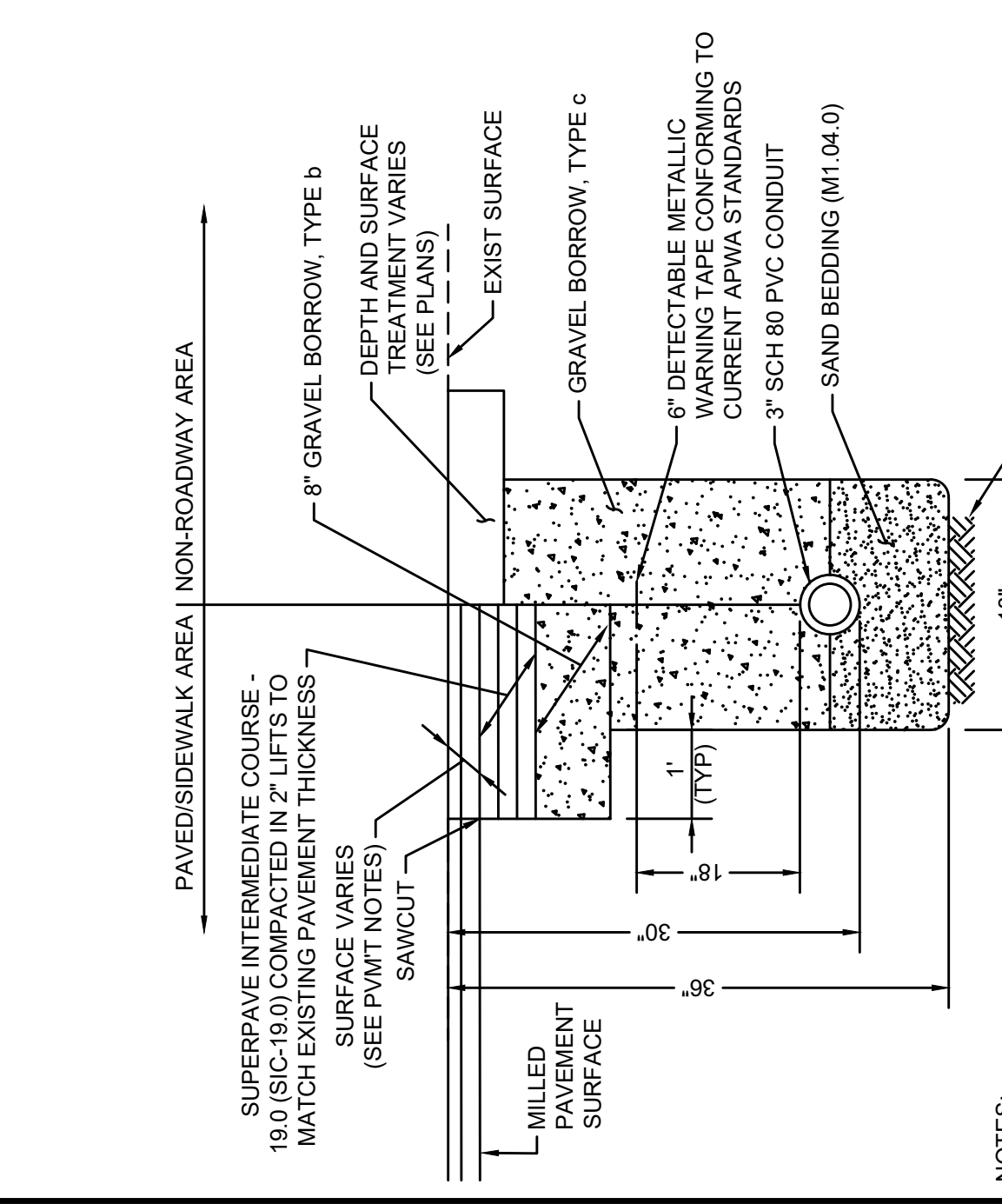
N.T.S.



- NOTES:**
1. EXISTING MATERIAL OBTAINED FROM EXCAVATION THAT IS DETERMINED TO BE SUITABLE AND APPROVED BY THE ENGINEER SHALL BE USED. BACKFILL SHALL BE PLACED IN LAYERS NO MORE THAN 6\"/>
  - \*\*SOFT OR UNSUITABLE MATERIAL EXISTING BELOW THE REQUIRED BEDDING GRADE SHALL BE REMOVED AS DIRECTED AND REPLACED WITH SAND, GRAVEL, CRUSHED STONE OR OTHER SUITABLE MATERIAL AND THOROUGHLY COMPACTED.

**UTILITY TRENCH**

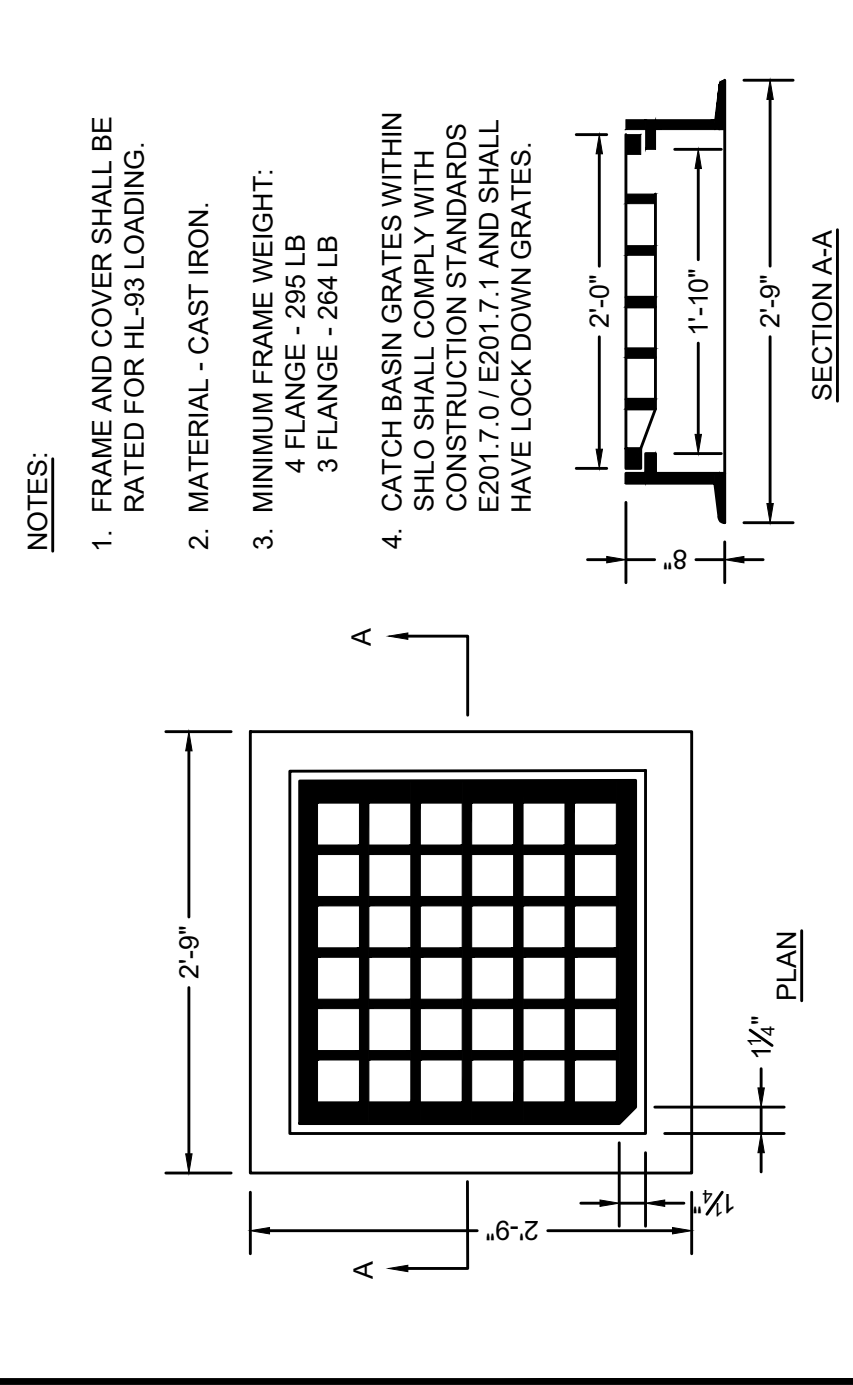
N.T.S.



- NOTES:**
1. SOFT OR UNSUITABLE MATERIAL EXISTING BELOW THE REQUIRED BEDDING GRADE SHALL BE REMOVED AS DIRECTED AND REPLACED WITH SAND, GRAVEL, CRUSHED STONE OR OTHER SUITABLE MATERIAL AND THOROUGHLY COMPACTED.

**CONDUIT TRENCH**

N.T.S.



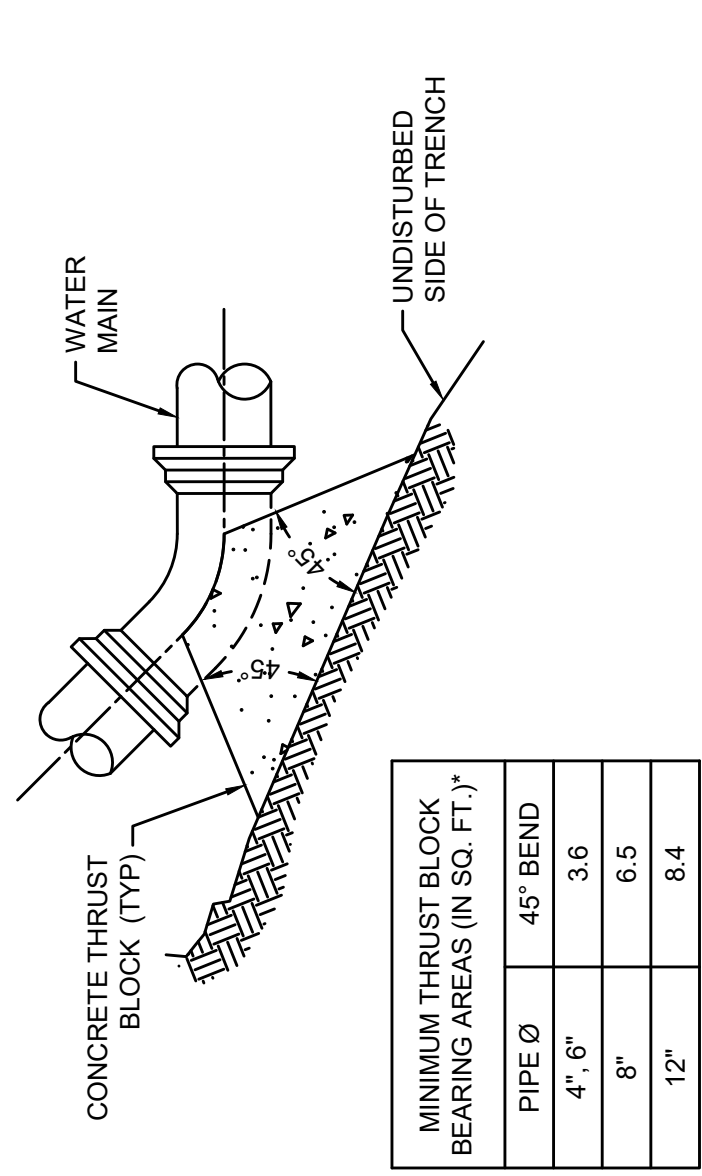
**CATCH BASIN FRAME & GRATE (MUNICIPAL STANDARD)**

N.T.S.

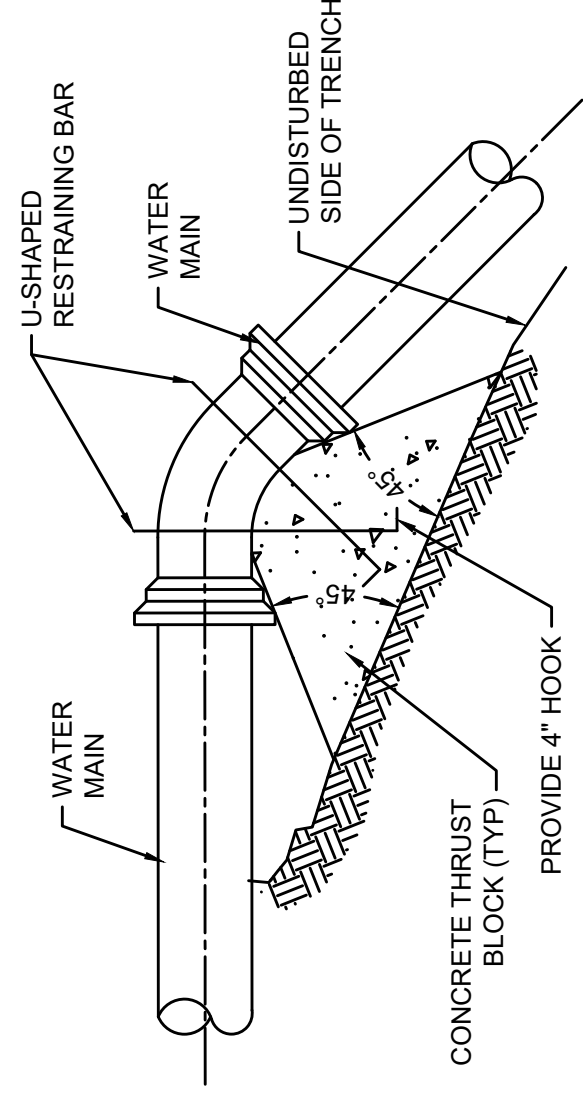
WESTFORD  
BOSTON ROAD

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	26	30
PROJECT FILE NO. 609035			

CONSTRUCTION DETAILS - 2 OF 6



PLAN AT UPWARD VERTICAL BEND

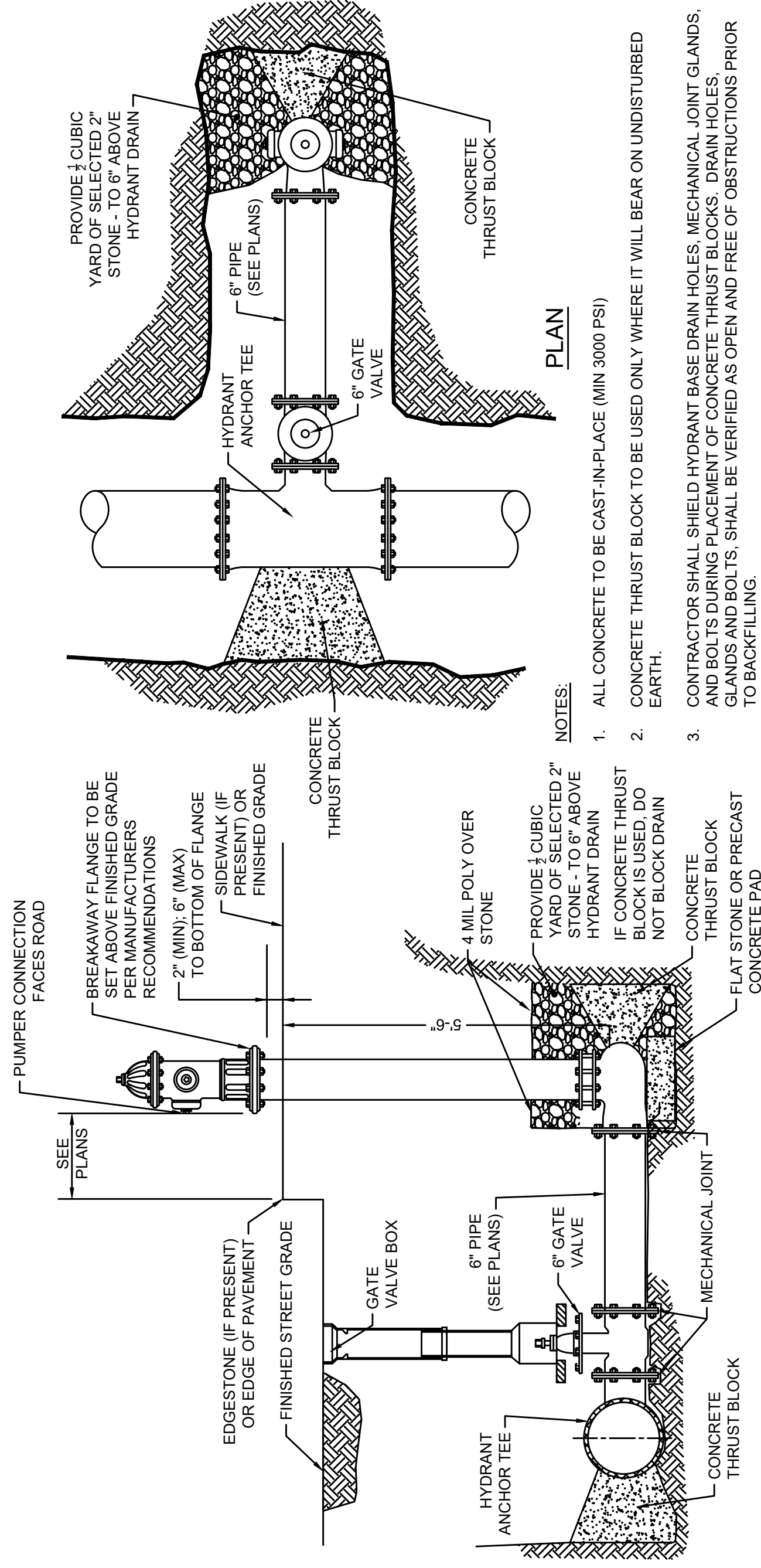


PLAN AT DOWNWARD VERTICAL BEND

- NOTES:
1. ALL WATER MAIN BENDS SHALL BE RESTRAINED W/ THRUST BLOCKS EXCEPT WHERE NOTED.
  2. ALL THRUST BLOCKS & COLLARS SHALL BE INSTALLED SO THAT THEY BEAR AGAINST UNDISTURBED EARTH.
  3. MINIMUM COMPRESSIVE STRENGTH OF THRUST BLOCK CONCRETE SHALL BE 3,000 P.S.I.
  4. KEEP CONCRETE CLEAR OF MECHANICAL JOINTS.
  5. MINIMUM BEARING CAPACITY SHALL BE BASED ON 250 P.S.I. INTERNAL PIPE PRESSURE & 1.5 TONS/S.F. ALLOWABLE SOIL BEARING CAPACITY.

THRUST BLOCK DETAILS - VERTICAL BENDS

N.T.S.

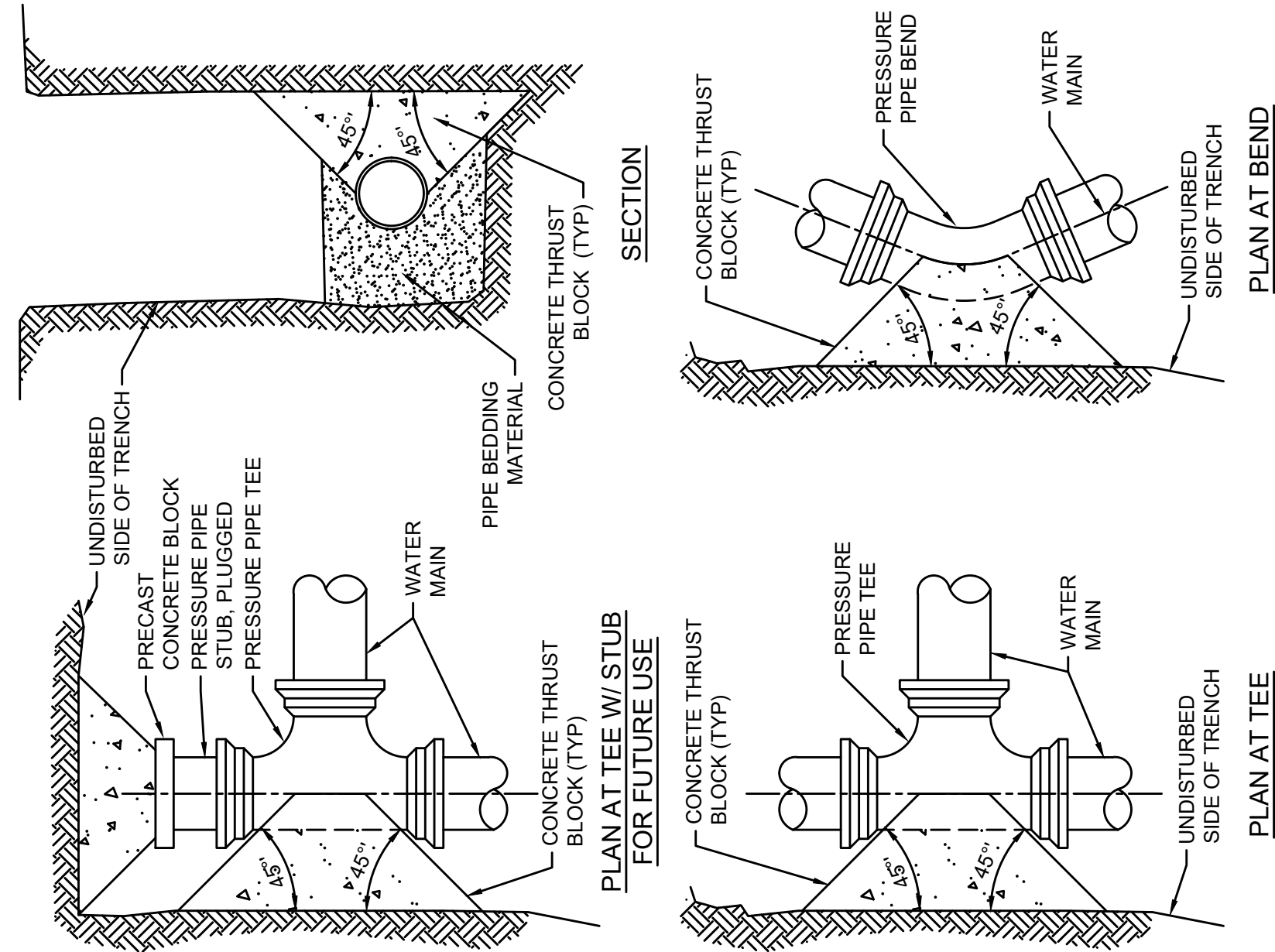


ELEVATION

HYDRANT ASSEMBLY  
N.T.S.

