

Haverhill, Massachusetts

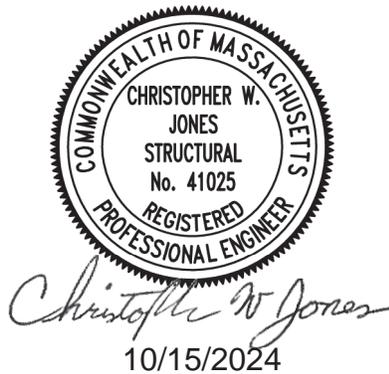
# Rosemont Street Bridge Replacement

Contract # IFB006.25

October 2024

**Bidding Requirements, Bond Forms, Contract Agreement,  
Conditions of the Contract and Technical Specifications**

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Professional Registration No.: 41025



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Norwood, Massachusetts 02062  
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[www.BETA-Inc.com](http://www.BETA-Inc.com)

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- B. Army Corps of Engineers Permit
- C. Geotechnical Report

**END OF SECTION**

## SECTION 00100

### NOTICE TO BIDDERS

City of Haverhill, Massachusetts

Rosemont Street Bridge Replacement

CONTRACT NO. IFB006.25

The City of Haverhill, Massachusetts, acting through its Purchasing Department, invites sealed bids for "City of Haverhill, MA, Rosemont Street Bridge over Little River, Bridge No. H-12-024 (CFF), Contract No. IFB006.25", in accordance with the Contract Documents prepared by BETA GROUP, INC., Consulting Engineers, 315 Norwood Park South, Norwood, Massachusetts, 02062.

Proposals may be submitted electronically at [www.Projectdog.com](http://www.Projectdog.com) until 10:00 AM Eastern Standard Time on November 6, 2024, at which time said proposals will be publicly opened.

The location, general characteristics, and principal details of the Work are indicated in a set of drawings, entitled " City of Haverhill, MA, Rosemont Street Bridge over Little River, Bridge No. H-12-024 (CFF), Contract No. IFB006.25 ".

The work in this Contract consists of furnishing all necessary labor, materials, and equipment for the replacement of the Rosemont Street Bridge over Little River. The work includes: Installing temporary cofferdams; installation of a temporary utility bridge; sewer bypass pumping; clearing and grubbing; removal of existing bridge; installing drilled micropiles; ledge excavation, tremie installation, installing new bridge; streambed restoration; providing slope protection; restoration of wetlands; drainage improvements; removing and replacing guardrail; milling and resurfacing roadway; pavement markings; signing; and the provision of safety controls and signing for construction operations and other incidental items included in the contract documents necessary to complete the Project.

To bid on this project, Contractors must be prequalified in accordance with 720 CMR 5.00, *Prequalification of Contractors* by MassDOT in the category of Bridge Construction with an estimated value of \$3,656,038.00.

Bid Security: Certified, treasurer's or cashier's check or bid bond in the sum of five (5) percent of the Total Bid is required.

This project is being Electronically Bid (E-Bid). All bids shall be submitted online at [www.Projectdog.com](http://www.Projectdog.com). Hard copy bids will not be accepted the Awarding Authority. Tutorials and Instructions are available online at [www.Projectdog.com](http://www.Projectdog.com). For assistance, contact Projectdog Inc. at 978.499.9014.

Bid Forms and Contract Documents shall be available online at [www.Projectdog.com](http://www.Projectdog.com) beginning on October 16, 2024. Log in and enter the Project Code **864455** in the search box and select "Acquire Documents" for a free, downloadable bid set. Hard copies of the documents may be purchased online. A free CD-ROM may be requested by contacting Projectdog – shipping & handling charges apply.

Neither Owner nor Architect/Engineer shall be responsible for full or partial sets of Bidding Documents, including Addenda if any, obtained from sources other than Projectdog Inc.

Addenda, if issued, will be posted to the Projectdog website and shall be accompanied by e-mail notification to every individual or firm on record as having received the Bid Documents. It shall be the sole responsibility of the Contractor to ascertain the existence of any and all addenda. Hard copies of addenda will not be mailed or faxed.

A pre-bid meeting will be held at the project site on October 23, 2024 at 11:00 AM. Approximate address is 143 Rosemont Street, Haverhill, MA. Attendance is strongly advised.

Direct all inquiries to Christopher W. Jones, P.E, BETA Group, Inc., 315 Norwood Park South, Norwood, Massachusetts, 02062. Email: [cjones@beta-inc.com](mailto:cjones@beta-inc.com)

All Bids for this project are subject to applicable bidding laws of Massachusetts, including General Laws Chapter 30, Section 39M as amended.

Attention of bidders is particularly called to the requirements as to conditions of employment to be observed and minimum wage rates to be paid under this Contract as determined by the Department of Labor and Industries under provisions of the Massachusetts General Laws Chapter 149, Section 26-27, inclusive, as amended.

No Bidder may withdraw his bid within Ninety (90) days after the actual date of the opening thereof.

The successful Bidder must furnish 100 percent Performance and Labor and Materials Bonds.

The Owner, being considered the sole and only judge, reserves the right to waive any informality in, or to reject, any or all bids, should the Owner deem it to be in the owner's best interest to do so.

City of Haverhill, Massachusetts,

Purchasing Department

**END OF SECTION**

## SECTION 00200

### INFORMATION FOR BIDDERS

- 1.01 Receipt and Opening of Bids
- 1.02 Location and Work to be Done
- 1.03 Contract Documents
- 1.04 Payments for Drawings and Documents
- 1.05 Questions Regarding Drawings and Documents
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- 1.07 Bidders to Investigate
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- 1.27 State Sales and Use Tax
- 1.28 Manufacturer's Experience
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- 1.33 Reserved
- 1.34 Materials Price Adjustment
- 1.35 Massachusetts Wage Rates

#### 1.01 RECEIPT AND OPENING OF BIDS

- A. The City of Haverhill, Massachusetts, acting through its Purchasing Department, invites sealed bids for "City of Haverhill, MA, Rosemont Street Bridge over Little River, Bridge No. H-12-024 (CFF), Contract No. IFB006.25", in accordance with the Contract Documents prepared by BETA GROUP, INC., Consulting Engineers, 315 Norwood Park South, Norwood, Massachusetts, 02062.