NOTES:

1. ALL CONCRETE TO BE CAST-IN-PLACE (MIN 3000 PSI)
2. CONCRETE THRUST BLOCK TO BE USED ONLY WHERE IT WILL BEAR ON UNDISTURBED EARTH.
3. CONTRACTOR SHALL SHIELD HYDRANT BASE DRAIN HOLES, MECHANICAL JOINT GLANDS, AND BOLTS DURING PLACEMENT OF CONCRETE THRUST BLOCKS. DRAIN HOLES, GLANDS AND BOLTS, SHALL BE VERIFIED AS OPEN AND FREE OF OBSTRUCTIONS PRIOR TO BACKFILLING.



PLAN AT TEE  
FOR FUTURE USE

PLAN AT BEND

PIPE Ø	90° BEND	45° BEND	22.5° BEND	TEES, PLUGS, CAPS & HYDRANTS
4", 6", 8"	6.0	2.9	2.3	4.5
10"	9.6	5.2	2.3	6.7
12"	13.3	6.7	3.7	9.6

\* BASED ON 250 P.S.I. & 1.5 TONS/S.F. ALLOWABLE SOIL BEARING CAPACITY

PIPE Ø	90° BEND	45° BEND	22.5° BEND	TEES	PLUG/CAP
8"	21.0	9.0	4.0	29.0	38.0
10"	26.0	11.0	5.0	38.0	46.0
12"	33.0	14.0	6.0	48.0	69.0

\* BASED ON DUCTILE IRON PIPE WITH A 150 P.S.I. TEST PRESSURE WITH 5.0 FEET OF BURY IN UNIFIED SOIL CLASSIFICATION SM.

\*\*NOTE: LONGER LENGTHS REQUIRED FOR PIPES WITH PLASTIC SLEEVES

- NOTES:
1. ALL WATER MAIN FITTINGS, BENDS, TEES, PLUGS ETC. SHALL BE RESTRAINED W/ THRUST BLOCKS EXCEPT WHERE NOTED.
  2. ALL THRUST BLOCKS & COLLARS SHALL BE INSTALLED SO THAT THEY BEAR AGAINST UNDISTURBED EARTH.
  3. MINIMUM COMPRESSIVE STRENGTH OF THRUST BLOCK CONCRETE SHALL BE 3,000 P.S.I.
  4. KEEP CONCRETE CLEAR OF MECHANICAL JOINTS.
  5. MINIMUM BEARING CAPACITY SHALL BE BASED ON 250 P.S.I. INTERNAL PIPE PRESSURE & 1.5 TONS/S.F. ALLOWABLE SOIL BEARING CAPACITY.
  6. MINIMUM PIPE RESTRAINT LENGTH IS BASED ON DUCTILE IRON PIPE WITH A 150 P.S.I. INTERNAL PIPE PRESSURE WITH 5.0' OF BURY IN UNIFIED SOIL CLASSIFICATION SM.

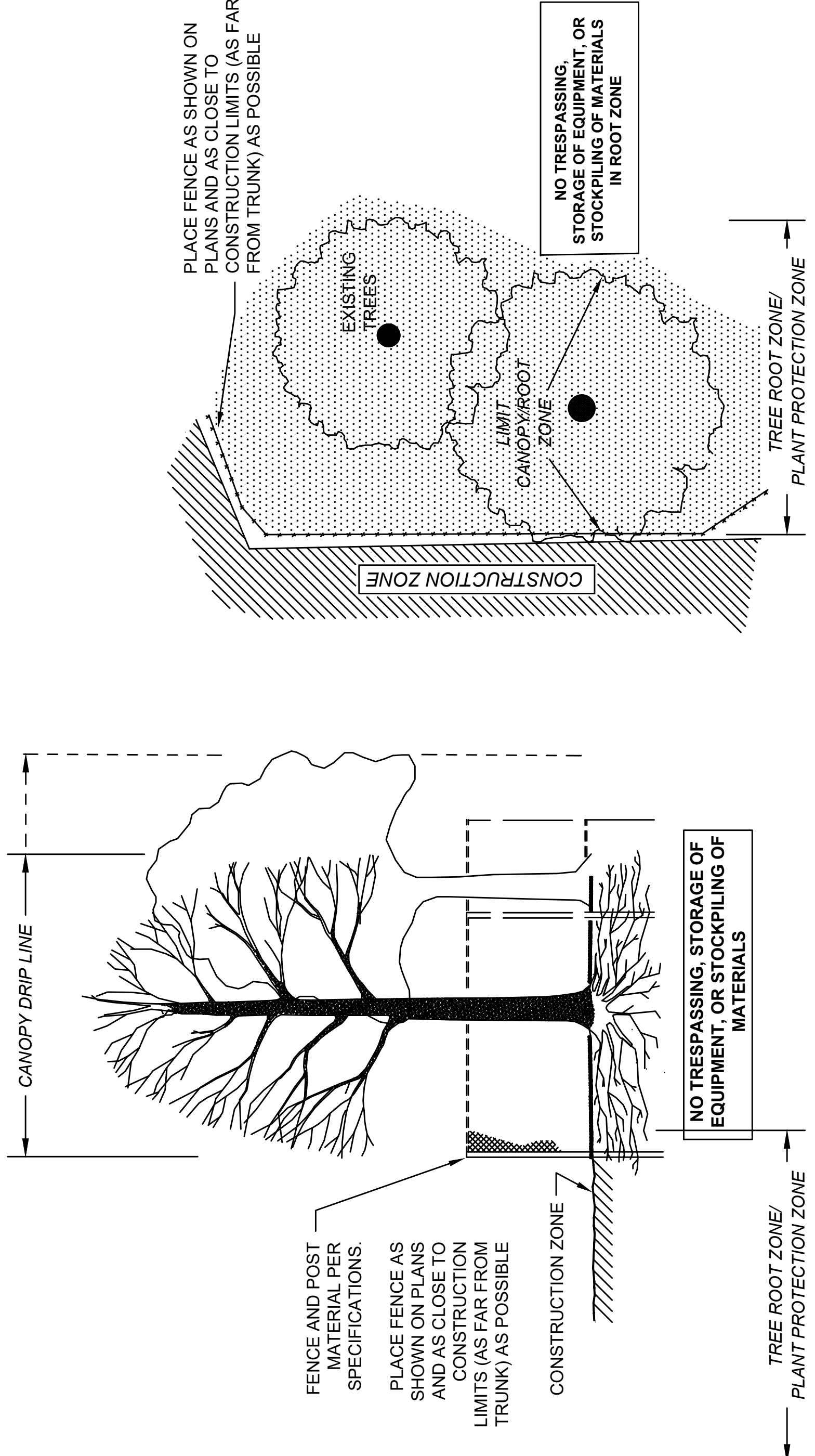
THRUST BLOCK - HORIZONTAL BENDS & PIPE RESTRAINT DETAILS

N.T.S.

**WESTFORD  
BOSTON ROAD**

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MA	-	27	30
PROJECT FILE NO. 609035			

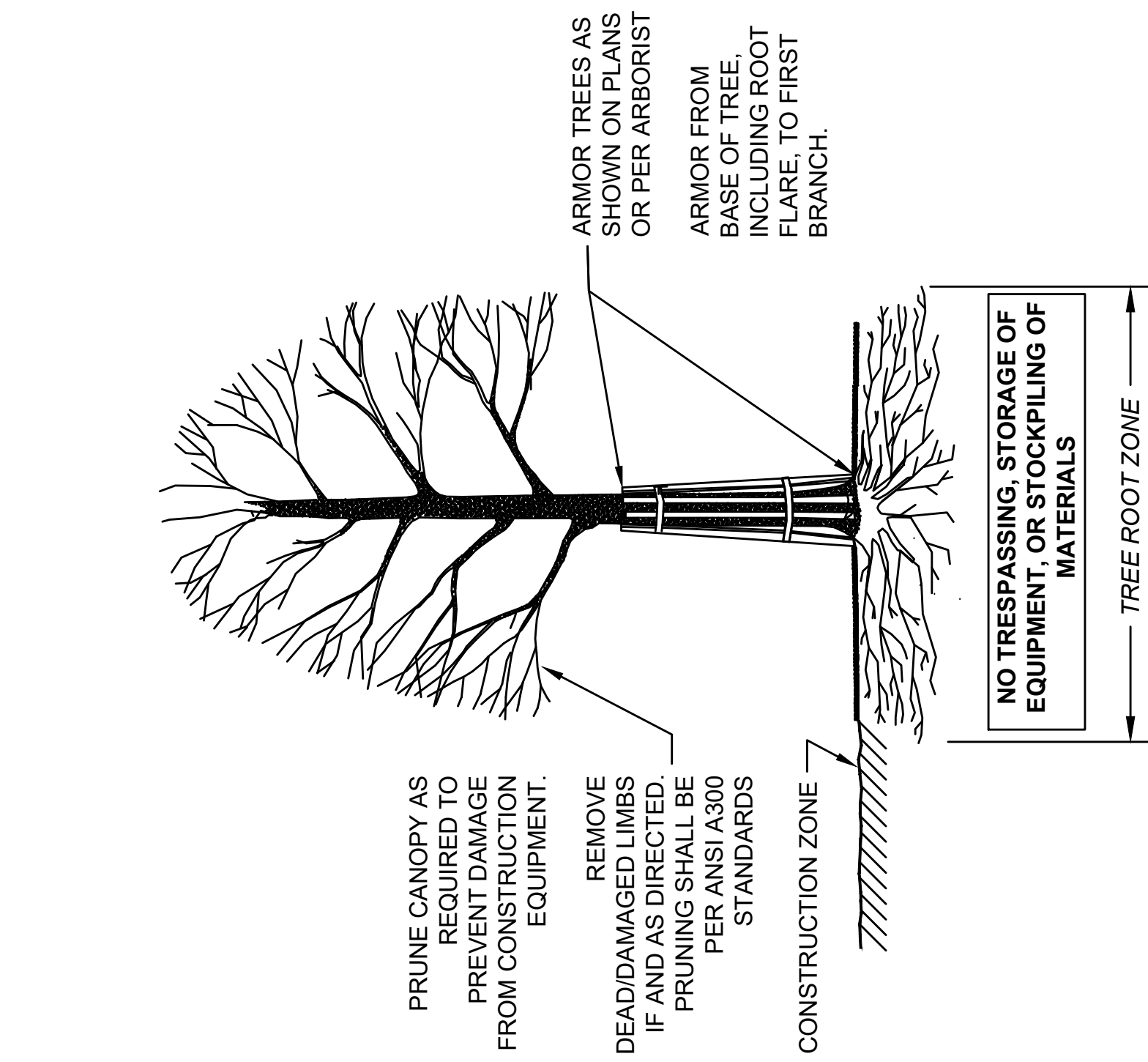
**CONSTRUCTION DETAILS - 3 OF 6**



**SECTION - FENCE PROTECTION OF ROOT ZONE**

**PLAN VIEW - FENCE PROTECTION OF ROOT ZONE**

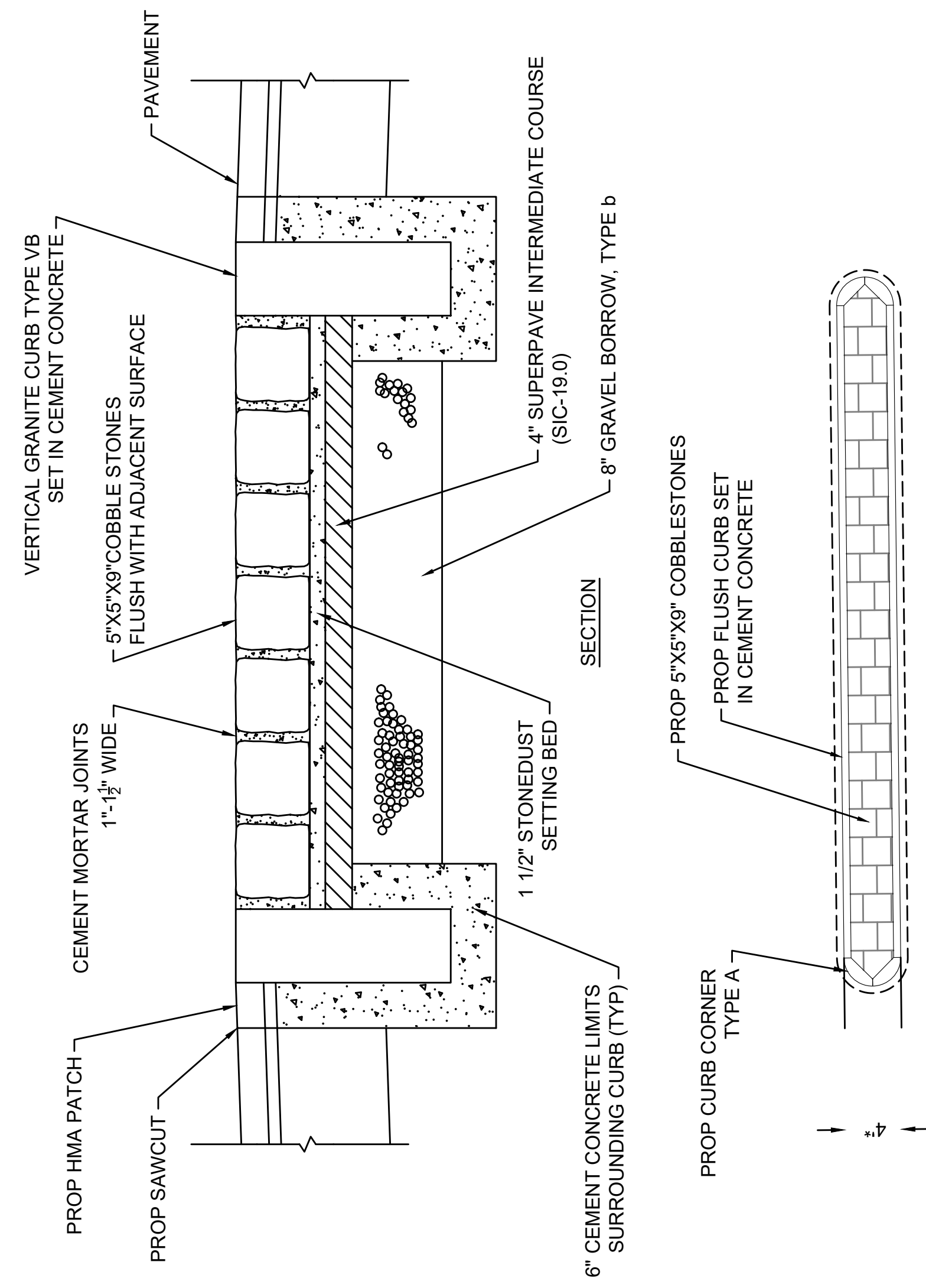
N.T.S.



**SECTION - TRUNK ARMORING & PRUNING**

**TREE PROTECTION - TRUNK**

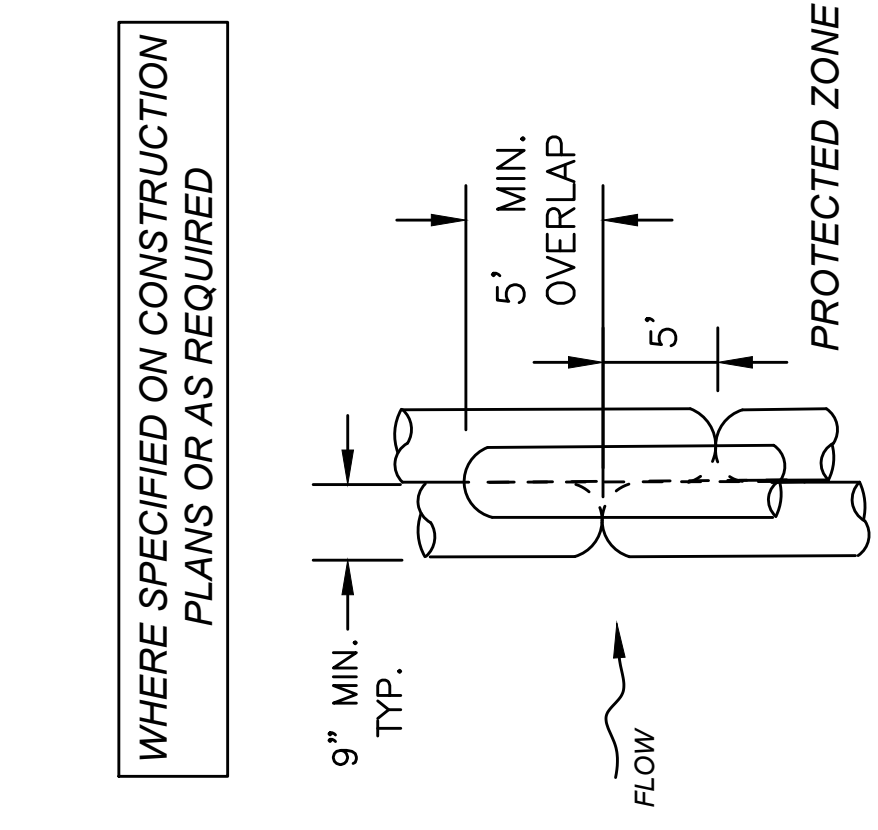
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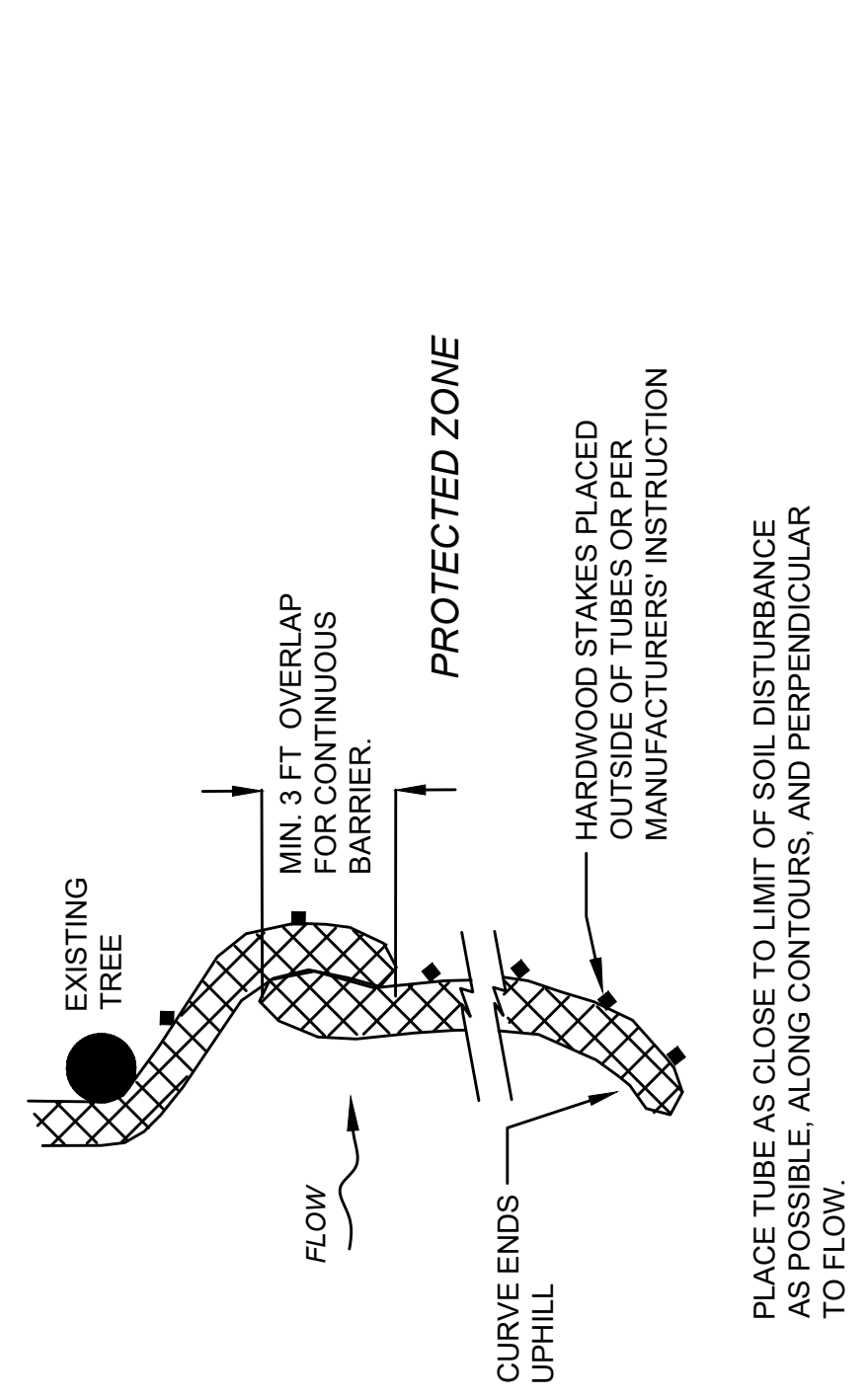
**COBBLESTONE ISLAND DETAIL**

N.T.S.