- B. Bid Forms will be posted online at [www.Projectdog.com](http://www.Projectdog.com). All required Bid Forms must be completed and submitted in unrestricted PDF formatted files. The Bidder must fill-in all required fields and signatures either digitally or manually (print, fill-in, and scan to PDF).
- C. The Bidder shall access the Projectdog.com E-Bidding System by entering the Project Code **864455** in the project locator box and then selecting “GC E-Bid” or “Sub E-Bid” from the project’s “Project Details” page. The Bidder must enter their bid price as a numeric, whole dollar value only with no punctuation. The E-Bidding system automatically translates the numeric value into words and displays the bid price in both figures and words on the submitted bid form.
- D. Bidders may upload (“Add File” or “Replace File”), review (“View File”), Save, submit (“Submit my E-Bid”), or retract (“Retract my E-Bid”) their E-Bid at any time prior to the designated deadline. The server clock is displayed on the project’s E-Bidding page and is the time of record. Bidders must select “Submit my E-Bid” prior to the designated deadline to officially submit their E-Bid online. Once submitted, an E-Bid cannot be edited. To modify a submitted E-Bid, Bidders must retract their submission, make and Save any changes, and then submit the updated E-Bid. Upon submitting or retracting their E-Bid, Bidders will receive a convenience e-mail for informational purposes only. Bidders are encouraged to contact Projectdog if the email is not received.
- E. Bidders are strongly encouraged to review their submitted E-Bid package by selecting “View My Bid Package” from the project’s E-Bidding page. Uploaded files may be reviewed individually by selecting “View File”. It is the Bidder’s responsibility to confirm online that their E-Bid package has been submitted successfully. Timely submission of an E-Bid shall be the full responsibility of the Bidder. It is also the Bidder’s responsibility to ensure that their submitted bid is 100% true, complete, and accurate.
- F. Addenda, if issued, will be posted to the Projectdog website and shall be accompanied by e-mail notification to every individual or firm on record as having received the Bid Documents. Hard copies of addenda will not be mailed or faxed. It shall be the sole responsibility of the Contractor to ascertain the existence of any and all addenda.
- G. If a bid is submitted prior to an Addendum being issued, the Bidder will receive an e-mail notification for informational purposes only. The Bidder must review the addendum, retract the bid, acknowledge all addenda, and re-submit the bid. If a Bidder fails to acknowledge all addenda their bid may be rejected by the Awarding Authority.
- H. Any bid may be withdrawn (retracted) prior to the designated deadline by selecting “Retract My E-Bid” from the project’s E-Bidding page. Upon retracting, the Bidder will receive a convenience e-mail for informational purposes only. It is the Bidder’s responsibility to review and confirm online that their bid has been retracted successfully.
- I. The Owner may consider informal, any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities in or reject any and all Bids. Conditional or qualified Bids will not be accepted. Any Bid received after the time and date specified shall not be considered. Should there be reasons why the Contract cannot be awarded within the specified period, the time may be extended by mutual agreement between the Owner and the Bidder.

- J. This project will be funded using federal assistance provided to the Owner by the US Department of Treasury under the American Rescue Plan Act (“ARPA Funds”). The supplement provided in 00650 is required to be completed and signed by the lowest apparent bidder as part of agreement execution.

#### 1.02 LOCATION AND WORK TO BE DONE

- A. The location, general characteristics, and principal details of the Work are indicated in a set of drawings, entitled " City of Haverhill, MA, Rosemont Street Bridge over Little River, Bridge No. H-12-024 (CFF), Contract No. IFB006.25 "
- B. Additional drawings showing details in accordance with which the Work is to be done will be furnished from time to time by the Engineer, if found necessary, and shall then become part of the Drawings.
- C. The Contractor shall furnish all labor, services, materials, equipment, plant machinery, apparatus, appliances, tools, supplies and all other things necessary to perform all work required for the completion of each item of the Work and as herein specified.
- D. The Work to be done and paid for under any item shall not be limited to the exact extent mentioned or described, but shall include all incidental work necessary or customarily done for the completion of that item.

#### 1.03 CONTRACT DOCUMENTS

- A. The Contract Documents, INFORMATION FOR BIDDERS, SPECIFICATIONS, and forms for BID, AGREEMENT, and BONDS may be downloaded free of charge at [www.projectdog.com](http://www.projectdog.com).

#### 1.04 PAYMENT FOR DRAWINGS AND DOCUMENTS

- A. Bid Documents are available online at [www.Projectdog.com](http://www.Projectdog.com). Enter the Project Code 864455 in the project locator box and select “Acquire Documents” to download documents. A free CD-ROM may be requested by contacting Projectdog – shipping & handling charges apply. All plan holders must have an active online account on [www.Projectdog.com](http://www.Projectdog.com) to acquire documents and to receive project notifications. Hard copies of the documents may also be viewed, but not removed, from the offices of Projectdog Inc., 18 Graf Road - Unit 8, Newburyport, MA 01950, Monday – Friday, 8:30 a.m. to 5:00 p.m.
- B. Addenda, if issued, will be posted to the Projectdog website and shall be accompanied by e-mail notification to every individual or firm on record as having received the Bid Documents. It shall be the sole responsibility of the Contractor to ascertain the existence of any and all addenda. Hard copies of addenda will not be mailed or faxed.

#### 1.05 QUESTIONS REGARDING DRAWINGS AND DOCUMENTS

- A. In general, no answer will be given to prospective bidders in reply to an oral question of the intent or meaning of the Drawings or other Contract Documents, or the equality or use of products or methods other than those designated or described on the Drawings or in the Specifications. Any information given to bidders other than by means of the Drawings and other Contract Documents, including Addenda, as described below, is given informally, for information and the convenience

of the bidder only and is not guaranteed. The bidder agrees that such information shall not be used as the basis of nor shall the giving of any such information entitle the bidder to assert any claim or demand against the Owner or the Engineer on account thereof.

- B. To receive consideration, such questions shall be submitted in writing by mail, email or fax to the Engineer (for this purpose, BETA Group, Inc., 315 Norwood Park South, Norwood, Massachusetts, 02062, Telephone No. (781) 255-1982, Fax No. (781) 255-1974, email [cjones@beta-inc.com](mailto:cjones@beta-inc.com) at least **seven calendar days** before the established date for receipt of Bids. If the question involves the equality or use of products or methods, it must be accompanied by drawings, specifications or other data in sufficient detail to enable the Engineer to determine the equality or suitability of the product or method. In general, the Engineer will neither approve nor disapprove particular products prior to the opening of Bids; such products will be considered when offered by the Contractor for incorporation into the Work.
- C. The Engineer will set forth as Addenda, which shall become a part of the Contract Documents, such questions received as above provided as in his sole judgment are appropriate or necessary and his decision regarding each. At least two (2) days prior to the receipt of Bids, he will send a copy of these Addenda to those prospective bidders known to have taken out sets of the Drawings and other Contract Documents.
- D. The Contractor agrees to use the products and methods designated or described in the Specifications as amended by the Addenda.

#### 1.06 PRE-BID CONFERENCE

- A. A pre-bid meeting will be held at the project site on October 23, 2024 at 11:00 AM. Approximate address is 143 Rosemont Street, Haverhill, MA. Attendance is strongly advised.

#### 1.07 BIDDERS TO INVESTIGATE

- A. Bidders are required to submit their Bids upon the following express conditions, which shall apply to and be deemed a part of every Bid received, viz.:
- B. Bidders must satisfy themselves by personal examination of the Work and by such other means as they may wish, as to the actual conditions there existing, the character and requirements of the Work and difficulties attendant upon its execution, and the accuracy of all estimated quantities stated in the Bid.

#### 1.08 INFORMATION NOT GUARANTEED

- A. All information given on the Drawings or in the other Contract Drawings relating to subsurface and other conditions, natural phenomena, existing pipes and other structures is from the best sources at present available to the Owner. All such information is furnished only for the information and convenience of bidders and is not guaranteed.
- B. It is agreed and understood that the Owner does not warrant or guarantee that the subsurface or other conditions, natural phenomena, existing pipes or other structures encountered during construction will be the same as those indicated on the Drawings or in the other Contract Documents.

- C. It is agreed further and understood that no bidder or Contractor shall use or be entitled to use any of the information made available to him or obtained in any examination made by him in any manner as a basis of or ground for any claim or demand against the Owner or the Engineer, arising from or by reason of any variance which may exist between the information made available and the actual subsurface or other conditions, natural phenomena, existing pipes or other structures actually encountered during the construction work, except as may otherwise be expressly provided for in the Contract Documents.

#### 1.09 CONDITIONS OF WORK

- A. Each bidder must inform himself fully of the conditions relating to the construction and labor under which the work is now or will be performed; failure to do so will not relieve the successful bidder of his obligation to furnish all materials and all labor necessary to carry out the provisions of the Contract Documents and to complete the contemplated Work for the consideration set forth in his bid. Insofar as possible, the Contractor, in the carrying out of his work, shall employ such methods or means as will not cause any interruption of or interference with: the operation of the existing sewer; traffic; use of existing facilities and utilities; locations of existing utilities and structures affecting the work or other similar conditions at the site; character of equipment and facilities needed preliminary to and during prosecution of the work; requirements of owners and controlling authorities, having jurisdiction over the various lands, existing structures, facilities, and utilities; and all other conditions affecting the work to be done, and the labor and materials needed; and he shall make his bid in sole reliance thereon; and shall not, at any time after submission of a bid, assert that there was any misunderstanding in regard to the nature or amount of the work to be done.

#### 1.10 BLANK FORM FOR BID

- A. Each bid must be submitted on the prescribed form, accompanied by the Bid Security and any other requested information. All blank spaces for bid prices must be filled in, in ink or typewritten, both in words and numerical figures, and be signed by the bidder with his business address and place of residence. Where both written words and numerical figures are given, the written words shall apply in the event of conflict. All bids shall be prepared in conformity with, and based upon and submitted subject to, all requirements of the Specifications and Drawings, together with all addenda thereto.
- B. Bidders shall remove and submit the Bid pages (section 00300) and Bid Bond pages (Section 00400) only. All pages shall be correctly assembled, and submitted in accordance with Section 00200. All erasures or other changes in the Bid must be properly initialed by an authorized representative of the Bidder.

#### 1.11 WITHDRAWAL OF BIDS

- A. Except as hereinafter in this subsection otherwise expressly provided, once his Bid is submitted and received by the Owner for consideration and comparison with other bids similarly submitted, the bidder agrees that he may not and will not withdraw it within Ninety (90) consecutive calendar days after the actual date of the opening of Bids.
- B. Upon proper written request and identification, Bids may be withdrawn only as follows:
  - 1. At any time prior to the designated time for the opening of Bids.
  - 2. Provided the Bid has not theretofore been accepted by the Owner, at any time subsequent to the expiration of the period during which the bidder has agreed not to withdraw his Bid.