NOTES:  
\* DIMENSIONS VARY BY LOCATION

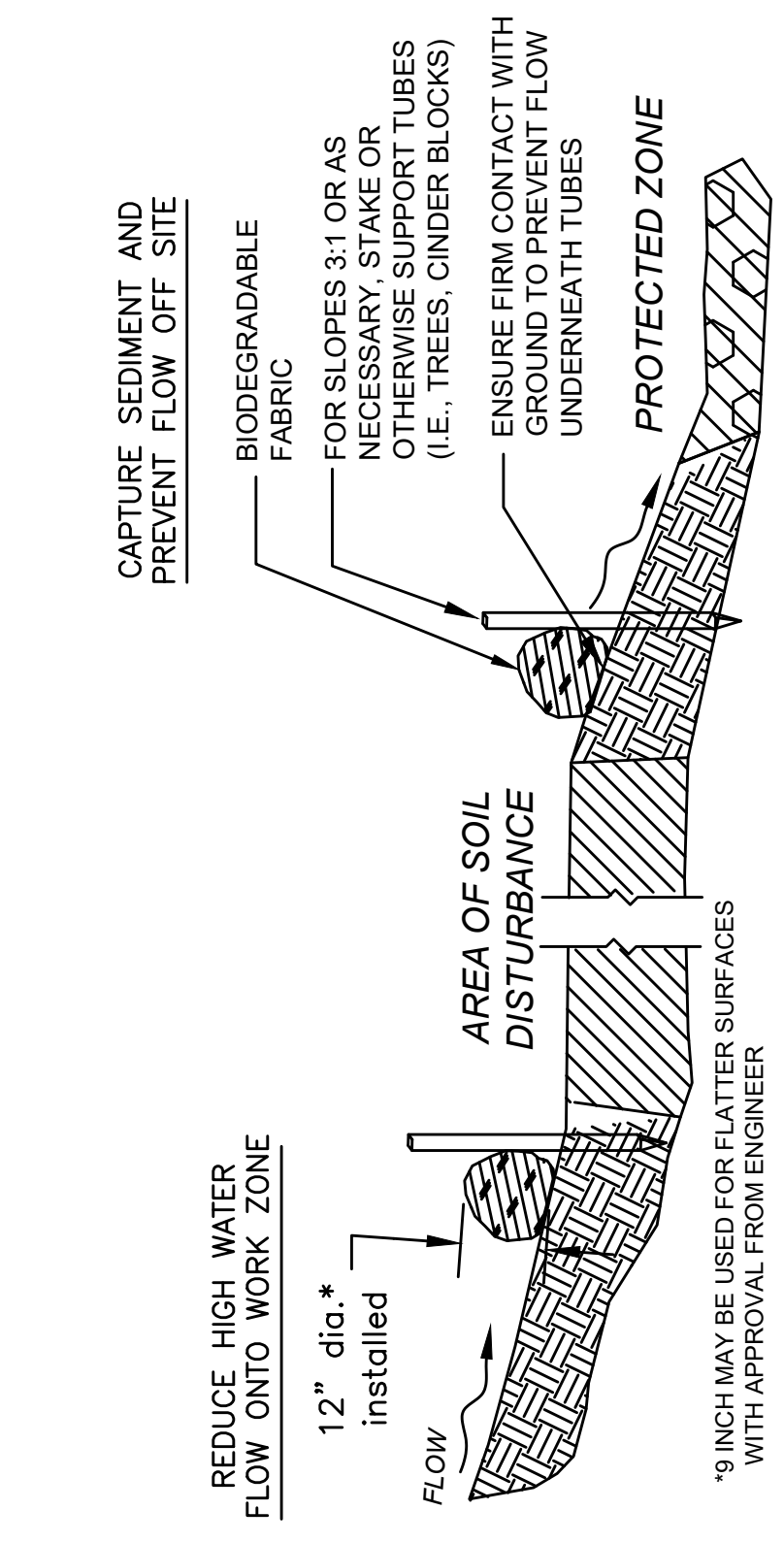


**PLAN VIEW**



**PLAN VIEW**

ADJUST LOCATION AS REQUIRED FOR OPTIMUM EFFECTIVENESS. DO NOT INSTALL IN WATERWAYS.

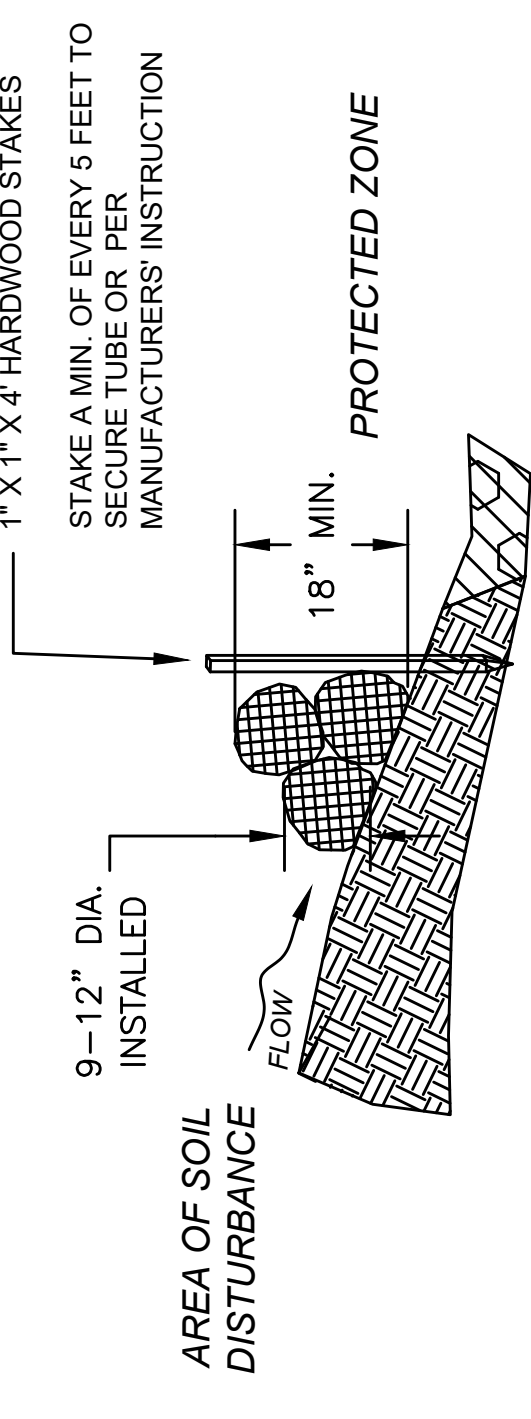


**SECTION**

9/16 INCH MAY BE USED FOR FLATTER SURFACES WITH APPROVAL FROM ENGINEER

**SEDIMENT BARRIER - COMPOST FILTER TUBE**

N.T.S.



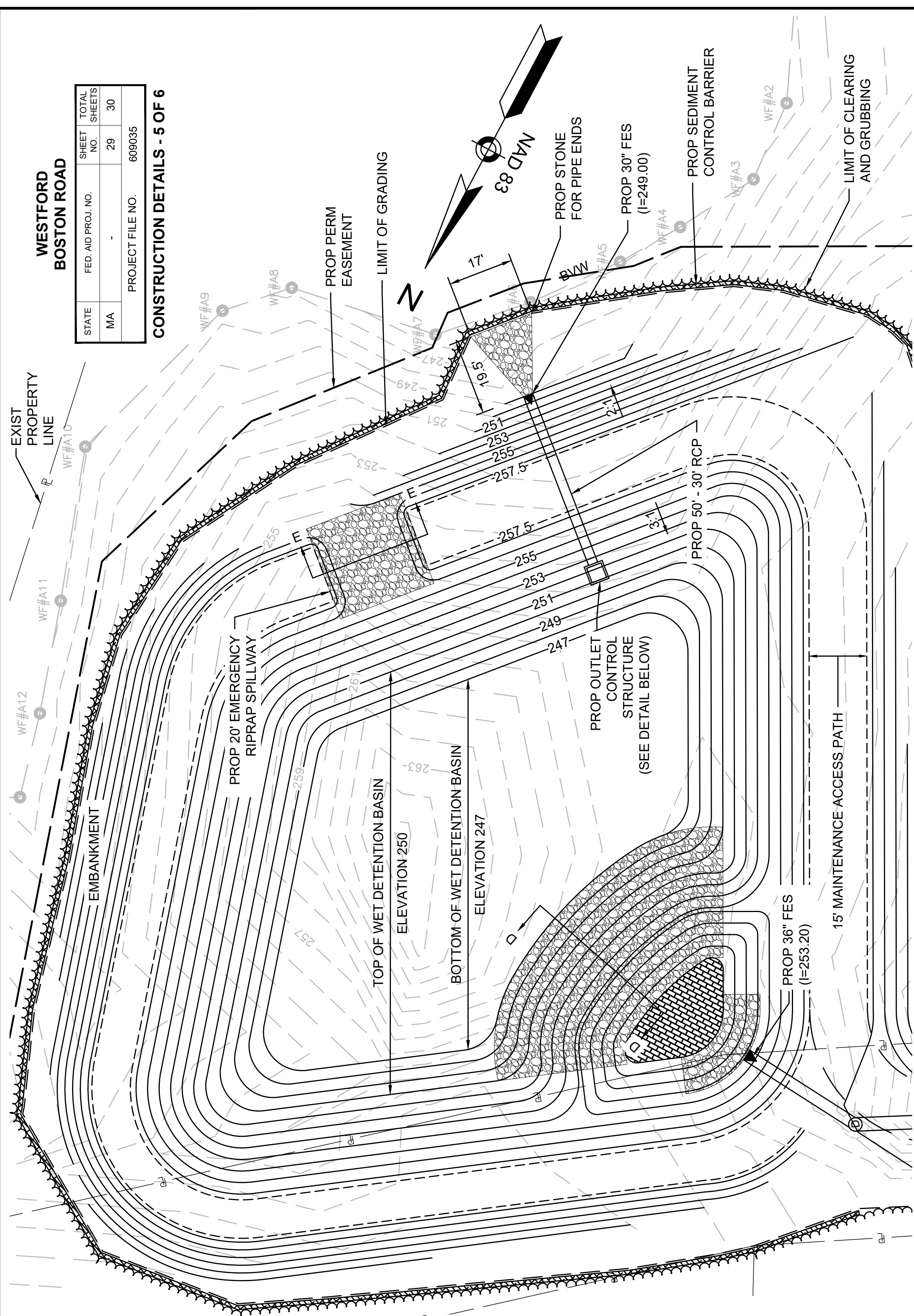
**SECTION**

**COMPOST FILTER TUBES STACKED**

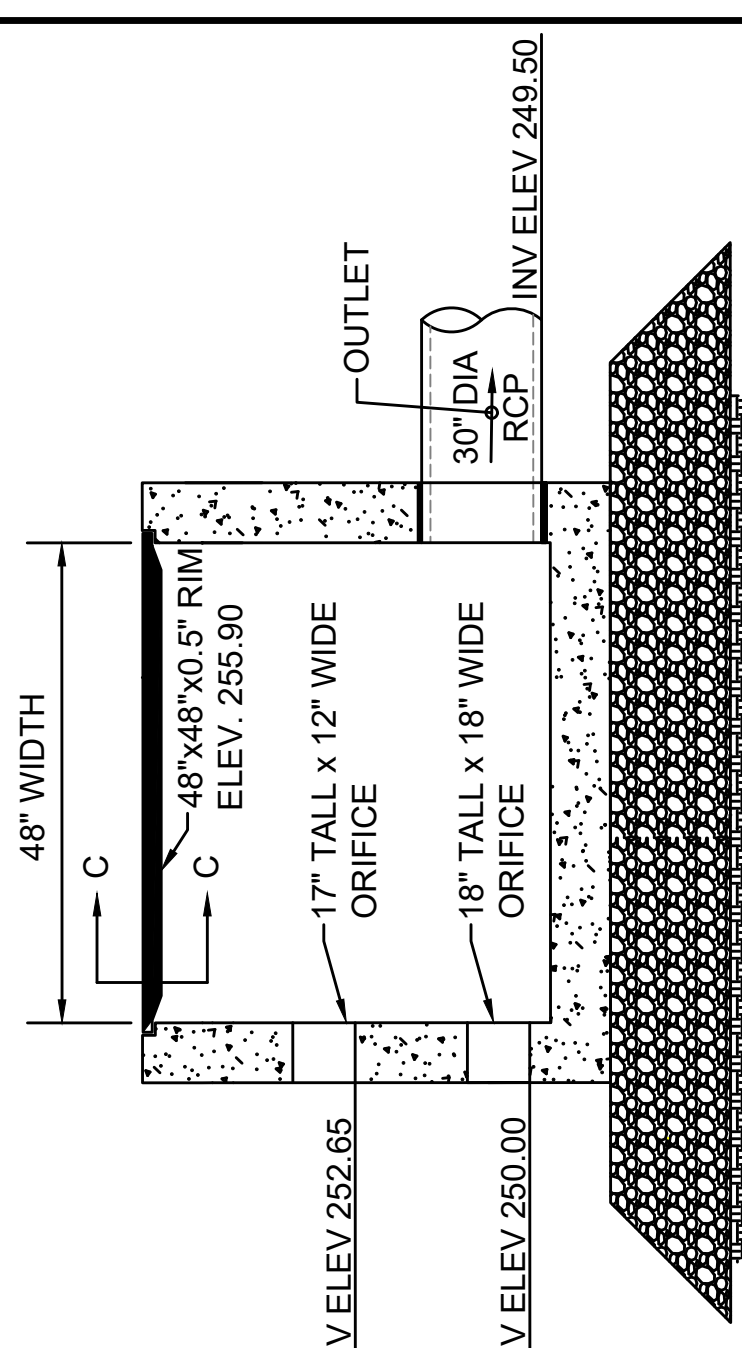
N.T.S.







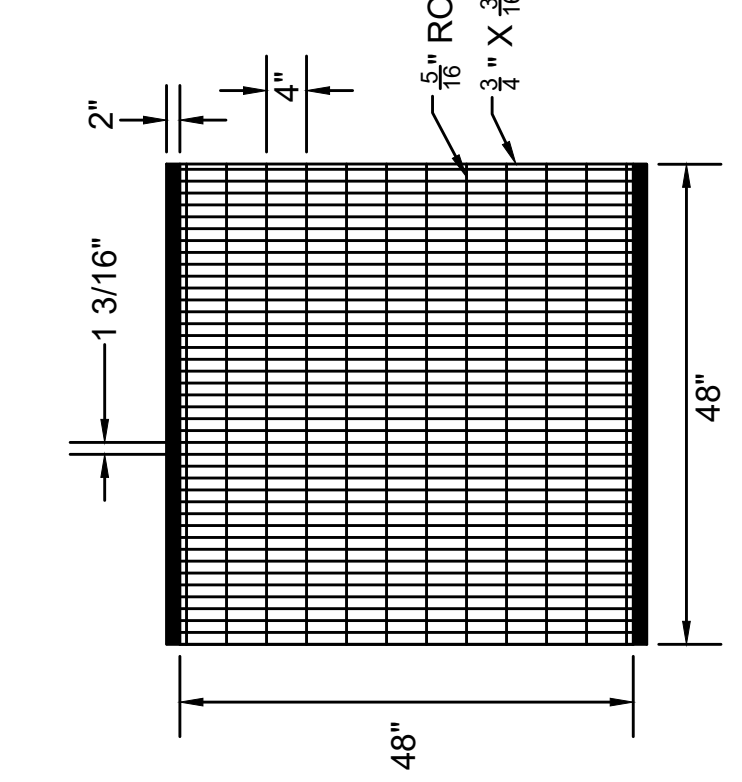
PLAN (WET DETENTION BASIN)  
 SCALE: 1" = 10'



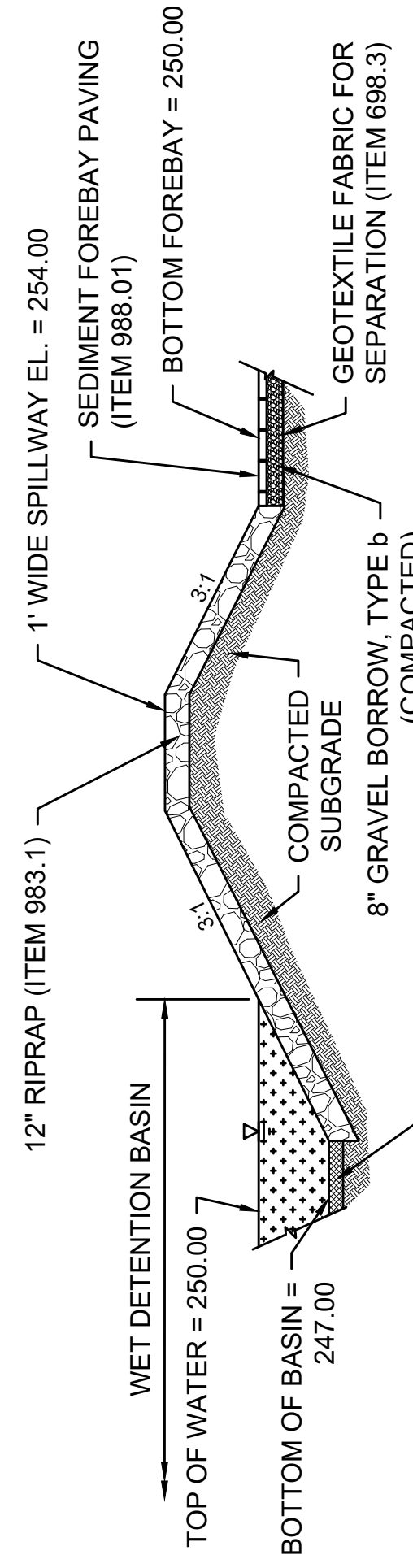
- SECTION C-C NOTES:**
- GRATE SHALL BE 48"x48" (INNER DIMENSIONS) WITH A 2" WIDE X 1/8" THICK (MIN) LIP ON TWO SIDES THAT ARE BOLTED TO THE PRECAST CONCRETE BOX STRUCTURE USING BOLTS THAT ARE 0.5" THICK X 2" LONG (MIN).
  - GRATE SHALL BE MADE OF ASTM-A36 MATERIAL WITH A GALVANIZED COATING.
  - GRATE SHALL HAVE A PEDESTRIAN LOAD RATING

- GENERAL NOTES:**
- STRUCTURE SHALL BE 48"x48" (INNER DIMENSIONS) PRECAST CONCRETE BOX STRUCTURE
  - ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
  - PROVIDE "V" KNOCKOUTS FOR PIPES WITH 2" MAX CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
  - JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE PREFORMED BUTYL RUBBER.

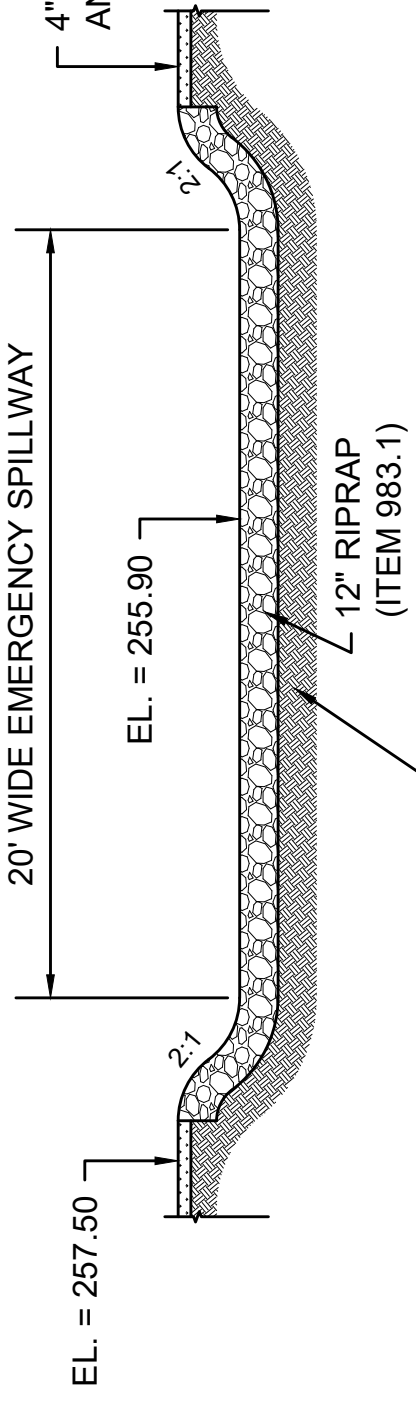
OUTLET CONTROL STRUCTURE DETAIL  
 N.T.S.



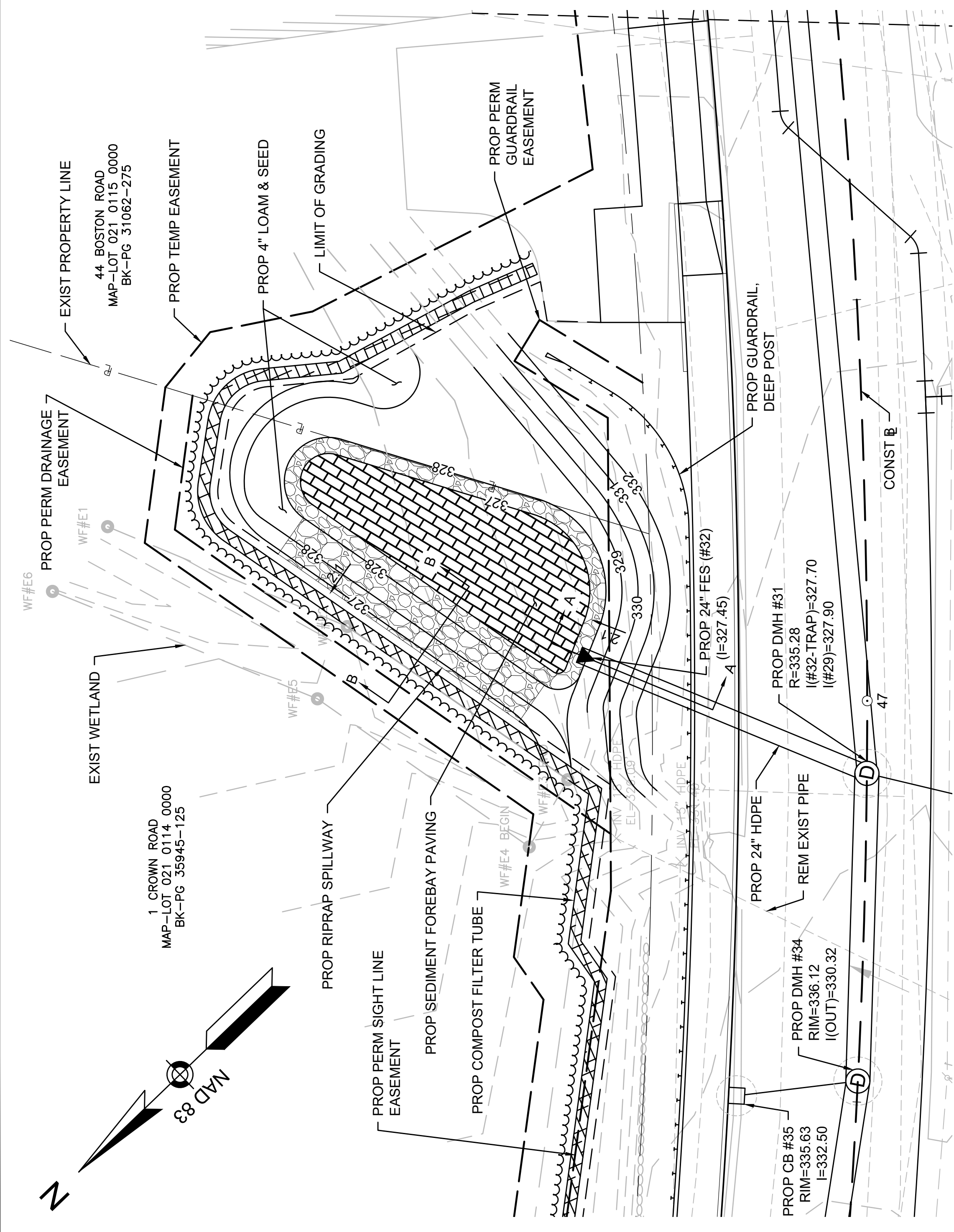
SECTION C-C  
 N.T.S.