- C. Unless a Bid is withdrawn as provided above, the bidder agrees that it shall be deemed open for acceptance until the AGREEMENT has been executed by both parties thereto or until the Owner notifies a bidder in writing that his Bid is rejected or that the Owner does not intend to accept it, or returns his Bid deposit. Notice of acceptance of a Bid shall not constitute rejection of any other Bid.

#### 1.12 BID SECURITY

- A. Bid Security shall be at least five percent (5%) of the greatest possible bid amount, considering all alternates. The Bid Security in the form of a Bid Bond shall be:
  - 1. with a surety company qualified to do business in the Commonwealth of Massachusetts and satisfactory to Owner;
  - 2. conditional upon the faithful performance by the principal of the agreements contained in the Bid; and
  - 3. submitted with your E-Bid online at [www.Projectdog.com](http://www.Projectdog.com).
- B. Bid Security in the form of cash, or a certified check, treasurer's or cashier's check issued by a responsible bank or trust company and made payable to the Owner must be submitted with a completed Cash Bid Bond Affidavit form and received by the Owner before the time of bidding. In addition, the Bidder must also submit a completed Cash Bid Bond Affidavit form with their E-Bid. Download the Cash Bid Bond Affidavit form at [www.Projectdog.com](http://www.Projectdog.com).
- C. Bid checks will be returned to all except the three lowest bidders within five days, Sundays and legal holidays excluded, after the opening of Bids, and to the three lowest bidders within five days, Sunday and legal holidays excluded, after the Owner and the accepted bidder have executed the AGREEMENT. In the event that the AGREEMENT has not been executed by both the accepted bidder and the Owner within 90 consecutive calendar days after the opening of Bids, the bid check will be returned promptly upon demand of any bidder who has not been notified of the acceptance of his Bid.
- D. Bid checks accompanying Bids, which are rejected, will be returned within five days, Sundays and legal holidays excluded, after rejection.
- E. None of the three lowest Bids shall be deemed rejected, notwithstanding acceptance of any Bid, until the AGREEMENT has been executed by both the Owner and the accepted bidder.

#### 1.13 INTERESTED PARTIES TO CONTRACT

- A. The undersigned declares; that the only person interested this Bid as principals are named herein as such; that no official of the Owner and no person acting for or employed by the Owner is interested directly or indirectly in this Bid, or in any contract which may be made under it, or in any expected profits to arise therefrom; that this Bid is made in good faith, without fraud, collusion or connection with any other person bidding or refraining from bidding for the same work; that he has examined carefully the said instructions and all other documents bound herewith and the Contract Drawings relating to the Contract covered by this Bid and hereby makes them part of this Bid; that he has informed himself fully in regard to all conditions pertaining to the work and place

where it is to be done; and that he has made his own examination and carefully checked his estimates for cost and from them makes this Bid.

#### 1.14 ABILITY AND EXPERIENCE OF BIDDER

- A. No award will be made to any bidder who cannot satisfy the Owner that he has sufficient ability and experience in this class of work and sufficient capital and plant to enable him to prosecute and complete the Work successfully within the time named. The Engineer and the Owner may make such investigation as they deem necessary to determine the ability of the bidder to perform the work; and the bidder shall furnish to the Engineer and the Owner all such information and data for this purpose as the Engineer and the Owner may request.
- B. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein within the time stated. The Owner's decision or judgment on these matters shall be final, conclusive, and binding for all parties involved.

#### 1.15 BIDS

- A. The Owner reserves the right to waive any informalities in, or to reject any or all Bids which in its sole judgment are either incomplete, conditional, obscure, or not responsive or which contain additions not called for, erasures not properly initialed, alternative, or similar irregularities, or the Owner may waive such omissions, conditions, or irregularities as he may feel appropriate.
- B. Conditional bids will not be accepted. Bidder(s) will be disqualified if more than one proposal is received from an individual, firm, partnership, corporation or association, under the same or different names and such proposals will not be considered.
- C. The Owner reserves the right to reject any or all Bids, should the Owner deem it to be in the public interest to do so.

#### 1.16 COMPARISON OF BID

- A. Bids will be compared on the basis of the experience and competence of the bidders and on the basis of the totals of the quantities listed in the proposal under the enumerated items at the unit prices or lump sums bid for these items. The Contract will be awarded to the lowest responsive, responsible and eligible bidder as determined by the Owner and/or its authorized representatives or agents. However, the Owner may reject any and all bids if it is in the public interest to do so.
- B. The term, "Lowest responsive, responsible and eligible bidder," shall mean the bidder whose bid is the lowest of those bidders possessing the skill, ability and integrity necessary for the faithful performance of the Work; who shall certify that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work.
- C. Bids should be made on each separate item of work shown in the bid (proposal) with reasonable relation to the probable cost of doing the work included in such items. The Owner reserves the right to reject, wholly, any bid on which an item or items thereof are obviously unbalanced or appear to the Owner to be so unbalanced as to affect or to be liable to affect adversely any interests of the Owner. The attention of the bidder is called to the fact that unbalancing of bids may adversely

affect the Contractor if certain portions for the Work are increased or decreased as provided in the Contract Documents.

- D. A bidder shall state the proposed price for the work by which the bids will be compared. This price is to cover all the expenses incidental to the completion of the work in full conformity with the Contract, Specifications, and Drawings. In the event that there is a discrepancy between the unit prices and the extended totals, the unit prices shall govern. In the event that there is a discrepancy between the lump-sum or unit prices written in words and numerical figures, the prices written in words shall govern. No bid will be accepted which does not contain a unit price or lump sum as indicated for each of the applicable items enumerated in the proposal form.

#### 1.17 ITEMS AND INDETERMINATE ITEMS

- A. The Work to be done under this Contract has been divided into parts or items to enable each bidder to bid on different portions of the work in accordance with his estimate of their cost and so that the actual quantity of work executed under each item may be paid for at the price bid for that particular item, even though such quantity is greater or less than the estimated quantity stated in the BID.
- B. The quantities listed in the bid (proposal) are approximate. The Owner does not expressly or by implication represent that the actual amounts of work will even approximately correspond therewith, but does call particular attention to the uncertainty in the quantities of the work involved which cannot be predicted in advance. The work under certain items may be materially greater or less than those given in the Bid as may be necessary in the judgment of the Owner complete the work contemplated in the Contract. Attention is particularly called to the fact that the quantity of work to be done under some bid items may be largely dependent on subsurface ground conditions encountered and, therefore, the quantities of work to be done under the various items may vary substantially from the estimated quantities or may even be omitted.
- C. Certain items in the BID cover classes of work of doubtful necessity or work for which it is impractical to estimate approximate quantities. Such items have been marked "Indeterminate". Prices for certain of such items have been stipulated in advance by the Owner as stated in the BID.
- D. Only such quantities of the respective items of work actually performed and accepted will be paid for. An increase or decrease in quantity for any item shall not be regarded as grounds for an increase or decrease in the bid prices.

#### 1.18 REDUCTION IN SCOPE OF WORK

- A. The Owner reserves the right to decrease the scope of the work to be done under this Contract and to omit any work in order to bring the cost within available funds. To this end, the Owner reserves the right to reduce the quantity of any items or omit all of any as set forth in the BID, either prior to executing the Contract or at any time during the progress of the Work. The Owner further reserves the right, at any time during the progress of the Work, to restore all or part of any items previously omitted or reduced. Exercise by the Owner of the above rights shall not constitute any ground or basis of claim for damages or for anticipated profits on the work omitted.

#### 1.19 CONTRACT BONDS

- A. The Bidder whose Bid is accepted agrees to furnish the Contract Bonds in the forms which follow in Section 00600, titled CONTRACT BONDS, each in the sum of the full amount of the Bid and/or

Contract Price as determined by the Engineer, and duly executed and acknowledged by the said bidder as Principal and by a surety company qualified to do business under the laws of Massachusetts and satisfactory to the Owner, as Surety, for the faithful performance of the contract and payment for labor and materials. The premiums for such Bonds shall be paid by the Contractor.

- B. Surety Companies executing the Contract Bonds must also appear on the U.S. Treasury Department's most current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (Amended) by the Audit Staff Bureau of Accounts.

#### 1.20 POWER OF ATTORNEY

- A. Attorneys-in-fact who sign Bid Bonds or Contract Bonds must file with each Bond a certified and effectively dated copy of their power of attorney.

#### 1.21 EXECUTION OF AGREEMENT

- A. The Bidder whose Bid is accepted will be required and agrees to duly execute the AGREEMENT and furnish the required CONTRACT BONDS within the time limit stated in the BID after notification that the AGREEMENT is ready for signature.
- B. The Bidder whose Bid is accepted upon his failure or refusal to duly execute the AGREEMENT and furnish the required CONTRACT BONDS within the time limit stated in the BID, shall forfeit to the Owner as liquidated damages for such failure or refusal, the surety deposited with his BID.

#### 1.22 INSURANCE CERTIFICATES

- A. The Contractor will not be permitted to start any construction work until he has submitted certificates covering all insurances called for under that subsection of the AGREEMENT, titled "Insurance." The Contractor shall submit said certificates using the forms supplied by the Engineer under said subsection.

#### 1.23 TIME FOR COMPLETION AND LIQUIDATED DAMAGES

- A. The bidder must agree to commence work on or before the date specified in the written "NOTICE TO PROCEED" issued by the Owner, and/or Engineer acting on behalf of the Owner, and to fully complete the project within the time specified in **Table A** of the Agreement, after the date specified in the written "NOTICE TO PROCEED" as stipulated in **Table A** of the AGREEMENT. The bidder must further agree to pay as liquidated damages to the Owner, the sum as specified in **Table A** of the Agreement for each consecutive calendar day thereafter as hereafter provided in the AGREEMENT.

#### 1.24 LAWS AND REGULATIONS

- A. The bidder's attention is directed to the fact that all applicable Federal and State laws, municipal ordinances, and rules and regulations or authorities having jurisdiction over construction of the project, shall apply to the Contract throughout, and shall be deemed to be included in the Contract the same as though herein written out in full.

1.25 WORK ON STATE, MUNICIPAL, AND PRIVATE PROPERTY

- A. Particular attention is hereby directed to the fact that portions of the Work included under this Contract will be done within the limits of properties that are State-owned, municipal-owned, or privately owned. The Contractor shall be responsible for coordinating the prosecution of the Work of this Contract with the property owner and for providing work in accordance with any additional requirements as specified herein.

1.26 DATUM OR LEVELS

- A. The figures given in the Contract and Specifications or upon the Drawings after the word elevation shall mean the distance in feet above the base of North American Vertical Datum (NAVD) of 1988. The coordinates, in feet given in the Contract and Specifications or upon the Drawings are based upon the Massachusetts State Plane.

1.27 STATE SALES AND USE TAX

- A. Materials and equipment purchased for installation under this Contract are exempt from Massachusetts Sales Tax. The Contractor shall file for exemption on behalf of the Owner with the State of Massachusetts Department of Taxation as required by law. The exemption from the Sales Tax shall be taken into account by the Contractor during bidding.

1.28 MANUFACTURER'S EXPERIENCE

- A. Wherever it may be written that an equipment manufacturer must have a specified period of experience with his product, equipment which does not meet the specified experience period may be considered by the Owner and/or Engineer if the equipment supplier or manufacturer is willing to provide a sufficient bond or cash deposit as determined by the Owner and/or Engineer for the duration of the specified time period which will guarantee full replacement of that equipment in the event of failure at no additional cost to the Owner.