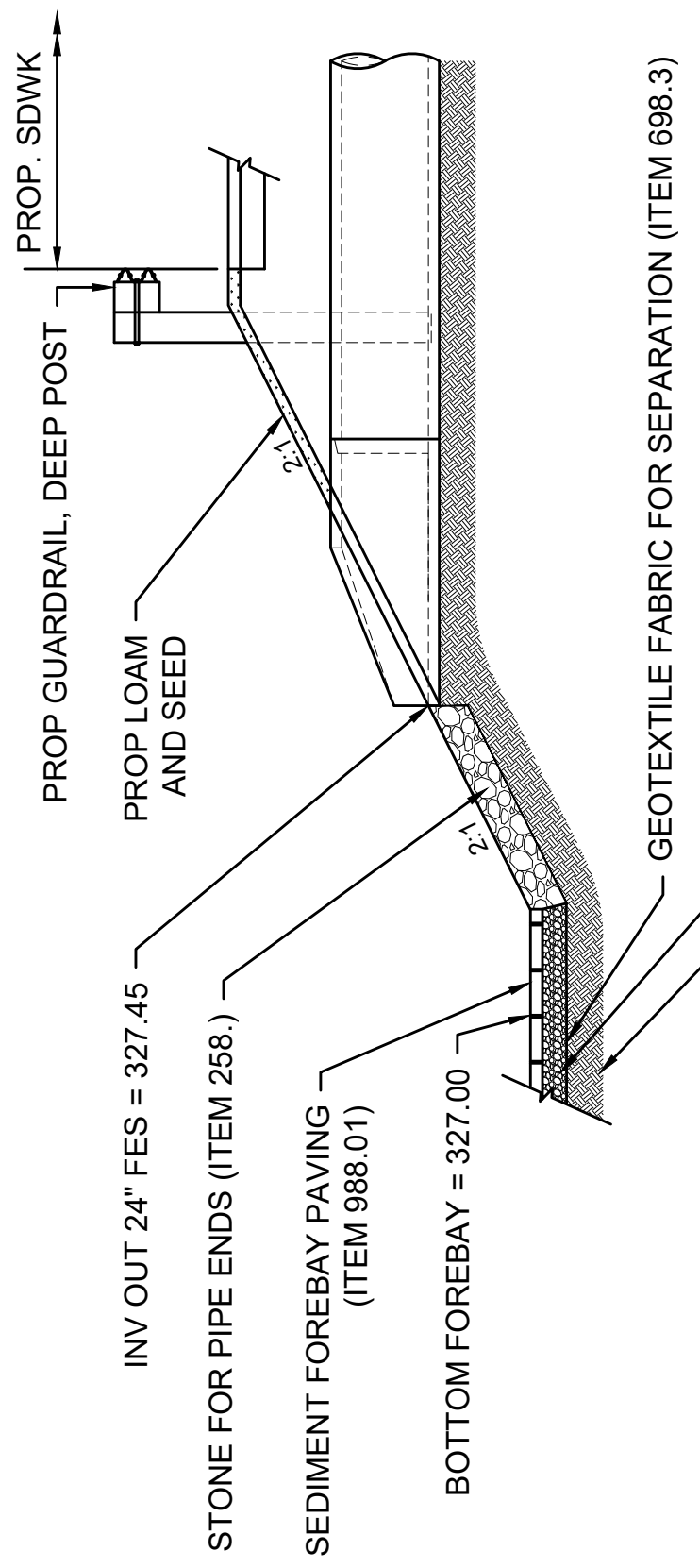
SECTION D-D (WET DETENTION BASIN)  
 N.T.S.



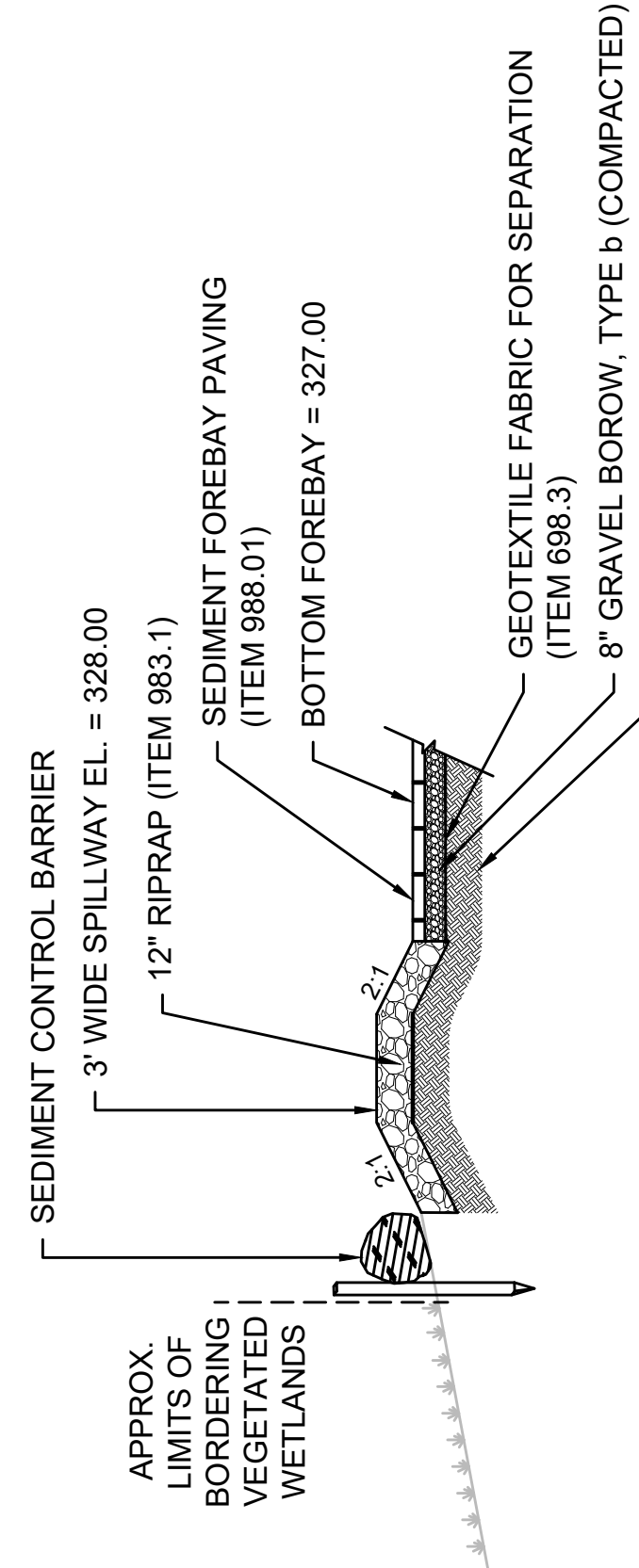
SECTION E-E (WET DETENTION BASIN)  
 N.T.S.



PLAN (OUTLET SEDIMENT TRAP)  
 SCALE: 1" = 10'



SECTION A-A (OUTLET SEDIMENT TRAP)  
 N.T.S.



SECTION B-B (OUTLET SEDIMENT TRAP)  
 N.T.S.



DOCUMENT A00861

**MASSACHUSETTS**

**DEPARTMENT OF ENVIRONMENTAL PROTECTION**

**ORDER OF CONDITIONS**

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TOWN OF WESTFORD  
CONSERVATION COMMISSION  
TOWN HALL  
55 Main Street  
Westford, Massachusetts 01886

April 27, 2023

Paul Starratt, Town Engineer  
Town of Westford Department of Public Works  
28 North Street  
Westford, MA 01886

RE: Order of Conditions DEP File # 334-1823 – Boston Road Improvement Project  
Work within 100' of Bordering Vegetated Wetlands and an intermittent stream for vehicular,  
bicycle, and pedestrian safety improvements, and drainage and utility improvements along  
Boston Road between 1 Crown Road and 44 Boston Road and to the rear of 70 Boston Road,  
as part of a larger project to improve Boston Road from Main Street to the on-ramps to  
Interstate 495 Southbound

Enclosed please find the approved Order of Conditions issued by the Westford Conservation  
Commission under the Massachusetts Wetlands Protection Act and Westford Non-Zoning Wetlands  
Bylaw. The Order of Conditions must be **recorded at the North Middlesex Registry of Deeds** in  
Lowell prior to any activity taking place on the site. Once recorded please submit the Book and Page  
number of the recorded information to the Conservation office.

If you have any questions, please feel free to contact me.

For the Commission,

A handwritten signature in black ink, appearing to read "Sierra Pelletier", is written over a faint, larger version of the same signature.

Sierra Pelletier  
Assistant Planner

cc: MA DEP (e-copy)  
Jonathan Rockwell & Tom Quinlan, TEC, Inc. (e-copy)  
Jeremy Downs, Westford Assistant Town Engineer (e-copy)

**Massachusetts Department of Environmental Protection**

Bureau of Resource Protection - Wetlands

**WPA Form 5 - Order of Conditions**

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40  
And Westford Non-Zoning Wetland Bylaw c.171

Provided by MassDEP:

MassDEP File #:334-1823

eDEP Transaction #:1550039

City/Town:WESTFORD

**A. General Information**

1. Conservation Commission      WESTFORD

2. Issuance                              a.  OOC                              b.  Amended OOC

3. Applicant Details

a. First Name	PAUL	b. Last Name	STARRATT
c. Organization	TOWN OF WESTFORD DEPARTMENT OF PUBLIC WORKS		
d. Mailing Address	28 NORTH STREET		
e. City/Town	WESTFORD	f. State	MA
		g. Zip Code	01886

4. Property Owner

a. First Name	b. Last Name
c. Organization	TOWN OF WESTFORD & MASSDOT
d. Mailing Address	
e. City/Town	f. State
	g. Zip Code

5. Project Location

a. Street Address	BOSTON ROAD
b. City/Town	WESTFORD
c. Zip Code	01886
d. Assessors	
e. Parcel/Lot#	-
f. Latitude	42.57288N
g. Longitude	71.42638W

6. Property recorded at the Registry of Deed for:

a. County	b. Certificate	c. Book	d. Page
NORTHERN MIDDLESEX		35945	125
NORTHERN MIDDLESEX		31062	275
NORTHERN MIDDLESEX		29812	168
NORTHERN MIDDLESEX		4446	228
NORTHERN MIDDLESEX		5117	304
NORTHERN MIDDLESEX		7048	249

7. Dates

a. Date NOI Filed : 3/22/2023      b. Date Public Hearing Closed: 4/26/2023      c. Date Of Issuance: 4/27/2023

8. Final Approved Plans and Other Documents

a. Plan Title:                      b. Plan Prepared by:                      c. Plan Signed/Stamped by:      d. Revised Final Date:      e. Scale:

**Massachusetts Department of Environmental Protection**

Bureau of Resource Protection - Wetlands

**WPA Form 5 - Order of Conditions**

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File #:334-1823

eDEP Transaction #:1550039

City/Town:WESTFORD

MASSACHUSETTS  
DEPARTMENT OF  
TRANSPORTATION,  
HIGHWAY  
DIVISION, PLAN  
AND PROFILE OF  
BOSON ROAD IN  
THE TOWN OF  
WESTFORD,  
MIDDLESEX  
COUNTY

TEC, INC.

JONATHAN A  
ROCKWELL, PE

03/22/2023

1"=20'

**B. Findings**

1. Findings pursuant to the Massachusetts Wetlands Protection Act

Following the review of the the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Act.

Check all that apply:

a. <input type="checkbox"/> Public Water Supply	b. <input type="checkbox"/> Land Containing Shellfish	c. <input checked="" type="checkbox"/> Prevention of Pollution
d. <input type="checkbox"/> Private Water Supply	e. <input type="checkbox"/> Fisheries	f. <input checked="" type="checkbox"/> Protection of Wildlife Habitat
g. <input type="checkbox"/> Ground Water Supply	h. <input checked="" type="checkbox"/> Storm Damage Prevention	i. <input checked="" type="checkbox"/> Flood Control

2. Commission hereby finds the project, as proposed, is:

**Approved** subject to:

a.  The following conditions which are necessary in accordance with the performance standards set forth in the wetlands regulations. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

**Denied** because:

b.  The proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect interests of the Act, and a final Order of Conditions is issued. **A description of the performance standards which the proposed work cannot meet is attached to this Order.**

c.  The information submitted by the applicant is not sufficient to describe the site, the work or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the interests of the Act, and a final Order of Conditions is issued. **A description of the specific information which is lacking and why it is necessary is attached to this Order as per 310 CMR 10.05(6)(c).**

3.  Buffer Zone Impacts: Shortest distance between limit of project disturbance and the wetland resource area specified in 310CMR10.02(1)(a). 1  
a. linear feet

**Massachusetts Department of Environmental Protection**  
 Bureau of Resource Protection - Wetlands  
**WPA Form 5 - Order of Conditions**  
 Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:  
 MassDEP File #:334-1823  
 eDEP Transaction #:1550039  
 City/Town:WESTFORD

**Inland Resource Area Impacts:(For Approvals Only):**

Resource Area	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
4. <input type="checkbox"/> Bank	<u>                    </u> a. linear feet	<u>                    </u> b. linear feet	<u>                    </u> c. linear feet	<u>                    </u> d. linear feet
5. <input type="checkbox"/> Bordering Vegetated Wetland	<u>                    </u> a. square feet	<u>                    </u> b. square feet	<u>                    </u> c. square feet	<u>                    </u> d. square feet
6. <input type="checkbox"/> Land under Waterbodies and Waterways	<u>                    </u> a. square feet	<u>                    </u> b. square feet	<u>                    </u> c. square feet	<u>                    </u> d. square feet
	<u>                    </u> e. c/y dredged	<u>                    </u> f. c/y dredged		
7. <input type="checkbox"/> Bordering Land Subject to Flooding	<u>                    </u> a. square feet	<u>                    </u> b. square feet	<u>                    </u> c. square feet	<u>                    </u> d. square feet
Cubic Feet Flood Storage	<u>                    </u> e. cubic feet	<u>                    </u> f. cubic feet	<u>                    </u> g. cubic feet	<u>                    </u> h. cubic feet
8. <input type="checkbox"/> Isolated Land Subject to Flooding	<u>                    </u> a. square feet	<u>                    </u> b. square feet		
Cubic Feet Flood Storage	<u>                    </u> c. cubic feet	<u>                    </u> d. cubic feet	<u>                    </u> e. cubic feet	<u>                    </u> f. cubic feet
9. <input type="checkbox"/> Riverfront Area	<u>                    </u> a. total sq. feet	<u>                    </u> b. total sq. feet		
Sq ft within 100 ft	<u>                    </u> c. square feet	<u>                    </u> d. square feet	<u>                    </u> e. square feet	<u>                    </u> f. square feet
Sq ft between 100-200 ft	<u>                    </u> g. square feet	<u>                    </u> h. square feet	<u>                    </u> i. square feet	<u>                    </u> j. square feet

**Coastal Resource Area Impacts:**

Resource Area	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
10. <input type="checkbox"/> Designated Port Areas	Indicate size under Land Under the Ocean, below			
11. <input type="checkbox"/> Land Under the Ocean	<u>                    </u> a. square feet	<u>                    </u> b. square feet		
	<u>                    </u> c. c/y dredged	<u>                    </u> d. c/y dredged		
12. <input type="checkbox"/> Barrier Beaches	Indicate size under Coastal Beaches and/or Coastal Dunes below			
13. <input type="checkbox"/> Coastal Beaches	<u>                    </u> a. square feet	<u>                    </u> b. square feet	<u>                    </u> c. c/y nourishment	<u>                    </u> d. c/y nourishment
14. <input type="checkbox"/> Coastal Dunes	<u>                    </u> a. square feet	<u>                    </u> b. square feet	<u>                    </u> c. c/y nourishment	<u>                    </u> d. c/y nourishment



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15. <input type="checkbox"/> Coastal Banks	<u>                    </u>	<u>                    </u>		
	a. linear feet	b. linear feet		
16. <input type="checkbox"/> Rocky Intertidal Shores	<u>                    </u>	<u>                    </u>		
	a. square feet	b. square feet		
17. <input type="checkbox"/> Salt Marshes	<u>                    </u>	<u>                    </u>	<u>                    </u>	<u>                    </u>
	a. square feet	b. square feet	c. square feet	d. square feet
18. <input type="checkbox"/> Land Under Salt Ponds	<u>                    </u>	<u>                    </u>		
	a. square feet	b. square feet		
	<u>                    </u>	<u>                    </u>		
	c. c/y dredged	d. c/y dredged		
19. <input type="checkbox"/> Land Containing Shellfish	<u>                    </u>	<u>                    </u>	<u>                    </u>	<u>                    </u>
	a. square feet	b. square feet	c. square feet	d. square feet
20. <input type="checkbox"/> Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above			
	<u>                    </u>	<u>                    </u>		
	c. c/y dredged	d. c/y dredged		
21. <input type="checkbox"/> Land Subject to Coastal Storm Flowage	<u>                    </u>	<u>                    </u>		
	a. square feet	b. square feet		

22.  Restoration/Enhancement (For Approvals Only)

If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.5.c & d or B.17.c & d above, please entered the additional amount here.

<u>                    </u>	<u>                    </u>
a. square feet of BVW	b. square feet of Salt Marsh

23.  Streams Crossing(s)

If the project involves Stream Crossings, please enter the number of new stream crossings/number of replacement stream crossings.

<u>                    </u>	<u>                    </u>
a. number of new stream crossings	b. number of replacement stream crossings

**C. General Conditions Under Massachusetts Wetlands Protection Act**

The following conditions are only applicable to Approved projects

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.
2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.
3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.
4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
  - a. the work is a maintenance dredging project as provided for in the Act; or

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- b. the time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.
5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order.
  6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not exceed the issuance date of the original Final Order of Conditions.
  7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.
  8. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.
  9. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to the Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work..
  10. A sign shall be displayed at the site not less than two square feet or more than three square feet in size bearing the words,  

" Massachusetts Department of Environmental Protection"  
[or "MassDEP"]  
File Number : "334-1823"
  11. Where the Department of Environmental Protection is requested to issue a Superseding Order, the Conservation Commission shall be a party to all agency proceedings and hearings before Mass DEP.
  12. Upon completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance (WPA Form 8A) to the Conservation Commission.
  13. The work shall conform to the plans and special conditions referenced in this order.
  14. Any change to the plans identified in Condition #13 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.
  15. The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.
  16. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.
  17. Prior to the start of work, and if the project involves work adjacent to a Bordering Vegetated Wetland, the boundary of the wetland in the vicinity of the proposed work area shall be marked by wooden stakes or flagging. Once in place, the wetland boundary markers shall be maintained until a Certificate of Compliance has been issued by the Conservation Commission.
  18. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the applicant or his/her designee shall inspect the erosion controls on a daily basis and shall

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remove accumulated sediments as needed. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

**NOTICE OF STORMWATER CONTROL AND MAINTENANCE REQUIREMENTS**

19. The work associated with this Order(the "Project") is (1)  is not (2)  subject to the Massachusetts Stormwater Standards. If the work is subject to Stormwater Standards, then the project is subject to the following conditions;
- a) All work, including site preparation, land disturbance, construction and redevelopment, shall be implemented in accordance with the construction period pollution prevention and erosion and sedimentation control plan and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollutant Discharge Elimination System Construction General Permit as required by Stormwater Standard 8. Construction period erosion, sedimentation and pollution control measures and best management practices (BMPs) shall remain in place until the site is fully stabilized.
  - b) No stormwater runoff may be discharged to the post-construction stormwater BMPs unless and until a Registered Professional Engineer provides a Certification that: *i.* all construction period BMPs have been removed or will be removed by a date certain specified in the Certification. For any construction period BMPs intended to be converted to post construction operation for stormwater attenuation, recharge, and/or treatment, the conversion is allowed by the MassDEP Stormwater Handbook BMP specifications and that the BMP has been properly cleaned or prepared for post construction operation, including removal of all construction period sediment trapped in inlet and outlet control structures; *ii.* as-built final construction BMP plans are included, signed and stamped by a Registered Professional Engineer, certifying the site is fully stabilized; *iii.* any illicit discharges to the stormwater management system have been removed, as per the requirements of Stormwater Standard 10; *iv.* all post-construction stormwater BMPs are installed in accordance with the plans (including all planting plans) approved by the issuing authority, and have been inspected to ensure that they are not damaged and that they are in proper working condition; *v.* any vegetation associated with post-construction BMPs is suitably established to withstand erosion.
  - c) The landowner is responsible for BMP maintenance until the issuing authority is notified that another party has legally assumed responsibility for BMP maintenance. Prior to requesting a Certificate of Compliance, or Partial Certificate of Compliance, the responsible party (defined in General Condition 19(e)) shall execute and submit to the issuing authority an Operation and Maintenance Compliance Statement ("O&M Statement") for the Stormwater BMPs identifying the party responsible for implementing the stormwater BMP Operation and Maintenance Plan ("O&M Plan") and certifying the following: *i.*) the O&M Plan is complete and will be implemented upon receipt of the Certificate of Compliance, and *ii.*) the future responsible parties shall be notified in writing of their ongoing legal responsibility to operate and maintain the stormwater management BMPs and implement the Stormwater Pollution Prevention Plan.
  - d) Post-construction pollution prevention and source control shall be implemented in accordance with the long-term pollution prevention plan section of the approved Stormwater Report and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollutant Discharge Elimination System Multi-Sector General Permit.
  - e) Unless and until another party accepts responsibility, the landowner, or owner of any drainage easement, assumes responsibility for maintaining each BMP. To overcome this presumption, the landowner of the property must submit to the issuing authority a legally binding agreement of record, acceptable to the issuing authority, evidencing that another entity has accepted responsibility for maintaining the BMP, and that the proposed responsible party shall be treated as a permittee for purposes of implementing the requirements of Conditions 19(f) through 19(k) with respect to that BMP. Any failure of the proposed responsible party to

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implement the requirements of Conditions 19(f) through 19(k) with respect to that BMP shall be a violation of the Order of Conditions or Certificate of Compliance. In the case of stormwater BMPs that are serving more than one lot, the legally binding agreement shall also identify the lots that will be serviced by the stormwater BMPs. A plan and easement deed that grants the responsible party access to perform the required operation and maintenance must be submitted along with the legally binding agreement.