1.29 PROTECTION OF LIVES AND HEALTH

- A. The project is subject to all of the Safety and Health Regulations as promulgated by the United States Department of Labor (Title 29, Part 1926/1910 CFR, and all revisions and amendments to date); the Contract Work Hours and Safety Standards Act (40 U.S.C. 327 et seq.) as supplemented by the Department of Labor Regulations (Title 29 CFR Part 5); and OSHA 2207, and all revisions and amendments to date. Contractors are urged to make themselves familiar with the requirements of these regulations.

1.30 NONDISCRIMINATION IN EMPLOYMENT

- A. Contracts for work under this bid (proposal) will obligate the Contractors and subcontractors not to discriminate in employment practices.
- B. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age, handicap, or national origin. The Contractor shall take affirmative action to ensure that applicants are employed and the employees are treated during employment without regard to their race, color, religion, sex, age, handicap, or national origin. Such actions shall include, but not be limited to, the following: employment, upgrading; demotions, or transfers;

recruitment or recruitment advertising, layoffs, or terminations; rates of pay or other forms of compensation; selection for training including apprenticeship; and participation in recreational and education activities. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notice to be provided setting forth the provisions of this non-discrimination clause. The Contractor will in all solicitations or advertisements for employees placed by or on behalf of the Contractor state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age, handicap or national origin. The Contractor will cause the foregoing provisions to be inserted in all sub-contracts for any work covered by this Contract so that such provisions will be binding upon each sub-contractor and upon sub-contracts for standard commercial supplies or raw materials.

- C. The Contractor shall keep such records and submit such reports concerning the racial and ethnic origin of applicants for employment and employees as the Owner may require as consistent with Federal and State law. The Contractor agrees to comply with such rules, regulations, or guidelines as the State of Massachusetts may implement these requirements. The Contractor further warrants that he will comply with the President's Executive Order No. 11246 or any preceding similar Executive Order relating thereto.
- D. Bidders and Contractors must, if required, submit a compliance report (EPA Form 5720-4) concerning their employment practices and policies in order to maintain their eligibility to receive award of the Contract.
- E. Successful bidders and Contractors must, if required, submit a list of all Subcontractors who will perform work on the project, and written signed statements from authorized agents of labor pools with which they will or may deal with for employees on the work, together with any information to the effect that such labor pools' practices or policies are in conformity with said Executive Order that they will affirmatively cooperate in or offer no hindrance to the recruitment, employment, and equal treatment of employees seeking employment and performing work under this Contract; or a certification as to when such agents or labor pools have failed or refused to furnish them, prior to award of the Contract.
- F. The successful bidder will be required to comply with Equal Opportunity Requirements and to abide by the prevailing wage rates for Public Work Projects for all employees on the job. It is the responsibility of Bidders to inform themselves as to the local labor conditions, overtime compensation, health and welfare contributions, labor supply and prospective changes or adjustment of wage rates. Information is available at the Office of Labor and Workforce Development.

#### 1.31 SEQUENCE OF OPERATIONS

- A. The Contractor must submit to the Engineer within fourteen (14) calendar days after execution of the Contractor Documents, a sequence of operations, giving detailed plans and schedules of his operation including any elements for by-pass pumping and/or flow diversion during the Work. Said sequence of operations shall be reviewed and must be approved by the Owner and Engineer prior to the start of the Work. The Owner reserves the right to limit or, if found necessary and/or required, delay construction, or certain activities thereof, in certain areas of the Contract should the Owner deem it to be in the public's best interest to do so.
- B. The Contractor shall have no claim for additional compensation or damage on account of any such delays and/or required sequence of operations.

- C. The Contractor shall maintain uninterrupted utility services at all times, and plan his work accordingly.
- D. The Contractor shall coordinate his activities with any other contract and/or contractor to complete the Work as detailed on the Plans and Specifications.

#### 1.32 WETLANDS AND WATERWAYS

- A. The Contractor's attention is directed to the fact that a portion of the work is located within and/or immediately adjacent to wetlands and waterways. Work within these areas is subject to the jurisdiction of the Massachusetts Department of Environmental Protection. All requirements and/or control measures deemed necessary by the Department shall be strictly adhered to throughout the duration of this Contract.
- B. The Contractor shall not have or assert any claim for nor shall he be entitled to any additional compensation or damages on account of requirements set forth by the Department of Environmental Protection regarding the wetlands and waterways encountered during construction.

#### 1.33 RESERVED

#### 1.34 MATERIAL PRICE ADJUSTMENT

- A. This contract is subject to the requirements of Massachusetts General Law c30 s38A, Price adjustment clause in contracts for road, bridge, water and sewer projects awarded under Sec. 39M. See Section 01065 Material Price Adjustments.

#### 1.35 MASSACHUSETTS WAGE RATES

- A. Minimum Wage Rates as determined by the Commissioner of Department of Workforce Development under the provision of the Massachusetts General Laws, Chapter 149, Sections 26 to 27D, as amended, apply to this project. It is the responsibility of the contractor, before bid opening, to request if necessary, any additional information on Minimum Wage Rates for those trades people who may be employed for the proposed work under this contract. See the Section 00650 for Prevailing Wage Rates.

**END OF SECTION**

## Projectdog E-Bidding Instructions to Bidders



### Bid Documents

Bid Forms and Contract Documents shall be available online at [www.Projectdog.com](http://www.Projectdog.com), Project Code **864455**. Documents are made available to all bidders in electronic form at no cost. Bidders desiring hard copies shall be solely responsible for all costs related to printing and shipping of hard copy documents. Neither Owner nor Architect/Engineer shall be responsible for full or partial sets of the Bidding Documents, including Addenda if any, obtained from sources other than Projectdog, Inc.