- f) The responsible party shall operate and maintain all stormwater BMPs in accordance with the design plans, the O&M Plan, and the requirements of the Massachusetts Stormwater Handbook.
- g) The responsible party shall:
  - 1. Maintain an operation and maintenance log for the last three (3) consecutive calendar years of inspections, repairs, maintenance and/or replacement of the stormwater management system or any part thereof, and disposal (for disposal the log shall indicate the type of material and the disposal location);
  - 2. Make the maintenance log available to MassDEP and the Conservation Commission ("Commission") upon request; and
  - 3. Allow members and agents of the MassDEP and the Commission to enter and inspect the site to evaluate and ensure that the responsible party is in compliance with the requirements for each BMP established in the O&M Plan approved by the issuing authority.
- h) All sediment or other contaminants removed from stormwater BMPs shall be disposed of in accordance with all applicable federal, state, and local laws and regulations.
- i) Illicit discharges to the stormwater management system as defined in 310 CMR 10.04 are prohibited.
- j) The stormwater management system approved in the Order of Conditions shall not be changed without the prior written approval of the issuing authority.
- k) Areas designated as qualifying pervious areas for the purpose of the Low Impact Site Design Credit (as defined in the MassDEP Stormwater Handbook, Volume 3, Chapter 1, Low Impact Development Site Design Credits) shall not be altered without the prior written approval of the issuing authority.
- l) Access for maintenance, repair, and/or replacement of BMPs shall not be withheld. Any fencing constructed around stormwater BMPs shall include access gates and shall be at least six inches above grade to allow for wildlife passage.

**Special Conditions:**

SEE ATTACHED SPECIAL CONDITIONS

**Massachusetts Department of Environmental Protection**  
Bureau of Resource Protection - Wetlands  
**WPA Form 5 - Order of Conditions**  
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**D. Findings Under Municipal Wetlands Bylaw or Ordinance**

1. Is a municipal wetlands bylaw or ordinance applicable?  Yes  No

2. The Conservation Commission hereby (check one that applies):

a.  DENIES the proposed work which cannot be conditioned to meet the standards set forth in a municipal ordinance or bylaw specifically:

1. Municipal Ordinance or Bylaw \_\_\_\_\_

2. Citation \_\_\_\_\_

Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides measures which are adequate to meet these standards, and a final Order or Conditions is issued. Which are necessary to comply with a municipal ordinance or bylaw:

b.  APPROVES the proposed work, subject to the following additional conditions.

1. Municipal Ordinance or Bylaw WESTFORD  
NONZONING  
WETLANDS BYLAW

2. Citation CHAPTER 171

3. The Commission orders that all work shall be performed in accordance with the following conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.

The special conditions relating to municipal ordinance or bylaw are as follows:  
SEE ATTACHED SPECIAL CONDITIONS

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**E. Signatures**

This Order is valid for three years from the date of issuance, unless otherwise specified pursuant to General Condition #4. If this is an Amended Order of Conditions, the Amended Order expires on the same date as the original Order of Conditions.

04/27/2023  
1. Date of Original Order

Please indicate the number of members who will sign this form. This Order must be signed by a majority of the Conservation Commission.

4  
2. Number of Signers

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate Department of Environmental Protection Regional Office, if not filing electronically, and the property owner, if different from applicant.

Signatures:

Margaret Wheeler  
J.R. Hill

Noel Almeida  
Marilyn Frank

by hand delivery on 04/27/2023

by certified mail, return receipt requested, on \_\_\_\_\_

Date

Date

**F. Appeals**

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate MassDEP Regional Office to issue a Superseding Order of Conditions. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Any appellants seeking to appeal the Department's Superseding Order associated with this appeal will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order, or providing written information to the Department prior to issuance of a Superseding Order.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40), and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal ordinance or bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

**G. Recording Information**

This Order of Conditions must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Conditions. The recording information on this page shall be submitted to the Conservation Commission listed below.

WESTFORD

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\_\_\_\_\_  
Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

\_\_\_\_\_  
WESTFORD  
\_\_\_\_\_  
Conservation Commission

Please be advised that the Order of Conditions for the Project at:

\_\_\_\_\_  
BOSTON ROAD  
\_\_\_\_\_  
Project Location

\_\_\_\_\_  
334-1823  
\_\_\_\_\_  
MassDEP File Number

Has been recorded at the Registry of Deeds of:

County	Book	Page
_____	_____	_____

for: \_\_\_\_\_  
Property Owner

and has been noted in the chain of title of the affected property in:

\_\_\_\_\_  
Book  
\_\_\_\_\_  
Page

In accordance with the Order of Conditions issued on:

\_\_\_\_\_  
Date

If recorded land, the instrument number identifying this transaction is:

\_\_\_\_\_  
Instrument Number

If registered land, the document number identifying this transaction is:

\_\_\_\_\_  
Document Number

\_\_\_\_\_  
Signature of Applicant

Rev. 4/1/2010

Westford Department of Public Works, Boston Road Right-of-Way  
Right-of-way along Boston Road between Main Street and the on-ramps for Interstate 495 Southbound  
(334-1823)

### **Project Description:**

The project involves work within 100' of Bordering Vegetated Wetlands and an intermittent stream for vehicular, bicycle, and pedestrian safety improvements, and drainage and utility improvements along Boston Road between 1 Crown Road and 44 Boston Road and to the rear of 70 Boston Road, as part of a larger project to improve Boston Road from Main Street to the on-ramps to Interstate 495 Southbound.

### **Findings**

The Commission finds that the project is a Limited Project under 310 CMR 10.53(3)(f) because it involves maintenance and improvement of an existing public roadway including pedestrian safety improvements and drainage and utility improvements.

The Commission finds that the project lies within developed, previously disturbed and altered land area.

The Commission finds that easements are required for work associated with the proposed sediment forebay on 1 Crown Road and 44 Boston Road and the proposed wet detention basin behind 70 Boston Road, and the Boston Road parcels shown on Sheet 24 of the approved Plan owned by Town of Westford and by Westford Gateway, LLC.

The Commission finds that the proposed project meets the applicable Stormwater Management Standards found in 310 CMR 10.05(6)(k-q) in accordance with 310 CMR 10.05(6)(k)7 by improving an undersized stormwater management system and providing in-system treatment through the installation of deep-sump catch basins. The Commission finds that no additional Stormwater Control Measures and/or Low Impact Development techniques could be implemented due to the limited space of the existing, developed residential corridor.

The Commission finds that the project will disturb more than one acre of land and therefore the project is subject to special filings associated with NPDES thresholds.

The Commission finds that the existing drainage system is undersized and not adequate to support the existing conditions nor the increased stormwater flow through the proposed widening, and the proposed upgrades will ensure proper drainage, including a new drainage trunkline and removal of the existing basin-to-basin connections, construction of an outlet sediment trap adjacent to the intermittent stream between 1 Crown Road and 44 Boston Road, and construction of a new detention basin to manage both quantity and quality of the stormwater before releasing into the existing wetland.

The Commission finds that there are no permanent impacts to the BVW.

The Commission finds that impacts to the Buffer Zone are limited to an approximately 200-foot length of Boston Road from 1 Crown Road to 44 Boston Road, and a portion of the proposed wet detention basin near 70 Boston Road and the I-495 on-ramps.

The Commission finds that permanent activities within the Buffer Zone will consist of new impervious surface associated with the roadway widening and sidewalk installation along Boston Road; abandonment of the existing water line and installation of a new water line; new drainage infrastructure including detention basin, outlet control structure, sediment trap, deep sump catch basins, and riprap spillway. The Commission further finds the temporary impacts to the Buffer Zone total 47,555 SF and all temporary impacts to the BVW 100-foot buffer area adjacent to Crown Road will be fully restored once construction is completed.

The Commission finds that the seed mixes proposed for the wet detention basin are ecotypic to the region and will provide ideal wildlife habitat and food sources.



Westford Department of Public Works, Boston Road Right-of-Way  
Right-of-way along Boston Road between Main Street and the on-ramps for Interstate 495 Southbound  
(334-1823)

The Commission finds that the project does not discharge to areas that are within or near areas of critical environmental concern.

The Commission finds that during construction, erosion control measures will be implemented to prevent construction-related pollutants from reaching the wetlands.

The Commission finds that the Contractor will be responsible for controlling erosion and dust throughout construction.

The Commission finds that stabilization, such as temporary vegetation, mulch, and/or jute netting will be provided on disturbed areas if final grading is to be delayed for more than 21 days.

The Commission finds that no portion of the proposed project is located in Estimated Habitat of Rare Wildlife as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP).

The Commission finds that the project has been designed to minimize disturbance to existing trees and shrubs.

The Commission finds that, due to the nature and purpose of the proposed activities, there are no practicable alternatives to the Project.

The Commission finds that the project, if completed in compliance with this Order of Conditions (OOC) and the approved plan, complies with the MA Wetlands Protection Act and Regulations and the Town of Westford's Non-zoning Wetland Bylaw and Regulations.

The following Special Conditions also apply to work within the jurisdictional areas of the Conservation Commission as defined by MA General Laws, Chapter 131 section 40 and the Westford Non-zoning Wetland Bylaw Ch. 171 and regulations Ch. 235.

**Special Conditions:**

21. It shall be understood by the applicant that the issuance of this Order of Conditions shall apply to the Massachusetts Wetlands Protection Act and the Town of Westford's Non-Zoning Wetlands Bylaw.
22. There shall be no adverse impacts to wetland areas.
23. Notice shall be given to the Commission or its agent no more than three (3) weeks and no less than one (1) week prior to the commencement of any construction activities.
24. This Order of Conditions shall be incorporated into all bid documents for the project and reviewed with, and a copy provided to all contractors and engineers working on the site involved with site preparation, earthwork, and landscaping.
25. Prior to the commencement of the project, there shall be a meeting onsite between the project contractor and the Commission's agent to review this Order of Conditions and its requirements. A copy of said Order of Conditions and referenced plans and documents shall be onsite during all construction activities. Any other plans not consistent with the Order shall not be onsite.
26. The Applicant and their employees and contractors shall make no changes or additions to any of the work or construction products shown on the approved plans without first having those changes reviewed and approved by the Commission or its agent.
27. Prior to any disturbance on the site, the applicant or their representative shall submit a schedule to the Commission or its agent for review and approval. The schedule shall include a sequence of events with approximate dates of activities relevant to this Order including but not limited to:

Westford Department of Public Works, Boston Road Right-of-Way  
Right-of-way along Boston Road between Main Street and the on-ramps for Interstate 495 Southbound  
(334-1823)

- Installation of erosion controls;
- Installation of tree protection measures/fencing;
- Removal and pruning of existing vegetation;
- Removal of existing pavement;
- Installation of the sidewalk and curbing;
- Installation of stormwater drainage infrastructure;
- Installation of utilities;
- Landscaping, stabilization, and restoration of the site;
- Removal of the erosion controls;
- Key dates or milestones for activities; and
- Site management information including, names, address, phone number and email of site contractor(s).

28. Prior to the performance of any other site work, a sedimentation and erosion control barrier consisting of compost filter tube, or other control feature as may be approved by the Commission or its agent, shall be properly installed (wattles staked flush to the ground so as not to be lifted or moved easily) in the locations shown as "Prop Sediment Control Barrier" on the Final Approved Plan or as directed by the Commission or its agent. This control feature shall be properly installed and inspected and approved by the Commission or its agent prior to the commencement of any other work on the site.

Silt sacks shall be maintained and regularly cleaned of sediments until all areas associated with the work permitted by this Order of Conditions have been permanently stabilized and the Conservation Commission or its agent has formally approved their removal. Filter fabric placed under the inlet rim is not an acceptable substitute for silt sacks.

The Commission's agent is authorized to require the installation of any other erosion/sedimentation/work limit controls on the site as deemed necessary to protect the wetlands.

29. The applicant shall have on hand at the start of any soil disturbance, removal, or stockpiling, a minimum of 100 feet of silt fence and 50 feet of compost filter tube. Said fence and tubes shall be used for control of emergency erosion problems and shall not be used for normal control of erosion.

30. Any disturbed areas that have a slope of 3:1 or steeper shall be stabilized with erosion control blankets or other measures approved by the Commission or its agent.

31. Erosion control features shall be implemented to prevent construction-related pollutants from reaching the wetlands. The Contractor shall be responsible for controlling erosion and dust throughout construction.

32. Erosion control features shall be maintained in proper working condition during and after construction. Erosion control features shall be removed promptly following satisfactory permanent stabilization of the site with approval of the Commission or its agent, or their direction to remove said barrier. Upon stabilization of the site, the applicant shall remove the erosion/sedimentation control barriers with the approval of the Commission or its agent.

33. Any ground disturbed during any phase of the project shall be seeded and stabilized with a seed mixture approved by the Commission or its agent. The disturbed areas shall be seeded and stabilized within the same growing season the work occurs and no later than September 15 to ensure adequate growth within the growing season. Any areas not satisfactorily stabilized by December 1 shall be temporarily stabilized during the winter months using erosion control blankets, jute netting, and/or straw mulch. Stabilization, such as

Westford Department of Public Works, Boston Road Right-of-Way  
Right-of-way along Boston Road between Main Street and the on-ramps for Interstate 495 Southbound  
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temporary vegetation, mulch, and/or jute netting shall be provided on disturbed areas if final grading is to be delayed for more than 21 days.

34. The project shall minimize disturbance to existing trees and shrubs to the extent practicable.
35. Any required dewatering shall be performed so as to direct water to an upland discharge point, as far away as possible from the wetlands and in such a fashion that said water is temporarily detained in a stilling pond or other acceptable feature as may be approved by the Commission or its agent, and overflow from said basin or feature shall flow back towards the wetlands through a line of silt fence in combination with staked straw bales. In no case shall there be direct discharge into wetlands.
36. While work is occurring within the wetland buffer area, a monthly report detailing the Project's progress shall be submitted to the Conservation Commission or its agent.
37. Open excavations shall not remain open overnight.
38. Stormwater shall not be directed to any permanent Best Management Practice (BMP) device or structure until the associated drainage areas are stabilized.
39. The applicant shall protect all stormwater BMPs during construction to prevent a reduction in the long-term capacity of the stormwater system. Upon completion of the project, the stormwater BMPs shall be cleaned of any silt and sediment.
40. During construction of the new drainage system components, care must be taken to prevent siltation from entering the system. Drainage pipes in open excavations shall not remain open overnight. Immediately following the installation of any binder course of pavement, all catch basins shall be raised and the associated stormwater system shall be fully functional as designed. Following site stabilization such that all potential flow of sediment has ceased, then all drainage features shall be cleaned of accumulated sediment, including catch basins and manholes. These features shall not be cleaned by discharge of water under pressure such that sediment is washed out into the wetland resource area.
41. All construction equipment, including, but not limited to machinery, heavy equipment and vehicles shall be parked and stored no closer than 100' from any wetland resource areas when not in use. All fuels, lubricants and hydraulic fluids shall be stored no closer than 100' from any wetland resource areas. All refueling and maintenance involving transfer of oils and hydraulic fluids shall be performed no closer than 100' from any wetland resource areas.
42. All excavate, fill, loam and any other earthen materials associated with the project shall be stored and stockpiled no closer than 100' from any wetland resource area. No excavate, fill, loam or other material shall be stockpiled against the sediment or erosion control feature.
43. No fill, excavate, construction debris or equipment or any other material shall be allowed to enter the wetlands; any such material entering the wetlands shall be removed immediately. No trees or shrubs shall be felled into or disposed of in the wetlands.
44. All imported topsoil shall be documented to be free of invasive weed seeds.
45. Only clean fill shall be used for the project. Clean fill shall be free from contamination, trash, debris, asphalt, brick, concrete, metal, wood, recycled construction materials, or other deleterious materials. No unsuitable material of any kind (stumps, roots, trash, debris, etc.) may be buried, placed, or dispersed on the property.
46. No site work shall be performed within any wetland resource area, 100 feet of any wetlands and/or floodplain between December 1 and April 1, except with the permission of the Conservation Commission or its agent following a written request from the Applicant.

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Right-of-way along Boston Road between Main Street and the on-ramps for Interstate 495 Southbound  
(334-1823)

47. Any waste materials generated by the project shall be disposed of at a proper disposal or recycling facility.
48. Any debris from the project shall be promptly removed from the site, and in no case shall be stored on the ground, except with the review and approval of the Commission or its agent, to ensure said storage will not result in discharge of waste materials into the BVW.
49. All landscaping on the site shall be installed so as to not require the ongoing use of fertilizers, herbicides, and pesticides within 100 feet of a jurisdictional wetland resource.
50. Within the wetland buffer, the Applicant shall stabilize disturbed areas with groundcover seed mixes composed of native species ecotypic to the region. Any substitutions shall be reviewed and approved by the Commission or its agent.
51. In the final condition, disturbed areas that are not paved shall be stabilized and landscaped with loam and seed; in areas with a slope of 1.5:1 or greater, modified, seeded rockfill shall be placed for stabilization.
52. **Upon completion of the project the proponent shall request a Certificate of Compliance.** If the project has been conducted in accordance with plans stamped by a registered professional engineer, a written statement by such a professional person certifying substantial compliance with the plans and setting forth what deviation, if any, exists from the plans approved in the Order shall accompany the request for the Certificate of Compliance.

After the project is constructed, a certified "as-built" plan shall be submitted to the Commission. The as-built plan shall include but not be limited to: work in the Buffer Zone final grades, calculations of impervious area and any additional information necessary to aid the Commission's evaluation of the project before issuance of a Certificate of Compliance for work under this Order.

#### **Final Approved Plan:**

"Massachusetts Department of Transportation, Highway Division, Plan and Profile of Boson Road in the Town of Westford, Middlesex County ," scale 1"=20', dated March 22, 2023, prepared by TEC, Inc., signed and stamped by Jonathan A. Rockwell, PE, containing 30 sheets.

#### **Plans and Documents Considered:**

- Notice of Intent application dated March 23, 2023 including Project Narrative;
- Wetland Delineation Report, dated November 20, 2018, prepared by Rimmer Environmental Consulting, LLC;
- "Massachusetts Department of Transportation, Highway Division, Plan and Profile of Boson Road in the Town of Westford, Middlesex County ," scale 1"=20', dated March 22, 2023, prepared by TEC, Inc., signed and stamped by Jonathan A. Rockwell, PE, containing 30 sheets;
- Stormwater Report, MassDOT Project No. 609035, dated March 22, 2023, prepared by TEC, Inc., including:
  - Appendices: MassDEP Checklist for Stormwater Report; Soils and FEMA Information; Supporting Calculations; Hydraulic and Hydrologic Information; Stormwater Management System Operations and Maintenance Plan and Long-Term Pollution Prevention Plan, dated March 22, 2023, prepared by TEC, Inc., including attached Figures and Maps;
  - Figures: Locus Figure; Existing Drainage Patterns; Existing Key Features and Resource Areas; NRCS Soils Information; Proposed Drainage Patterns;

Westford Department of Public Works, Boston Road Right-of-Way  
Right-of-way along Boston Road between Main Street and the on-ramps for Interstate 495 Southbound  
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- Project Location Map, scale 1'=1,000', prepared by TEC, Inc.;
- MassMapper – Boston Road – Westford;
- MassMapper – NHESP Priority Habitats of Rare Species;
- Flood Insurance Rate Map, Middlesex County, Massachusetts, Map Revised July 7, 2014;
- Flood Insurance Rate Map, Middlesex County, Massachusetts, Effective Date June 4, 2010;
- Photo Log, Site Photographs (6).

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DOCUMENT A00869

**UNITED STATES DEPARTMENT OF THE INTERIOR**

**FISH AND WILDLIFE SERVICE**

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## United States Department of the Interior



FISH AND WILDLIFE SERVICE  
New England Ecological Services Field Office  
70 Commercial Street, Suite 300  
Concord, NH 03301-5094  
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To:

February 08, 2023

Project code: 2023-0043149

Project Name: 609035 - WESTFORD- REHABILITATION OF BOSTON ROAD

Subject: Concurrence verification letter for the '609035 - WESTFORD- REHABILITATION OF BOSTON ROAD' project under the revised February 5, 2018, FHWA, FRA, FTA Programmatic Biological Opinion for Transportation Projects within the Range of the Indiana Bat and Northern Long-eared Bat.

To whom it may concern:

The U.S. Fish and Wildlife Service (Service) has received your request dated February 08, 2023 to verify that the **609035 - WESTFORD- REHABILITATION OF BOSTON ROAD** (Proposed Action) may rely on the concurrence provided in the February 5, 2018, FHWA, FRA, FTA Programmatic Biological Opinion for Transportation Projects within the Range of the Indiana Bat and Northern Long-eared Bat (PBO) to satisfy requirements under Section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended; 16 U.S.C 1531 *et seq.*).

Based on the information you provided (Project Description shown below), you have determined that the Proposed Action is within the scope and adheres to the criteria of the PBO, including the adoption of applicable avoidance and minimization measures, and may affect, but is not likely to adversely affect (NLAA) the endangered Indiana bat (*Myotis sodalis*) and/or the threatened Northern long-eared bat (*Myotis septentrionalis*). Consultation with the Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) is required.

The Service has 14 calendar days to notify the lead Federal action agency or designated non-federal representative if we determine that the Proposed Action does not meet the criteria for a NLAA determination under the PBO. If we do not notify the lead Federal action agency or designated non-federal representative within that timeframe, you may proceed with the Proposed Action under the terms of the NLAA concurrence provided in the PBO. This verification period allows Service Field Offices to apply local knowledge to implementation of the PBO, as we may identify a small subset of actions having impacts that were unanticipated. In such instances, Service Field Offices may request additional information that is necessary to verify inclusion of the proposed action under the PBO.

NOTE: The Service reclassified the NLEB as an endangered species on November 30, 2022. This ruling becomes effective on March 31, 2023. This NLAA determination does not require reinitiation. For projects requiring consultation after the effective date of March 31, 2023, please use the 2023 FHWA, FRA, FTA PBO.

**For Proposed Actions that include bridge/culvert or structure removal, replacement, and/or maintenance activities:** If your initial bridge/culvert or structure assessment documented signs of bat use or occupancy, or an assessment failed to detect Indiana bats and/or NLEBs, yet are later detected prior to, or during construction, please submit the Post Assessment Discovery of Bats at Bridge/Culvert or Structure Form (User Guide Appendix E) to this Service Office within 2 working days of any potential take. In these instances, potential incidental take of Indiana bats and/or NLEBs is covered under the Incidental Take Statement in the 2018 FHWA, FRA, FTA PBO (provided that the take is reported to the Service).

If the Proposed Action is modified, or new information reveals that it may affect the Indiana bat and/or Northern long-eared bat in a manner or to an extent not considered in the PBO, further review to conclude the requirements of ESA Section 7(a)(2) may be required. If the Proposed Action may affect any other federally-listed or proposed species, and/or any designated critical habitat, additional consultation between the lead Federal action agency and this Service Office is required. If the proposed action has the potential to take bald or golden eagles, additional coordination with the Service under the Bald and Golden Eagle Protection Act may also be required. In either of these circumstances, please contact this Service Office.

The following species may occur in your project area and **are not** covered by this determination:

- Monarch Butterfly *Danaus plexippus* Candidate

## **Project Description**

The following project name and description was collected in IPaC as part of the endangered species review process.

### ***Name***

609035 - WESTFORD- REHABILITATION OF BOSTON ROAD

### ***Description***

609035 - WESTFORD- REHABILITATION OF BOSTON ROAD

The multi-modal improvements encompass a 1.05-mile section of Boston Road from Main Street (Westford Town Center) to the Interstate 495 (I-495) Southbound Off-Ramp within the Town of Westford. The improvements include redefining the cross-section to include a 5-foot bicycle lane and 11-foot travel lane in each direction through the project limits. The improvements also include the construction of sidewalks with vertical granite curbing along the easterly side of Boston Road from Main Street to the I-495 SB Ramps and along the westerly side of Boston Road from Blakes Hill Road to the I-495 SB Ramps; construction of ADA/AAB compliant wheelchair ramps at corridor intersections; construction of a new traffic signal at the intersection of Boston Road and Main Street; modifying traffic signal timings/phasing/infrastructure at three Boston Road intersections including the I-495 SB Ramps, I-495 NB Ramps, and Route 110; reconstruction of the existing storm drain infrastructure; water line replacement; construction of retaining walls; full depth pavement reclaim throughout the corridor; new pavement markings and signs; and accessible pedestrian signals.

Monarch Butterfly: Candidate Species only, no conservation measures at this time.

## Determination Key Result

Based on your answers provided, this project(s) may affect, but is not likely to adversely affect the endangered Indiana bat and/or the threatened Northern long-eared bat, therefore, consultation with the U.S. Fish and Wildlife Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended 16 U.S.C. 1531 *et seq.*) is required. However, also based on your answers provided, this project may rely on the concurrence provided in the revised February 5, 2018, FHWA, FRA, FTA Programmatic Biological Opinion for Transportation Projects within the Range of the Indiana Bat and Northern Long-eared Bat.

## Qualification Interview

1. Is the project within the range of the Indiana bat<sup>[1]</sup>?

[1] See [Indiana bat species profile](#)

**Automatically answered**

*No*

2. Is the project within the range of the Northern long-eared bat<sup>[1]</sup>?

[1] See [Northern long-eared bat species profile](#)

**Automatically answered**

*Yes*

3. Which Federal Agency is the lead for the action?

*A) Federal Highway Administration (FHWA)*

4. Are *all* project activities limited to non-construction<sup>[1]</sup> activities only? (examples of non-construction activities include: bridge/abandoned structure assessments, surveys, planning and technical studies, property inspections, and property sales)

[1] Construction refers to activities involving ground disturbance, percussive noise, and/or lighting.

*No*

5. Does the project include *any* activities that are **greater than** 300 feet from existing road/rail surfaces<sup>[1]</sup>?

[1] Road surface is defined as the actively used [e.g. motorized vehicles] driving surface and shoulders [may be pavement, gravel, etc.] and rail surface is defined as the edge of the actively used rail ballast.

*No*

6. Does the project include *any* activities **within** 0.5 miles of a known Indiana bat and/or NLEB hibernaculum<sup>[1]</sup>?

[1] For the purpose of this consultation, a hibernaculum is a site, most often a cave or mine, where bats hibernate during the winter (see suitable habitat), but could also include bridges and structures if bats are found to be hibernating there during the winter.

*No*

7. Is the project located **within** a karst area?

*No*

8. Is there *any* suitable<sup>[1]</sup> summer habitat for Indiana Bat or NLEB **within** the project action area<sup>[2]</sup>? (includes any trees suitable for maternity, roosting, foraging, or travelling habitat)

[1] See the Service's [summer survey guidance](#) for our current definitions of suitable habitat.

[2] The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR Section 402.02). Further clarification is provided by the [User's Guide for the Range-wide Programmatic Consultation for Indiana Bat and Northern Long-eared Bat](#).

Yes

9. Will the project remove *any* suitable summer habitat<sup>[1]</sup> and/or remove/trim any existing trees **within** suitable summer habitat?

[1] See the Service's [summer survey guidance](#) for our current definitions of suitable habitat.

Yes

10. Will the project clear more than 20 acres of suitable habitat per 5-mile section of road/rail?

No

11. Have presence/probable absence (P/A) summer surveys<sup>[1][2]</sup> been conducted<sup>[3][4]</sup> **within** the suitable habitat located within your project action area?

[1] See the Service's [summer survey guidance](#) for our current definitions of suitable habitat.

[2] Presence/probable absence summer surveys conducted within the fall swarming/spring emergence home range of a documented Indiana bat hibernaculum (contact local Service Field Office for appropriate distance from hibernacula) that result in a negative finding requires additional consultation with the local Service Field Office to determine if clearing of forested habitat is appropriate and/or if seasonal clearing restrictions are needed to avoid and minimize potential adverse effects on fall swarming and spring emerging Indiana bats.

[3] For projects within the range of either the Indiana bat or NLEB in which suitable habitat is present, and no bat surveys have been conducted, the transportation agency will assume presence of the appropriate species. This assumption of presence should be based upon the presence of suitable habitat and the capability of bats to occupy it because of their mobility.

[4] Negative presence/probable absence survey results obtained using the [summer survey guidance](#) are valid for a minimum of two years from the completion of the survey unless new information (e.g., other nearby surveys) suggest otherwise.

Yes

#### **SUBMITTED DOCUMENTS**

- [609035\\_MassDOT\\_Westford\\_NLEB Memo-Final.pdf](#) <https://ipac.ecosphere.fws.gov/project/QY7O4DF65ZGFTDCGEULLMTJCAA/projectDocuments/122174611>

12. Did the presence/probable absence (P/A) summer surveys detect Indiana bats and/or NLEB<sup>[1]</sup>?

[1] P/A summer surveys conducted within the fall swarming/spring emergence home range of a documented Indiana bat hibernaculum (contact local Service Field Office for appropriate home range) that result in a negative finding requires additional consultation with the local Service Field Office to determine if clearing of forested habitat is appropriate and/or if seasonal clearing restrictions are needed to avoid and minimize potential adverse effects on fall swarming and spring emerging Indiana bats.

No

13. Were the P/A summer surveys conducted **within** the fall swarming/spring emergence range of a documented Indiana bat hibernaculum<sup>[1]</sup>?

[1] Contact the local Service Field Office for appropriate distance from hibernacula.

No

14. Does the project include activities **within documented NLEB habitat**<sup>[1][2]</sup>?

[1] Documented roosting or foraging habitat – for the purposes of this consultation, we are considering documented habitat as that where Indiana bats and/or NLEB have actually been captured and tracked using (1) radio telemetry to roosts; (2) radio telemetry triangulation/triangulation to estimate foraging areas; or (3) foraging areas with repeated use documented using acoustics. Documented roosting habitat is also considered as suitable summer habitat within 0.25 miles of documented roosts.)

[2] For the purposes of this key, we are considering documented corridors as that where Indiana bats and/or NLEB have actually been captured and tracked to using (1) radio telemetry; or (2) treed corridors located directly between documented roosting and foraging habitat.

No

15. Will the removal or trimming of habitat or trees occur **within** suitable but **undocumented NLEB** roosting/foraging habitat or travel corridors?

Yes

16. What time of year will the removal or trimming of habitat or trees **within** suitable but **undocumented NLEB** roosting/foraging habitat or travel corridors occur?

*C) During both the active and inactive seasons*

17. Will *any* tree trimming or removal occur **within** 100 feet of existing road/rail surfaces?

Yes

18. Will *any* tree trimming or removal occur **between** 100-300 feet of existing road/rail surfaces?

No

19. Are *all* trees that are being removed clearly demarcated?

Yes

20. Will the removal of habitat or the removal/trimming of trees involve the use of **temporary** lighting?

Yes

21. Will the removal of habitat or the removal/trimming of trees include installing new or replacing existing **permanent** lighting?  
*Yes*
22. Does the project include wetland or stream protection activities associated with compensatory wetland mitigation?  
*Yes*
23. Does the project include slash pile burning?  
*No*
24. Does the project include *any* bridge removal, replacement, and/or maintenance activities (e.g., any bridge repair, retrofit, maintenance, and/or rehabilitation work)?  
*No*
25. Does the project include the removal, replacement, and/or maintenance of *any* structure other than a bridge? (e.g., rest areas, offices, sheds, outbuildings, barns, parking garages, etc.)  
*No*
26. Will the project involve the use of *any* **temporary** lighting in addition to the lighting already indicated for habitat removal (including the removal or trimming of trees), or bridge/structure removal, replacement or maintenance activities?  
*Yes*
27. Is there *any* suitable habitat **within** 1,000 feet of the location(s) where **temporary** lighting (other than the lighting already indicated for habitat removal (including the removal or trimming of trees) or bridge/structure removal, replacement or maintenance activities) will be used?  
*Yes*
28. Will the project install *any* new or replace any existing **permanent** lighting in addition to the lighting already indicated for habitat removal (including the removal or trimming of trees) or bridge/structure removal, replacement or maintenance activities?  
*Yes*
29. Is there *any* suitable habitat **within** 1,000 feet of the location(s) where **permanent** lighting (other than the lighting already indicated for habitat removal (including the removal or trimming of trees) or bridge/structure removal, replacement or maintenance activities) will be installed or replaced?  
*Yes*
30. Does the project include percussives or other activities (**not including tree removal/trimming or bridge/structure work**) that will increase noise levels above existing traffic/background levels?  
*Yes*

31. Will the activities that use percussives (**not including tree removal/trimming or bridge/structure work**) and/or increase noise levels above existing traffic/background levels be conducted *during* the active season<sup>[1]</sup>?

[1] Coordinate with the local Service Field Office for appropriate dates.

Yes

32. Will *any* activities that use percussives (**not including tree removal/trimming or bridge/structure work**) and/or increase noise levels above existing traffic/background levels be conducted *during* the inactive season<sup>[1]</sup>?

[1] Coordinate with the local Service Field Office for appropriate dates.

Yes

33. Are *all* project activities that are **not associated with** habitat removal, tree removal/trimming, bridge and/or structure activities, temporary or permanent lighting, or use of percussives, limited to actions that DO NOT cause any additional stressors to the bat species?

Examples: lining roadways, unlighted signage, rail road crossing signals, signal lighting, and minor road repair such as asphalt fill of potholes, etc.

Yes

34. Will the project raise the road profile **above the tree canopy**?

No

35. Are the wetland or stream protection activities associated with compensatory wetland/stream mitigation portion of this project consistent with a Not Likely to Adversely Affect determination in this key?

**Automatically answered**

*Yes, because your activities associated with compensatory wetland/stream mitigation activities do not clear suitable summer habitat and are not within 0.5 miles of Indiana bat or NLEB hibernaculum.*

36. Are the project activities that use percussives (not including tree removal/trimming or bridge/structure work) consistent with a Not Likely to Adversely Affect determination in this key?

**Automatically answered**

*Yes, because the activities are within 300 feet of the existing road/rail surface, greater than 0.5 miles from a hibernacula, and conducted during the active season within undocumented habitat.*

37. Are the project activities that use percussives (not including tree removal/trimming or bridge/structure work) and/or increase noise levels above existing traffic/background levels consistent with a No Effect determination in this key?

**Automatically answered**

*Yes, because the activities are within 300 feet of the existing road/rail surface, greater than 0.5 miles from a hibernacula, and conducted during the inactive season*



38. Is the location of this project consistent with a Not Likely to Adversely Affect determination in this key?

**Automatically answered**

*Yes, because no bats were detected during presence/probable absence surveys conducted during the summer survey season and outside of the fall swarming/spring emergence periods. Additionally, all activities were at least 0.5 miles from any hibernaculum.*

39. **General AMM 1**

Will the project ensure *all* operators, employees, and contractors working in areas of known or presumed bat habitat are aware of *all* FHWA/FRA/FTA (Transportation Agencies) environmental commitments, including all applicable Avoidance and Minimization Measures?

Yes

## Project Questionnaire

1. Have you made a No Effect determination for *all* other species indicated on the FWS IPaC generated species list?

N/A

2. Have you made a May Affect determination for *any* other species on the FWS IPaC generated species list?

N/A

3. How many acres<sup>[1]</sup> of trees are proposed for removal between 0-100 feet of the existing road/rail surface?

[1] If described as number of trees, multiply by 0.09 to convert to acreage and enter that number.

3

## Avoidance And Minimization Measures (AMMs)

This determination key result includes the commitment to implement the following Avoidance and Minimization Measures (AMMs):

### GENERAL AMM 1

Ensure all operators, employees, and contractors working in areas of known or presumed bat habitat are aware of all FHWA/FRA/FTA (Transportation Agencies) environmental commitments, including all applicable AMMs.

## **Determination Key Description: FHWA, FRA, FTA Programmatic Consultation For Transportation Projects Affecting NLEB Or Indiana Bat**

This key was last updated in IPaC on February 02, 2023. Keys are subject to periodic revision.

This decision key is intended for projects/activities funded or authorized by the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), and/or Federal Transit Administration (FTA), which may require consultation with the U.S. Fish and Wildlife Service (Service) under Section 7 of the Endangered Species Act (ESA) for the endangered **Indiana bat** (*Myotis sodalis*) and the threatened **Northern long-eared bat** (NLEB) (*Myotis septentrionalis*).

This decision key should only be used to verify project applicability with the Service's [February 5, 2018, FHWA, FRA, FTA Programmatic Biological Opinion for Transportation Projects](#). The programmatic biological opinion covers limited transportation activities that may affect either bat species, and addresses situations that are both likely and not likely to adversely affect either bat species. This decision key will assist in identifying the effect of a specific project/activity and applicability of the programmatic consultation. The programmatic biological opinion is not intended to cover all types of transportation actions. Activities outside the scope of the programmatic biological opinion, or that may affect ESA-listed species other than the Indiana bat or NLEB, or any designated critical habitat, may require additional ESA Section 7 consultation.

## **IPaC User Contact Information**

Agency: Massachusetts Department of Transportation  
Name: Penelope Pappas  
Address: 10 Park Plaza  
City: Boston  
State: MA  
Zip: 02116  
Email: penelope.e.pappas@dot.state.ma.us  
Phone: 8574452880

## **Lead Agency Contact Information**

Lead Agency: Federal Highway Administration

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DOCUMENT A00875

**POLICY DIRECTIVE P-22-001  
AND  
POLICY DIRECTIVE P-22-002**

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zoned property, schools, daycare facilities, playgrounds, parks, recreational areas, hospitals, elderly housing and convalescent facilities.

Temporary off-site storage of excavated soil from a MassDOT project is only permissible at a location approved and permitted by MassDOT. The temporary storage location should be located within the same municipality where the soil was excavated, where possible. Stockpiled soil must be securely covered, and appropriate measures must be taken to minimize fugitive dust and erosion.

Signs indicating the source of the soil, the date the soil was generated, and contact information must be erected and maintained until the stockpiled soils are transported to a disposal facility or reused on the project site.

### **Implementation Procedures**

To ensure that off-site storage of excavated soils is managed properly on MassDOT projects, this policy requires the following:

#### **1. Off-Site Stockpile Storage Locations**

- a. The Contractor shall provide proposed off-site storage locations to the Engineer for approval at least 30 days prior to transporting soil off site. Off-site storage locations should be in the same municipality as the work site.
- b. The Contractor shall keep excavated soil on site until adequately characterized to the satisfaction of the Engineer.
- c. The Contractor shall provide notification of the approved off-site storage location to the local Board of Health and the Town Manager's/Mayor's Office at least 7-days prior to transporting soil off site.
- d. The Contractor shall provide the Engineer with at least 3-days' notice prior to transporting soil off site.
- e. For off-site storage locations on MassDOT property, the Contractor is required to obtain an Access Permit through the District Permits Office prior to storage of soil or other materials. MassDOT will issue these permits at no cost to the Contractor. Information to be submitted by the Contractor as part of the permit application shall include:
  - i. A description of material to be stored off-site, including available analytical data;
  - ii. A figure of the location with distances to residences and residential receptors; and
  - iii. Anticipated duration of temporary storage.
- f. Stockpile locations should not be within 500 feet of residential receptors (e.g., residential dwellings, residentially zoned property, schools, daycare facilities, playgrounds, parks, recreational areas, hospitals, elderly housing and convalescent facilities).
  - i. If the stockpile location must be within 500 feet of residential receptors, then soil must be less than RCS-1 (per 310 CMR 40.1600) and free of potentially hazardous or regulated items.

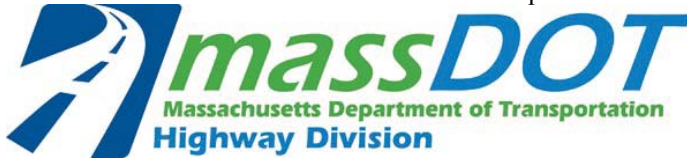


- g. For off-site storage locations on non-MassDOT property, the Contractor must notify the property owner(s) at least 7 days prior to transporting material.
- h. Exceptions to these rules will be reviewed by MassDOT and may be approved by the District Highway Director on a case-by-case basis.

## **2. Off-Site Stockpile Management**

- a. The Contractor shall keep soil stockpiles on impermeable surfaces (e.g., asphalt or concrete) or on 10-mil polyethylene sheeting.
- b. The Contractor shall cover soil stockpiles with 10-mil polyethylene sheeting and surround with a berm made of hay bales, straw wattles, or similar.
  - i. Piles that are actively being worked on must be covered and re-secured at the end of the work shift.
- c. The Contractor shall label stockpiles with signs, including:
  - i. Location of origin (including any Release Tracking Numbers)
  - ii. Stockpile ID number (including MassDOT District office-assigned tracking ID, if different)
  - iii. Date of initial accumulation
  - iv. Applicable telephone numbers for the Contractor and MassDOT.
- d. The Contractor shall mitigate fugitive dust at storage locations under the direction of an appropriately trained/certified environmental professional.
- e. The Contractor shall remedy noncompliance with this policy within 48 hours.
- f. The Contractor shall remedy noncompliance with this policy on the SAME DAY for potentially hazardous material, as determined by the Engineer.
- g. The Contractor shall handle excavated soil according to federal, state, and local regulations.
- h. The Contractor shall use appropriate shipping documents for all movements of excavated soil on public roadways (e.g., Bill of Lading, Material Shipping Record, Manifest, Asbestos Waste Shipment Record, etc.).

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Number:           P-22-002            
Date:           9/23/22          

# **POLICY DIRECTIVE**

Jonathan Gulliver (signature on original)  
\_\_\_\_\_  
HIGHWAY ADMINISTRATOR

## **Use of MassDOT Property for Staging and other Construction-Related Operations**

### **Purpose**

This Policy Directive is intended to address the use of MassDOT property by MassDOT Contractors for construction staging and other construction-related operations that are not specifically defined in the construction contract. Such use of MassDOT property will only be allowed if permitted by the District Office in accordance with 700 CMR 13.00, Approval of Access to MassDOT Highways and Other Property. This includes the use of MassDOT property for staging, laydown, and storage of equipment and materials, including soil excavated from a project site.

This Policy Directive requires the Contractor/applicant to obtain a Non-Vehicular Access Permit from MassDOT to use MassDOT property for these purposes.

This Policy Directive is effective immediately and applies to all MassDOT construction projects.

### **General Permit Considerations and Conditions**

In addition to other normal MassDOT Access Permit procedures, MassDOT shall consider the following during the application, review, implementation and monitoring processes of Access Permits required by this Policy Directive:

- Storage and placement of the Contractor’s equipment and materials should not be allowed within the clear zone of the roadway.
- Stockpiled soils should not be located within 500 feet of residential receptors, as defined herein to include, but not be limited to, residential dwellings, residentially zoned property, schools, daycare facilities, playgrounds, parks, recreational areas, hospitals, elderly housing and convalescent facilities.
- The Contractor/applicant shall identify the access/egress locations of the proposed storage areas. MassDOT will only approve locations determined to be safe for roadway users, construction workers and the general public.
- The Contractor may be required to submit a Traffic Management Plan and/or Lighting Plan for MassDOT review and approval as part of the permit application, depending on the proposed use of the area.

- The Contractor shall submit the permit application through MassDOT's online State Highway Access Permit System (SHAPS).
- MassDOT will waive the permit application fee for any application received from a MassDOT Contractor for any permit required by this Policy Directive and will waive any subsequent amendment and extension fees that may otherwise be required.
- MassDOT will review the permit application in accordance with applicable standard procedures and will apply standard permit terms and conditions, as necessary.
- The Resident Engineer will verify that the permit is approved before allowing the Contractor to use the affected area for the requested purpose.
- Areas permitted are for use by the approved applicant only and are not to be shared with or used by other vendors. Subcontractors specifically engaged with the applicant working on the specific MassDOT project will be allowed to use the area in accordance with the terms of the permit.
- Permits are issued on an annual basis and will require the Contractor to file for an extension each year to continue use.

### **Exemptions from Permit Requirements**

Equipment and materials being used for active construction operations and located within the work zone of the construction contract are exempt from this permit requirement, provided they do not interfere with the safety or operation of the roadway or the work zone. Examples of these types of exempt uses are:

- Equipment and materials parked or stored within a protected (barriered) work zone.
- Materials placed in the work zone prior to same-day installation or use.
- Soils excavated temporarily and scheduled to be replaced, such as for trenching operations or for installation of drainage structures.

DOCUMENT B00420

PROPOSAL

WESTFORD

For: **Rehabilitation of Boston Road**

COMMONWEALTH OF MASSACHUSETTS

LOCATION

The work referred to herein is in the Town of WESTFORD in Middlesex County, in the Commonwealth of Massachusetts, and is shown by the locus map (Document 00331) in the Proposal Pamphlet, the work locations extend as follows:

**Boston Road Road**

**Beginning – Station 20+00.00 +/-**

**Ending –Station 75+50.00 +/-**

**Limit of Work – Station 10+60.00 +/-**

**Limit of Work – Station 14+25.00 +/-**

**Limit of Work – Station 82+57.00 +/-**

The contract prices shall include the furnishing of all materials (except as otherwise herein specified), the performing of all the labor requisite or proper, the providing of all necessary machinery, tools, apparatus and other means of construction, the doing of all the abovementioned work in the manner set forth, described and shown in the specifications and on the drawings for the work, and in the form of contract, and the completion thereof within **1,000 CALENDAR DAYS** upon receipt of a Notice to Proceed, except that if the completion date falls between December 1 and March 15 then the same number of days beyond December 1st will be extended after March 15<sup>th</sup>.

The Work of this project is described by the following Items and quantities.

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Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
100.	1	SCHEDULE OF OPERATIONS - FIXED PRICE \$87500  AT Eighty Seven Thousand Five Hundred Dollars LUMP SUM	\$87,500.00	\$87,500.00
101.	2	CLEARING AND GRUBBING  AT _____ PER ACRE		
102.1	1,050	TREE TRIMMING  AT _____ PER FOOT		
102.3	40	HERBICIDE TREATMENT OF INVASIVE PLANTS  AT _____ PER HOUR		
102.33	8	INVASIVE PLANT MANAGEMENT STRATEGY  AT _____ PER HOUR		
102.511	33	TREE PROTECTION – ARMORING & PRUNING  AT _____ EACH		
102.513	4	TREE PROTECTION - AIR EXCAVATION & ROOT - PRUNING  AT _____ EACH		
102.521	275	TREE AND PLANT PROTECTION FENCE  AT _____ PER FOOT		
102.533	1,000	TREE CARE - WATERING  AT _____ PER GALLON		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
102.55	40	ARBORIST  AT _____ PER HOUR		
103.	20	TREE REMOVED - DIAMETER UNDER 24 INCHES  AT _____ EACH		
104.	9	TREE REMOVED - DIAMETER 24 INCHES AND OVER  AT _____ EACH		
105.	2	STUMP REMOVED  AT _____ EACH		
120.	12,500	EARTH EXCAVATION  AT _____ PER CUBIC YARD		
121.	570	CLASS A ROCK EXCAVATION  AT _____ PER CUBIC YARD		
127.	400	CONCRETE EXCAVATION  AT _____ PER CUBIC YARD		
141.	30	CLASS A TRENCH EXCAVATION  AT _____ PER CUBIC YARD		
141.1	100	TEST PIT FOR EXPLORATION  AT _____ PER CUBIC YARD		



Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
142.	2,350	CLASS B TRENCH EXCAVATION  AT _____ PER CUBIC YARD		
144.	15	CLASS B ROCK EXCAVATION  AT _____ PER CUBIC YARD		
146.	31	DRAINAGE STRUCTURE REMOVED  AT _____ EACH		
150.	200	ORDINARY BORROW  AT _____ PER CUBIC YARD		
150.1	150	SPECIAL BORROW  AT _____ PER CUBIC YARD		
151.	2,750	GRAVEL BORROW  AT _____ PER CUBIC YARD		
153.	175	CONTROLLED DENSITY FILL - EXCAVATABLE  AT _____ PER CUBIC YARD		
154.	1,000	SAND BORROW  AT _____ PER CUBIC YARD		
156.	1,900	CRUSHED STONE  AT _____ PER TON		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
170.	22,500	FINE GRADING AND COMPACTING - SUBGRADE AREA  AT _____ PER SQUARE YARD		
180.01	1	ENVIRONMENTAL HEALTH AND SAFETY PROGRAM  AT _____ LUMP SUM		
180.02	80	PERSONAL PROTECTION LEVEL C UPGRADE  AT _____ PER HOUR		
180.03	80	LICENSED SITE PROFESSIONAL SERVICES  AT _____ PER HOUR		
181.11	14,000	DISPOSAL OF UNREGULATED SOIL  AT _____ PER TON		
181.12	400	DISPOSAL OF REGULATED SOIL - IN-STATE FACILITY  AT _____ PER TON		
181.13	400	DISPOSAL OF REGULATED SOIL - OUT-OF-STATE FACILITY  AT _____ PER TON		
181.14	325	DISPOSAL OF HAZARDOUS WASTE  AT _____ PER TON		
182.1	1	INSPECTION AND TESTING FOR ASBESTOS  AT _____ LUMP SUM		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
182.2	600	REMOVAL OF ASBESTOS  AT _____ PER FOOT		
201.	52	CATCH BASIN  AT _____ EACH		
201.1	14	CATCH BASIN WITH DOUBLE GRATE  AT _____ EACH		
202.	9	MANHOLE  AT _____ EACH		
203.12	1	STORMWATER BASIN OUTLET STRUCTURE  AT _____ LUMP SUM		
203.5	22	SPECIAL MANHOLE - 5 FOOT DIAMETER  AT _____ EACH		
203.6	7	SPECIAL MANHOLE - 6 FOOT DIAMETER  AT _____ EACH		
203.7	3	SPECIAL MANHOLE - 7 FOOT DIAMETER  AT _____ EACH		
204.	5	GUTTER INLET  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
206.	1	DROP INLET, TYPE A  AT _____ EACH		
209.1	1	DROP INLET, TYPE DF  AT _____ EACH		
220.	66	DRAINAGE STRUCTURE ADJUSTED  AT _____ EACH		
220.2	20	DRAINAGE STRUCTURE REBUILT  AT _____ PER FOOT		
220.5	62	DRAINAGE STRUCTURE REMODELED  AT _____ EACH		
221.	16	FRAME AND COVER  AT _____ EACH		
222.	3	FRAME AND GRATE - MASSDOT BAR TYPE  AT _____ EACH		
222.1	21	FRAME AND GRATE - MASSDOT CASCADE TYPE  AT _____ EACH		
222.3	58	FRAME AND GRATE (OR COVER) MUNICIPAL STANDARD  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
222.31	1	FRAME AND GRATE (BEEHIVE)  AT _____ EACH		
224.12	49	12 INCH HOOD  AT _____ EACH		
224.15	5	15 INCH HOOD  AT _____ EACH		
227.3	10	REMOVAL OF DRAINAGE STRUCTURE SEDIMENT  AT _____ PER CUBIC YARD		
227.31	100	REMOVAL OF DRAINAGE PIPE SEDIMENT  AT _____ PER FOOT		
227.4	25	MASONRY PLUG  AT _____ PER SQUARE FOOT		
238.10	100	10 INCH DUCTILE IRON PIPE  AT _____ PER FOOT		
241.30	50	30 INCH REINFORCED CONCRETE PIPE CLASS III  AT _____ PER FOOT		
241.36	360	36 INCH REINFORCED CONCRETE PIPE CLASS III  AT _____ PER FOOT		

Project # 609035		Contract # 126590		
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ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
242.30	1	30 INCH REINFORCED CONCRETE PIPE FLARED END  AT _____ EACH		
242.36	1	36 INCH REINFORCED CONCRETE PIPE FLARED END  AT _____ EACH		
252.12	1,200	12 INCH CORRUGATED PLASTIC (POLYETHYLENE) PIPE  AT _____ PER FOOT		
252.124	1	24 INCH CORRUGATED PLASTIC PIPE FLARED END  AT _____ EACH		
252.15	100	15 INCH CORRUGATED PLASTIC (POLYETHYLENE) PIPE  AT _____ PER FOOT		
252.18	350	18 INCH CORRUGATED PLASTIC (POLYETHYLENE) PIPE  AT _____ PER FOOT		
252.24	1,150	24 INCH CORRUGATED PLASTIC (POLYETHYLENE) PIPE  AT _____ PER FOOT		
252.30	2,300	30 INCH CORRUGATED PLASTIC PIPE  AT _____ PER FOOT		
252.36	1,125	36 INCH CORRUGATED PLASTIC PIPE  AT _____ PER FOOT		

Project # 609035		Contract # 126590		
Location : WESTFORD				
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ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
258.	75	STONE FOR PIPE ENDS  AT _____ PER SQUARE YARD		
269.08	1,450	8 INCH SLOT-PERFORATED CORRUGATED PLASTIC PIPE (SUBDRAIN)  AT _____ PER FOOT		
269.10	500	10 INCH SLOT-PERFORATED CORRUGATED PLASTIC PIPE (SUBDRAIN)  AT _____ PER FOOT		
269.12	1,600	12INCH SLOT-PERFORATED CORRUGATED PLASTIC PIPE (SUBDRAIN)  AT _____ PER FOOT		
271.121	4,400	12 INCH AND UNDER PIPE REMOVED AND DISCARDED  AT _____ PER FOOT		
271.181	35	18 INCH PIPE REMOVED AND DISCARDED  AT _____ PER FOOT		
302.12	5,400	12 INCH DUCTILE IRON WATER PIPE (RUBBER GASKET)  AT _____ PER FOOT		
303.04	75	4 INCH DUCTILE IRON WATER PIPE (MECHANICAL JOINT)  AT _____ PER FOOT		
303.06	210	6 INCH DUCTILE IRON WATER PIPE (MECHANICAL JOINT)  AT _____ PER FOOT		

Project # 609035		Contract # 126590		
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ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
303.08	15	8 INCH DUCTILE IRON WATER PIPE (MECHANICAL JOINT)  AT _____ PER FOOT		
303.12	100	12 INCH DUCTILE IRON WATER PIPE (MECHANICAL JOINT)  AT _____ PER FOOT		
309.	4,000	DUCTILE IRON FITTINGS FOR WATER PIPE  AT _____ PER POUND		
336.1	900	1 INCH PLASTIC WATER PIPE  AT _____ PER FOOT		
336.2	35	2 INCH PLASTIC WATER PIPE  AT _____ PER FOOT		
345.1	1,000	1 INCH TEMPORARY SERVICE PIPE  AT _____ PER FOOT		
345.41	3,200	4 INCH TEMPORARY WATER LINE BYPASS PIPE  AT _____ PER FOOT		
350.06	12	6 INCH GATE AND GATE BOX  AT _____ EACH		
350.08	1	8 INCH GATE AND GATE BOX  AT _____ EACH		



Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
350.12	14	12 INCH GATE AND GATE BOX  AT _____ EACH		
355.04	3	4 INCH GATE AND GATE BOX REMOVED AND STACKED  AT _____ EACH		
357.06	1	6 INCH GATE BOX  AT _____ EACH		
358.	5	GATE BOX ADJUSTED  AT _____ EACH		
363.1	36	1 INCH CORPORATION COCK  AT _____ EACH		
363.2	1	2 INCH CORPORATION COCK  AT _____ EACH		
367.04	3	4 INCH CAST IRON PLUG  AT _____ EACH		
367.08	1	8 INCH CAST IRON PLUG  AT _____ EACH		
371.04	1	4 INCH COUPLING  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
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ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
371.06	1	6 INCH COUPLING  AT _____ EACH		
371.08	3	8 INCH COUPLING  AT _____ EACH		
371.12	3	12 INCH COUPLING  AT _____ EACH		
376.	11	HYDRANT  AT _____ EACH		
376.3	7	HYDRANT - REMOVED AND STACKED  AT _____ EACH		
376.5	1	HYDRANT - ADJUSTED  AT _____ EACH		
381.	38	SERVICE BOX  AT _____ EACH		
382.	1	METER BOX  AT _____ EACH		
382.2	1	METER BOX REMOVED AND STACKED  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
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ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
384.	38	CURB STOP  AT _____ EACH		
402.	275	DENSE GRADED CRUSHED STONE FOR SUB-BASE  AT _____ PER CUBIC YARD		
403.	20,000	RECLAIMED PAVEMENT FOR BASE COURSE AND/OR SUB-BASE  AT _____ PER SQUARE YARD		
403.1	300	CRUSHED STONE FOR BLENDING  AT _____ PER TON		
403.2	20,000	FULL DEPTH RECLAMATION WITH EMULSIFIED ASPHALT STABILIZATION  AT _____ PER SQUARE YARD		
403.21	26,000	EMULSIFIED ASPHALT FOR FULL DEPTH RECLAMATION  AT _____ PER GALLON		
404.5	1,450	RECLAIMED PAVEMENT BORROW MATERIAL  AT _____ PER CUBIC YARD		
415.2	8,500	PAVEMENT FINE MILLING  AT _____ PER SQUARE YARD		
431.	70	HIGH EARLY STRENGTH CEMENT CONCRETE BASE COURSE  AT _____ PER SQUARE YARD		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
443.	230	WATER FOR ROADWAY DUST CONTROL  AT _____ PER 1000 GALLONS		
450.231	2,650	SUPERPAVE SURFACE COURSE - 12.5 POLYMER (SSC - 12.5 - P)  AT _____ PER TON		
450.31	2,800	SUPERPAVE INTERMEDIATE COURSE - 12.5 (SIC -12.5)  AT _____ PER TON		
450.42	5,750	SUPERPAVE BASE COURSE - 37.5 (SBC - 37.5)  AT _____ PER TON		
451.	550	HMA FOR PATCHING  AT _____ PER TON		
452.	4,500	ASPHALT EMULSION FOR TACK COAT  AT _____ PER GALLON		
453.	25,000	HMA JOINT SEALANT  AT _____ PER FOOT		
472.	1,950	ASPHALT MIXTURES FOR TEMPORARY WORK  AT _____ PER TON		
487.1	100	IMPRINTED PREFORMED THERMOPLASTIC CROSSWALK  AT _____ PER SQUARE YARD		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
504.2	10	GRANITE CURB TYPE VA4 - SPLAYED END  AT _____ EACH		
506.	5,550	GRANITE CURB TYPE VB - STRAIGHT  AT _____ PER FOOT		
506.1	250	GRANITE CURB TYPE VB - CURVED  AT _____ PER FOOT		
509.	950	GRANITE TRANSITION CURB FOR WHEELCHAIR RAMPS - STRAIGHT  AT _____ PER FOOT		
509.1	125	GRANITE TRANSITION CURB FOR WHEELCHAIR RAMPS - CURVED  AT _____ PER FOOT		
514.	35	GRANITE CURB INLET - STRAIGHT  AT _____ EACH		
515.	1	GRANITE CURB INLET - CURVED  AT _____ EACH		
516.	20	GRANITE CURB CORNER TYPE A  AT _____ EACH		
580.	2,000	CURB REMOVED AND RESET  AT _____ PER FOOT		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
583.	25	EDGING REMOVED AND RESET  AT _____ PER FOOT		
594.	600	CURB REMOVED AND DISCARDED  AT _____ PER FOOT		
620.12	675	GUARDRAIL, TL-2 (SINGLE FACED)  AT _____ PER FOOT		
620.131	180	GUARDRAIL, DEEP POST (SINGLE FACED)  AT _____ PER FOOT		
620.32	20	GUARDRAIL - CURVED, TL-2 (SINGLE FACED)  AT _____ PER FOOT		
627.1	3	TRAILING ANCHORAGE  AT _____ EACH		
627.82	1	GUARDRAIL TANGENT END TREATMENT, TL-2  AT _____ EACH		
628.314	2	TEMPORARY IMPACT ATTENUATOR, REDIRECTIVE, TL-2  AT _____ EACH		
628.4	2	TEMPORARY IMPACT ATTENUATOR, REMOVED AND RESET  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
630.2	225	HIGHWAY GUARD REMOVED AND DISCARDED  AT _____ PER FOOT		
670.	60	FENCE REMOVED AND RESET  AT _____ PER FOOT		
685.1	2	STONE MASONRY WALL, DRY  AT _____ PER CUBIC YARD		
691.	265	BALANCE STONE WALL REMOVED AND REBUILT  AT _____ PER FOOT		
691.1	1,100	BALANCE STONE WALL REMOVED AND STACKED  AT _____ PER FOOT		
693.1	35	GRANITE WALL REMOVE AND RESET  AT _____ PER FOOT		
697.1	79	SILT SACK  AT _____ EACH		
698.3	725	GEOTEXTILE FABRIC FOR SEPARATION  AT _____ PER SQUARE YARD		
701.	750	CEMENT CONCRETE SIDEWALK  AT _____ PER SQUARE YARD		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
701.1	80	CEMENT CONCRETE SIDEWALK AT DRIVEWAYS  AT _____ PER SQUARE YARD		
701.2	150	CEMENT CONCRETE WHEELCHAIR RAMP  AT _____ PER SQUARE YARD		
702.	825	HOT MIX ASPHALT WALK SURFACE  AT _____ PER TON		
703.3	5	CONCRETE BLOCK REMOVED AND STACKED  AT _____ EACH		
703.4	4	CONCRETE POST REMOVED AND STACKED  AT _____ EACH		
706.	5	BRICK WALK  AT _____ PER SQUARE YARD		
706.1	20	BRICK WALK REMOVED AND RELAID  AT _____ PER SQUARE YARD		
706.41	1	GRANITE STEPS LOCATION NO. 1  AT _____ LUMP SUM		
706.42	1	GRANITE STEPS LOCATION NO. 2  AT _____ LUMP SUM		



Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
706.43	1	GRANITE STEPS LOCATION NO. 3  AT _____ LUMP SUM		
706.45	1	GRANITE STEPS REMOVED AND RESET  AT _____ LUMP SUM		
706.61	1	GRANITE THRESHOLD REMOVED AND STACKED  AT _____ LUMP SUM		
706.7	100	COBBLESTONE PAVERS  AT _____ PER SQUARE YARD		
706.71	130	COBBLESTONE EDGING REMOVED AND RESET  AT _____ PER FOOT		
706.72	5	COBBLESTONE WALK REMOVED AND RESET  AT _____ PER SQUARE YARD		
706.73	5	COBBLESTONES REMOVED AND STACKED  AT _____ PER SQUARE YARD		
710.3	13	BOUND - LETTERED GRANITE  AT _____ EACH		
710.4	5	BOUND - PLAIN GRANITE  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
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ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
711.	2	BOUND REMOVED AND RESET  AT _____ EACH		
712.	1	BOUND REMOVED AND STACKED  AT _____ EACH		
715.	41	RURAL MAIL BOX REMOVED AND RESET  AT _____ EACH		
740.	33	ENGINEERS FIELD OFFICE AND EQUIPMENT (TYPE A)  AT _____ PER MONTH		
748.	1	MOBILIZATION  AT _____ LUMP SUM		
751.	600	LOAM BORROW  AT _____ PER CUBIC YARD		
751.1	525	LOAM FOR LAWNS  AT _____ PER CUBIC YARD		
751.765	30	COMPOST AND SEED OVER MODIFIED ROCK  AT _____ PER CUBIC YARD		
756.	1	NPDES STORMWATER POLLUTION PREVENTION PLAN  AT _____ LUMP SUM		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
760.	225	IMPERVIOUS SOIL BORROW  AT _____ PER CUBIC YARD		
765.	7,700	SEEDING  AT _____ PER SQUARE YARD		
765.21	40	ANNUAL COVER CROP FOR NATIVE SEEDING  AT _____ PER POUND		
765.415	20	NATIVE SHORT GRASSLAND MIX  AT _____ PER POUND		
765.553	15	WETLAND - RIPARIAN MIX  AT _____ PER POUND		
765.635	4,650	NATIVE SEEDING AND ESTABLISHMENT  AT _____ PER SQUARE YARD		
767.121	1,050	SEDIMENT CONTROL BARRIER  AT _____ PER FOOT		
767.6	60	AGED PINE BARK MULCH  AT _____ PER CUBIC YARD		
767.9	3,000	JUTE MESH  AT _____ PER SQUARE YARD		

Project # 609035		Contract # 126590		
Location : WESTFORD				
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ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
769.	750	PAVEMENT MILLING MULCH UNDER GUARD RAIL  AT _____ PER FOOT		
771.11	1	IRRIGATION SYSTEM REPAIR LOCATION NO. 1  AT _____ LUMP SUM		
771.12	1	IRRIGATION SYSTEM REPAIR LOCATION NO. 2  AT _____ LUMP SUM		
771.13	1	IRRIGATION SYSTEM REPAIR LOCATION NO. 3  AT _____ LUMP SUM		
773.438	1	PINE - WHITE 7-8 FEET  AT _____ EACH		
776.557	1	MAPLE - RED - RED SUNSET 2-2.5 INCH CALIPER  AT _____ EACH		
778.363	3	CHERRY - MT. FUJI 1.5-2 INCH CALIPER  AT _____ EACH		
778.393	1	CHERRY - YOSHINO 1.5-2 INCH CALIPER  AT _____ EACH		
778.423	2	CRABAPPLE - DONALD WYMAN 1.5-2 INCH CALIPER  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
778.436	1	CRABAPPLE - PRAIRIFIRE 1.5-2 INCH CALIPER  AT _____ EACH		
781.263	1	HAWTHORN - WINTER KING 1.5-2 INCH CALIPER  AT _____ EACH		
782.536	3	REDBUD - EASTERN 7-8 FEET  AT _____ EACH		
783.044	1	SERVICEBERRY - AUTUMN BRILLIANCE 7-8 FEET  AT _____ EACH		
784.101	10	TREES -STREET CONTINGENCY 2-2.5 INCH CAL.  AT _____ EACH		
788.265	3	AZALEA - SWAMP 2-3 FEET / #5  AT _____ EACH		
804.3	450	3 INCH ELECTRICAL CONDUIT TYPE NM - PLASTIC -(UL)  AT _____ PER FOOT		
811.22	1	ELECTRIC HANDHOLE - SD2.022  AT _____ EACH		
811.31	5	PULL BOX 12 X 12 INCHES - SD2.031  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
811.35	3	PULL BOX ADJUSTED  AT _____ EACH		
811.351	2	PULL BOX REMOVED AND STACKED  AT _____ EACH		
813.811	1	ELECTRIC SERVICE RISER RELOCATION  AT _____ LUMP SUM		
813.812	1	TEMPORARY SERVICE STANCHION RELOCATION  AT _____ LUMP SUM		
813.91	1	SOLAR PANEL AND TRANSMITTER RELOCATION LOCATION NO. 1  AT _____ LUMP SUM		
816.01	1	TRAFFIC SIGNAL RECONSTRUCTION LOCATION NO. 1  AT _____ LUMP SUM		
816.02	1	TRAFFIC SIGNAL RECONSTRUCTION LOCATION NO. 2  AT _____ LUMP SUM		
816.81	1	TEMPORARY TRAFFIC CONTROL SIGNAL  AT _____ LUMP SUM		
816.811	14	TEMPORARY MODIFICATIONS TO TRAFFIC SIGNALS  AT _____ PER DAY		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
816.82	1	TEMPORARY TRAFFIC CONTROL SIGNAL LOCATION NO. 2  AT _____ LUMP SUM		
823.72	8	HIGHWAY LIGHTING ARM AND LUMINAIRE REMOVED AND RESET  AT _____ EACH		
824.501	1	LED EMERGENCY VEHICLE SIGN REMOVED AND RESET  AT _____ LUMP SUM		
824.62	3	RADAR FEEDBACK SIGN ASSEMBLY  AT _____ EACH		
824.621	1	RADAR FEEDBACK SIGN REMOVED AND RESET  AT _____ LUMP SUM		
829.	7	ROADSIDE GUIDE SIGN (G) - ALUMINUM PANEL (TYPE B)  AT _____ PER SQUARE FOOT		
832.	325	WARNING-REGULATORY AND ROUTE MARKER - ALUMINUM PANEL (TYPE A)  AT _____ PER SQUARE FOOT		
841.81	2	SUPPORTS FOR GUIDE SIGN (D1-3) S5X10 STEEL  AT _____ EACH		
847.1	23	SIGN SUP (N/GUIDE)+RTE MKR W/1 BRKWAY POST ASSEMBLY - STEEL  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
848.1	6	SIGN SUP (N/GUIDE)+RTE MKR W/2 BRKWAY POST ASSEMBLIES-STEEL  AT _____ EACH		
849.1	21	HISTORIC DISTRICT SIGN POST  AT _____ EACH		
852.	1,050	SAFETY SIGNING FOR TRAFFIC MANAGEMENT  AT _____ PER SQUARE FOOT		
852.11	100	TEMPORARY PEDESTRIAN BARRICADE  AT _____ PER FOOT		
852.12	2	TEMPORARY PEDESTRIAN CURB RAMP  AT _____ EACH		
853.1	4	PORTABLE BREAKAWAY BARRICADE TYPE III  AT _____ EACH		
853.2	650	TEMPORARY BARRIER (TL-2)  AT _____ PER FOOT		
853.21	300	TEMPORARY BARRIER REMOVED AND RESET  AT _____ PER FOOT		
853.8	10	TEMPORARY ILLUMINATION FOR WORK ZONE  AT _____ PER DAY		



Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
854.016	55,000	TEMPORARY PAVING MARKINGS - 6 INCH (PAINTED)  AT _____ PER FOOT		
854.036	4,000	TEMPORARY PAVING MARKINGS - 6 INCH (TAPE)  AT _____ PER FOOT		
856.	850	ARROW BOARD  AT _____ PER DAY		
856.12	2,200	PORTABLE CHANGEABLE MESSAGE SIGN  AT _____ PER DAY		
859.	80,000	REFLECTORIZED DRUM  AT _____ PER DAY		
864.04	325	PAVEMENT ARROWS AND LEGENDS REFLECTORIZED WHITE (THERMOPLASTIC)  AT _____ PER SQUARE FOOT		
864.12	200	RECESSED CONTRAST ROUTE SHIELD (PREFORMED)  AT _____ PER SQUARE FOOT		
864.221	38	SYMBOLS FOR BIKE FACILITIES (PF)  AT _____ EACH		
864.231	35	ARROWS FOR BIKE FACILITIES (PF)  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
864.33	4	SLOTTED PAVEMENT MARKER TWO-WAY WHITE/RED  AT _____ EACH		
864.34	4	SLOTTED PAVEMENT MARKER TWO-WAY YELLOW/RED  AT _____ EACH		
864.41	800	GREEN COLORIZED PAVEMENT MARKINGS  AT _____ PER SQUARE FOOT		
868.106	13,500	6 INCH REFLECTIVE RECESSED WHITE LINE (THERMOPLASTIC)  AT _____ PER FOOT		
868.112	2,000	12 INCH REFLECTIVE RECESSED WHITE LINE (THERMOPLASTIC)  AT _____ PER FOOT		
869.106	13,000	6 INCH REFLECTIVE RECESSED YELLOW LINE (THERMOPLASTIC)  AT _____ PER FOOT		
869.112	200	12 INCH REFLECTIVE RECESSED YELLOW LINE (THERMOPLASTIC)  AT _____ PER FOOT		
874.	6	STREET NAME SIGN  AT _____ EACH		
874.2	22	TRAFFIC SIGN REMOVED AND RESET  AT _____ EACH		

Project # 609035		Contract # 126590		
Location : WESTFORD				
Description : Rehabilitation of Boston Road				
ITEM #	QUANTITY	ITEM WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE	AMOUNT
874.21	1	MUSEUM SIGN REMOVED AND RESET  AT _____ LUMP SUM		
874.22	1	TRAIL SIGN REMOVED AND RESET  AT _____ LUMP SUM		
874.41	26	TRAFFIC SIGN REMOVED AND DISCARDED  AT _____ EACH		
901.	5	4000 PSI, 1.5 INCH, 565 CEMENT CONCRETE  AT _____ PER CUBIC YARD		
902.	1	3500 PSI, 1.5 INCH, 520 CEMENT CONCRETE  AT _____ PER CUBIC YARD		
903.	15	3000 PSI, 1.5 INCH, 470 CEMENT CONCRETE  AT _____ PER CUBIC YARD		
983.1	360	RIPRAP  AT _____ PER TON		
986.	350	MODIFIED ROCKFILL  AT _____ PER TON		
988.01	950	SEDIMENT FOREBAY PAVING  AT _____ PER SQUARE FOOT		

<b>Project # 609035</b>		<b>Contract # 126590</b>		
<b>Location : WESTFORD</b>				
<b>Description : Rehabilitation of Boston Road</b>				
<b>ITEM #</b>	<b>QUANTITY</b>	<b>ITEM WITH UNIT BID PRICE WRITTEN IN WORDS</b>	<b>UNIT PRICE</b>	<b>AMOUNT</b>
992.33	20	COORDINATION OF TEMPORARY SUPPORT FOR UTILITY POLES  AT _____ EACH		
<b>Total Qty:</b>		424,357		

DOCUMENT B00853

SCHEDULE OF PARTICIPATION BY DISADVANTAGED BUSINESS ENTERPRISES (DBES)

PRIME BIDDER: \_\_\_\_\_

DATE OF BID OPENING: \_\_\_\_\_ PROJECT NO.: 609035

FEDERAL AID PROJECT NO. STP/CMO/TAP-0033(038)X

PROJECT LOCATION: WESTFORD

Name, Address, and Phone Number(s) of DBE	Name of Activity	(a)† DBE Contractor Activity Amount <i>Construction Work</i>	(b) DBE Other Business Amount <i>Services, Supplies, Material</i>	(c) Total amount eligible for credit under rules in Section 6 of Document 00719 - DBE Special Provisions
Total Bid Amount	TOTALS:	\$	\$	\$
\$	DBE Percentage of Total Bid:	%	%	%

†Column (a) must be at least one-half of the DBE participation goal. Attach additional sheets as necessary.

Is MassDOT Document B00855 (Joint Check Approval) being submitted for any of the above?  Yes  No  
 Not Known at This Time

Will any of the contractors listed above be using a third party (i.e. manufacturer) to deliver materials or perform any portion of work by a third party?  Yes  No

**CERTIFICATION:** I HEREBY DECLARE, TO THE BEST OF MY KNOWLEDGE, THAT I HAVE READ THE SPECIAL PROVISIONS FOR PARTICIPATION BY DISADVANTAGED BUSINESS ENTERPRISES - DOCUMENT 00719. BOTH THIS SCHEDULE AND THE RELEVANT AND ACCOMPANYING LETTER(S) OF INTENT ARE IN FULL COMPLIANCE WITH THE PROVISIONS OF, AND IN ACCORDANCE WITH, TITLE 49 CODE OF FEDERAL REGULATIONS, PART 26 (49 CFR Part 26).

SIGNATURE: \_\_\_\_\_ DATE \_\_\_\_\_

NAME AND TITLE (PRINT): \_\_\_\_\_

EMAIL ADDRESS: \_\_\_\_\_ TEL NO.: \_\_\_\_\_

\*\*\* END OF DOCUMENT \*\*\*

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DOCUMENT B00854

DISADVANTAGED BUSINESS ENTERPRISES (DBE) PARTICIPATION  
LETTER OF INTENT

(To be completed by the DBE – Page 1 of 2)

TO: \_\_\_\_\_ (Prime Bidder)

FROM: \_\_\_\_\_ (DBE Firm)

RE: PROJECT NO.: 609035 FEDERAL AID PROJECT NO.: STP/CMQ/TAP-0033(038)X

PROJECT LOCATION: WESTFORD

DATE OF BID OPENING: \_\_\_\_\_

I, \_\_\_\_\_, authorized signatory of the above-referenced DBE firm hereby declare:  
*Print Name*

1. My company is currently certified as a Disadvantaged Business Enterprise (DBE) by the Massachusetts Supplier Diversity Office (“SDO”), formerly known as the State Office of Minority and Women Business Assistance (SOMWBA), as a: (check all applicable, see Section 1 of the Special Provisions For Participation By Disadvantaged Business Enterprises, MassDOT Document 00719 additional guidance is available at Title 49, Code of Federal Regulations, Part 26.55 (49 CFR Part 26.55)):

- CONTRACTOR       REGULAR DEALER       BROKER
- MANUFACTURER       TRUCKING OPERATIONS       PROFESSIONAL SERVICES

2. My firm has the ability to manage, supervise and perform the activity described on page 2 of this Letter of Intent. If you are awarded the contract, my company intends to enter into a contract with your firm to perform the items of work or other activity described on the following sheet for the prices indicated.

3. There have been no changes affecting the ownership, control or independence of my company since my last certification review on \_\_\_\_\_, 20\_\_\_. If any such change is planned or occurs prior to my company's completion of this proposed work, I will give prior written notification to your firm and to the Massachusetts Department of Transportation (“MassDOT”) Office of Civil Rights and SDO.

4. I have read the MassDOT proposal for the Project which may be entitled “Project Contract Documents and Special Provisions” or the draft “Contract” which includes MassDOT Document 00719, and acknowledge that my company will comply with that document and the requirements of 49 CFR Part 26.

5. For the purpose of obtaining subcontractor approval from MassDOT, my firm will provide to you:

**A. The following construction work:**

- (i) a resume, stating the qualifications and experience, of the superintendent or foreperson who will supervise on site-work;
- (ii) a list of equipment owned or leased by my firm for use on this project; and
- (iii) a list of all projects (public or private) upon which my firm is currently performing, is committed to perform, or intends to make a commitment to perform. I shall also include, for each project: the name and telephone number of a contact person for the contracting authority, person, or organization; the dollar value of the work; a description of the work; and my firm's work schedule for the project.

**B. The following services, materials or supplies:**

- (i) a written agreement and invoices for the materials or supplies, and any other documents evidencing the terms of providing such items;
- (ii) information concerning brokers fees and commissions for providing services or materials; and
- (iii) a statement concerning whether my firm intends or will be required to use a joint check arrangement; and any other documents that may be required by MassDOT.

\_\_\_\_\_  
*DBE Company Authorized Signature*

Date \_\_\_\_\_

DISADVANTAGED BUSINESS ENTERPRISES (DBE) PARTICIPATION  
LETTER OF INTENT  
(To be completed by the DBE – Page 2 of 2)

DATE OF BID OPENING: \_\_\_\_\_

PROJECT NUMBER: 609035

FEDERAL AID PROJECT NUMBER: STP/CMO/TAP-0033(038)X

PROJECT LOCATION: Westford

PRIME BIDDER: \_\_\_\_\_

DBE COMPANY NAME: \_\_\_\_\_

<u>Item number</u> if applicable	<u>NAICS</u> <u>Code</u>	<u>Description of Activity</u> with notations such as Services, or Brokerage, Installation Only, Material Only, or Complete	<u>Quantity</u>	<u>Unit Price</u>	<u>Amount</u>
TOTAL AMOUNT:					

*Please give full explanations, attach additional sheets if necessary.*

I HEREBY VERIFY THAT \_\_\_\_\_ WILL SOLELY  
(DBE company name)  
PERFORM THE WORK, OR PROVIDE THE SERVICES OR MATERIALS, AS DESCRIBED ABOVE.

DBE AUTHORIZED SIGNATURE: \_\_\_\_\_

NAME AND TITLE (PRINT): \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_ FAX NUMBER: \_\_\_\_\_

EMAIL ADDRESS: \_\_\_\_\_

\*\*\* END OF DOCUMENT \*\*\*

*Rev'd 9/20/19*



DOCUMENT B00855

DBE JOINT CHECK ARRANGEMENT APPROVAL FORM

(to be submitted by Prime Contractor)

Contract No: 126590 Project No. 609035 Federal Aid No.: STP/CMQ/TAP-0033(038)X

Location: WESTFORD Bid Opening Date:

Project Description: Rehabilitation of Westford Road

We have received the attached request for the use of a joint check arrangement from \_\_\_\_\_, a DBE on the above- referenced Contract and \_\_\_\_\_, a Material Supplier/Vendor for the subject Contract. The DBE has complied with the requirements of 49 CFR Part 26.55(c)(1). In particular, the DBE has:

- a written agreement with the material supplier/vendor;
• applied for credit with the subject material supplier and has supplied the vendor's response;
• shown that it will place all orders to the subject material supplier/vendor;
• made and retains all decision-making responsibilities concerning the materials; and
• provided a Joint Check Agreement that is acceptable to MassDOT;

As the Contractor for the Project, we agree to issue joint checks (made payable to the Material Supplier/Vendor and the DBE) for payment of sums due pursuant to invoices from the Supplier/Vendor and DBE.

Contractor:

Company Name Signature Duly Authorized
Printed Name
Date Title

SubContractor:

Company Name Signature - Duly Authorized
Printed Name
Date Title

\*\*\* END OF DOCUMENT \*\*\*

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DOCUMENT B00856

JOINT VENTURE AFFIDAVIT  
(All Firms)

- All Information Requested By This Schedule Must Be Answered. Additional Sheets May Be Attached.
- If, there is any change in the information submitted, the Joint Venture parties must inform MassDOT Pre-Qualifications Office (and, if one of the companies is a DBE, the Director of Contract Compliance, Office of Civil Rights) *prior* to such change, in writing, either directly or through the Prime Contractor if the Joint Venture is a subcontractor.
- If the Joint Venture Entity will be the bidder on a prime Contract, it must bid and submit all required documents (insurance, worker’s compensation, bonds, etc.) in the name of the Joint Venture Entity.

**I. Name of Joint Venture:** \_\_\_\_\_  
 Type of Entity if applicable (Corp., LLC): \_\_\_\_\_ Filing State \_\_\_\_\_  
 Address of joint venture: \_\_\_\_\_  
 \_\_\_\_\_  
 Phone No(s) for JV Entity: \_\_\_\_\_ E-mail: \_\_\_\_\_  
 Contact Person(s) \_\_\_\_\_  
 Tax ID/EIN of Joint Venture: \_\_\_\_\_ Vendor Code: \_\_\_\_\_

**II. Identify each firm or party to the Joint Venture:**  
 Name of Firm: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Phone : \_\_\_\_\_ E-mail: \_\_\_\_\_  
 Contact person(s) \_\_\_\_\_  
 Name of Firm: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Phone: \_\_\_\_\_ E-mail: \_\_\_\_\_  
 Contact Person(s) \_\_\_\_\_

**III. Describe the role(s) of the each party to the Joint Venture:**  
 \_\_\_\_\_  
 \_\_\_\_\_

**IV. Attach a copy of the Joint Venture Agreement.** The proposed Joint Venture Agreement should include specific details including, but not limited to: (1) the contributions of capital and equipment; (2) work items to be performed by each company’s forces, (3) work items to be performed under the supervision of any DBE Venturer; (4) the commitment of management, supervisory and operative personnel employed by the DBE to be dedicated to the performance of the Project; and (5) warranty, guaranty, and indemnification clauses.

**V. Attach any applicable Corporate or LLC Votes, Authorizations, etc.**

**VI. Ownership of the Joint Venture:**

A. What is the percentage(s) of each company’s ownership in the Joint Venture?

ownership percentage(s): \_\_\_\_\_

ownership percentage(s): \_\_\_\_\_

B. Specify percentages for each of the following (provide narrative descriptions and other detail as applicable):

1. Sharing of profit and loss: \_\_\_\_\_

2. Capital contributions:

(a) Dollar amounts of initial contribution: \_\_\_\_\_

(b) Dollar amounts of anticipated on-going contributions: \_\_\_\_\_

(c) Contributions of equipment (specify types, quality and quantities of equipment to be provided by each firm): \_\_\_\_\_

4. Other applicable ownership interests, including ownership options or other agreements, which restrict or limit ownership and/or control:

\_\_\_\_\_  
\_\_\_\_\_

5. Provide copies of all other written agreements between firms concerning bidding and operation of this Project or projects or contracts.

6. Identify all current contracts and contracts completed during the past two (2) years by either of the Joint Venture partners to this Joint Venture:

\_\_\_\_\_  
\_\_\_\_\_

**VII. Control of and Participation in the Joint Venture.** Identify by name and firm those individuals who are, or will be, responsible for and have the authority to engage in the following management functions and policy decisions. (Indicate any limitations to their authority such as dollar limits and co-signatory requirements.):

A. Joint Venture check signing:

\_\_\_\_\_  
\_\_\_\_\_

B. Authority to enter Contracts on behalf of the Joint Venture:

\_\_\_\_\_  
\_\_\_\_\_

C. Signing, co-signing and/or collateralizing loans:

\_\_\_\_\_  
\_\_\_\_\_

D. Acquisition of lines of credit:

\_\_\_\_\_

\_\_\_\_\_

E. Acquisition and indemnification of payment and performance bonds:

\_\_\_\_\_

\_\_\_\_\_

F. Negotiating and signing labor agreements:

\_\_\_\_\_

\_\_\_\_\_

G. Management of contract performance. *(Identify by name and firm only):*

1. Supervision of field operations: \_\_\_\_\_
2. Major purchases: \_\_\_\_\_
3. Estimating: \_\_\_\_\_
4. Engineering: \_\_\_\_\_

**VIII. Financial Controls of Joint Venture:**

A. Which firm and/or individual will be responsible for keeping the books of account?

\_\_\_\_\_

\_\_\_\_\_

B. Identify the "Managing Partner," if any, and describe the means and measure of their compensation:

\_\_\_\_\_

\_\_\_\_\_

C. What authority does each firm have to commit or obligate the other to insurance and bonding companies, financing institutions, suppliers, subcontractors, and/or other parties participating in the performance of this Contract or the work of this Project?

\_\_\_\_\_

**IX. Personnel of Joint Venture:** State the approximate number of personnel (by trade) needed to perform the Joint Venture's work under this Contract. Indicate whether they will be employees of the majority firm, DBE firm, or the Joint Venture.

	Firm 1 (number)	Firm 2 (number)	Joint Venture (number)
Trade			
Professional			
Administrative/Clerical			
Unskilled Labor			

Will any personnel proposed for this Project be employees of the Joint Venture?: \_\_\_\_\_

If so, who: \_\_\_\_\_

A. Are any proposed Joint Venture employees currently employed by either firm?

Employed by Firm 1: \_\_\_\_\_ Employed by firm 2 \_\_\_\_\_

B. Identify by name and firm the individual who will be responsible for Joint Venture hiring: \_\_\_\_\_

\_\_\_\_\_

**X. Additional Information.** Please state any material facts and additional information pertinent to the control and structure of this Joint Venture.

\_\_\_\_\_  
\_\_\_\_\_

**XI. AFFIDAVIT OF JOINT VENTURE PARTIES.** The undersigned affirm that the foregoing statements and attached documents are correct and include all material information necessary to identify and explain the terms and operations of our Joint Venture and the intended participation of each firm in the undertaking. Further, the undersigned covenant and agree to provide to MassDOT current, complete and accurate information regarding actual Joint Venture work, payments, and any proposed changes to any provisions of the Joint Venture, or the nature, character of each party to the Joint Venture. We understand that any material misrepresentation will be grounds for terminating any Contract awarded and for initiating action under Federal or State laws concerning false statements.

\_\_\_\_\_  
Firm 1

\_\_\_\_\_  
Firm 2

\_\_\_\_\_  
Signature  
Duly Authorized

\_\_\_\_\_  
Signature  
Duly Authorized

\_\_\_\_\_  
Printed Name and Title

\_\_\_\_\_  
Printed Name and Title

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\*\*\* END OF DOCUMENT \*\*\*