### Receipt of Bids

This project is being Electronically Bid (E-Bid). All bids shall be submitted online at [www.Projectdog.com](http://www.Projectdog.com). Hard copy bids will not be accepted by the Awarding Authority. Tutorials and Instructions are available online at [www.Projectdog.com](http://www.Projectdog.com). For assistance, contact Projectdog, Inc. at 978.499.9014.

### Preparation and Submission of Bids

Bid Forms will be posted online at [www.Projectdog.com](http://www.Projectdog.com). All required Bid Forms must be completed and submitted in unrestricted PDF formatted files. The Bidder must fill-in all required fields and signatures either digitally or manually (print, fill-in, and scan to PDF).

The Bidder shall access the Projectdog.com E-Bidding System by entering the Project Code in the project locator box and then selecting "Sub E-Bid" or "GC E-Bid" from the project's "Project Details" page. The Bidder must enter their bid price as a numeric, whole dollar value only with no punctuation. If no base bid price is applicable, Bidders are instructed to enter an amount of \$1.00 (one dollar). **For GC E-Bids with Sub-Bids, General Contractors shall input the total Contract Price, i.e., the sum of all selected Sub-Bid amounts plus the amount for the work of the General Contractor.** The E-Bidding system automatically translates the numeric value into words and displays the bid price in both figures and words on the submitted bid form.

Bidders may upload ("Add File" or "Replace File"), review ("View File"), Save, submit ("Submit my E-Bid"), or retract ("Retract my E-Bid") their E-Bid at any time prior to the designated deadline. The server clock is displayed on the project's E-Bidding page and is the time of record. **Bidders must select "Submit my E-Bid" prior to the designated deadline to officially submit their E-Bid online.** Once submitted, an E-Bid cannot be edited. To modify a submitted E-Bid, Bidders must retract their submission, save any changes, and then submit the updated E-Bid. Upon submitting or retracting their E-Bid, Bidders will receive a convenience email for informational purposes only. Bidders shall contact Projectdog if the email is not received.

Bidders shall review their submitted E-Bid package by selecting "View My Bid Package" from the

project's E-Bidding page. Uploaded files may be reviewed individually by selecting "View File". It is also the Bidder's responsibility to ensure that their submitted bid is 100% true, complete, and accurate.

It is also the Bidder's responsibility to confirm online that their E-Bid package has been submitted successfully. Timely submission of an E-Bid shall be the full responsibility of the Bidder.

### **Alternates** (if applicable)

Each Bidder shall acknowledge Alternates by entering the dollar amount and selecting the "Add" or "Subtract" radio button necessitated by each Alternate listed in the corresponding space on the project's E-Bidding page.

If an Alternate does not involve a change in dollar value, the Bidder shall so indicate by typing "0" for the dollar value of that Alternate and by selecting the "Add" radio button in the corresponding space on the project's E-Bidding page.

### **Bid Security** (if requested)

Bid Security in the form of a Bid Bond shall be submitted with your E-Bid online at [www.Projectdog.com](http://www.Projectdog.com). In lieu of an insurance Bid Bond certificate, Bid Security in the form of cash, or a certified check, treasurer's, or cashier's check issued by a responsible bank or trust company and made payable to the Owner, and a completed [Cash Bid Bond Affidavit](#) form must be received by the Owner before the bidding deadline. In addition, the Bidder must also submit the completed Cash Bid Bond Affidavit form with their E-Bid online at [www.Projectdog.com](http://www.Projectdog.com).

### **Addenda**

Addenda, if issued, will be posted to the Projectdog website and shall be accompanied by email notification to every individual or firm on record as having received the Bid Documents. Hard copies of addenda will not be mailed or faxed. It shall be the sole responsibility of the Contractor to ascertain and acknowledge " Yes" to the existence of zero or all addenda within the E-Bidding System.

If a bid is submitted prior to an Addendum being issued, the Bidder will receive an email notification for informational purposes only. The Bidder must review the addendum, retract the bid, acknowledge all addenda, and re-submit the bid. If a Bidder fails to acknowledge all addenda their bid may be rejected by the Awarding Authority.

### **Withdrawal of Bids** (Before the Bid Opening)

Any bid may be withdrawn (retracted) prior to the designated deadline by selecting "Retract My E-Bid" from the project's E-Bidding page. Upon retracting, the Bidder will receive a convenience email for informational purposes only. It is the Bidder's responsibility to review and confirm online that their bid has been retracted successfully.

### **Bid Opening**

Once the bid deadline has closed the E-Bid links are no longer available. All E-Bids are compiled in real time upon bid close and published forthwith on the "Project Details" page titled as "List of Bids Received". Official bid tabulations are posted at the discretion of the Awarding Authority.

## SECTION 00300

### BID FORM

To the City of Haverhill, Massachusetts, herein called the "Owner", for  
"Rosemont Street Bridge over Little River, Bridge No. H-12-024 (CFF), Contract No. IFB006.25"

The Undersigned, as a bidder herein referred to as singular and masculine, declares as follows:

- (1) The only parties interested in this BID as Principals are named herein;
- (2) this BID is made without collusion with any other person, firm, or corporation;
- (3) no officer, agent, or employee of the Owner is directly or indirectly interested in this BID;
- (4) he has carefully examined the site of the proposed Work and fully informed and satisfied himself as to the conditions there existing, the character and requirements of the proposed Work, the difficulties attendant upon its execution and the accuracy of all estimated quantities stated in this BID, and he has carefully read and examined the Drawings, the annexed proposed AGREEMENT and the Specifications and other Contract Documents therein referred to and knows and understands the terms and provisions thereof;
- (5) he understands that information relative to subsurface and other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) has been furnished only for his information and convenience without any warranty or guarantee, expressed or implied, that the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered will be the same as those shown on the Drawings or in any of the other Contract Documents and he agrees that he shall not use or be entitled to use any such information made available to him through the Contract Documents or otherwise or obtained by him in his own examination of the site as a basis of or ground for any claim against the Owner or the Engineer arising from or by reason of any variance which may exist between the aforesaid information made available to or acquired by him and the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered during the construction work, and he has made due allowance therefore in this BID;
- (6) and he understands that the quantities of work tabulated in this BID or indicated on the Drawings or in the Specifications or other Contract Documents are only approximate and are subject to increase or decrease as deemed necessary by the Engineer; and he agrees that, if this BID is accepted he will contract with the Owner, as provided in the copy of the Contract Documents deposited in the office of the Engineer, this BID form being part of said Contract Documents, and that he will perform all the work and furnish all the materials and equipment, and provide all labor, services, plant, machinery, apparatus, appliances, tools, supplies and all other things required by the Contract Documents in the manner and within the time therein prescribed and according to the requirements of the Engineer as therein set forth, and that he will take in full compensation therefore the total dollar amount tabulated from the actual measured quantities of said work and each unit or lump sum price stated in this BID as hereinafter set forth.

(7) It is required that all bidders submitting proposals for this project be MassDOT prequalified in the Bridge Construction category with an estimated value of \$3,656,038.00.

**ELECTRONIC BID**  
**Hard Copy Submissions Will Not Be Accepted**  
**Use form provided on [Projectdog.com](http://Projectdog.com)**

**BID ITEMS**

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
102.3	16	HERBICIDE TREATMENT OF INVASIVE PLANTS At				
		Per Hour				
102.33	16	INVASIVE PLANT MANAGEMENT STRATEGY At				
		Per Hour				
102.53	1	WOOD TURTLE PROTECTION PLAN At				
		Per Lump Sum				
102.531	16	WOOD TURTLE MONITOR At				
		Per Hour				
115.1	1	DEMOLITION OF BRIDGE At				
		Per Lump Sum				
120.1	370	UNCLASSIFIED EXCAVATION At				
		Per Cubic Yard				
140.	30	BRIDGE EXCAVATION At				
		Per Cubic Yard				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
140.1	1250	BRIDGE EXCAVATION WITHIN COFFERDAM				
		At				
		Per Cubic Yard				
141.1	10	TEST PIT FOR EXPLORATION				
		At				
		Per Cubic Yard				
144.	11	CLASS B ROCK EXCAVATION				
		At				
		Per Cubic Yard				
146.	1	DRAINAGE STRUCTURE REMOVED				
		At				
		Per Each				
151.	160	GRAVEL BORROW				
		At				
		Per Cubic Yard				
151.2	190	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES				
		At				
		Per Cubic Yard				
151.9	1	STREAMBED RESTORATION				
		At				
		Per Lump Sum				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
156.	218	CRUSHED STONE At				
		Per Ton				
156.1	42	CRUSHED STONE FOR BRIDGE FOUNDATIONS At				
		Per Ton				
160.7	1	PERMANENT BENCHMARK At				
		Per Each				
163.1	1	DEFORMATION AND VIBRATION MONITORING At				
		Per Lump Sum				
164.	12	PRE AND POST-CONSTRUCTION CONDITION SURVEYS At				
		Per Each				
170.	445	FINE GRADING AND COMPACTING SUBGRADE AREA At				
		Per Square Yard				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
180.01	1	ENVIRONMENTAL HEALTH AND SAFETY PROGRAM At				
		Per Lump Sum				
180.02	10	PERSONAL PROTECTION LEVEL C UPGRADE At				
		Per Hour				
180.03	60	LICENSED SITE PROFESSIONAL SERVICES At				
		Per Hour				
181.11	112	DISPOSAL OF UNREGULATED SOIL At				
		Per Ton				
181.12	1026	DISPOSAL OF REGULATED SOIL - IN STATE FACILITY At				
		Per Ton				
181.13	206	DISPOSAL OF REGULATED SOIL - OUT-OF-STATE FACILITY At				
		Per Ton				

Hard Copy Submissions Will Not Be Accepted  
Use form provided on Projectdog.com

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
181.14	70	DISPOSAL OF HAZARDOUS WASTE At				
		Per Ton				
182.1	1	INSPECTION AND TESTING FOR ASBESTOS At				
		Per Lump Sum				
182.2	40	REMOVAL OF ASBESTOS At				
		Per Foot				
184.1	0.5	DISPOSAL OF TREATED WOOD PRODUCTS At				
		Per Ton				
201.	1	CATCH BASIN At				
		Per Each				
204.	1	GUTTER INLET At				
		Per Each				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
210.	2	SANITARY SEWER MANHOLE At				
		Per Each				
210.02	2	SANITARY SEWER MANHOLE REMOVED At				
		Per Each				
212.	1	TEMPORARY SEWER BYPASS At				
		Per Lump Sum				
220.	1	DRAINAGE STRUCTURE ADJUSTED At				
		Per Each				
220.7	2	SANITARY SEWER ADJUSTED At				
		Per Each				
221.	3	FRAME AND COVER At				
		Per Each				

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 Use form provided on Projectdog.com

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
222.1	1	FRAME AND GRATE – MASSDOT CASCADE TYPE At				
		Per Each				
227.3	4	REMOVAL OF DRAINAGE STRUCTURE SEDIMENT At				
		Per Cubic Yard				
227.31	60	REMOVAL OF DRAINAGE PIPE SEDIMENT At				
		Per Foot				
238.1	5	10 INCH DUCTILE IRON PIPE At				
		Per Foot				
250.06	130	6 INCH POLYVINYL CHLORIDE SANITARY SEWER PIPE At				
		Per Foot				
250.12	210	12 INCH POLYVINYL CHLORIDE SANITARY SEWER PIPE At				
		Per Foot				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
254.123	1	12 INCH SEWER PIPE INSULATION, CASING, & SLEEVE At				
		Per Lump Sum				
280.	5	HOT MIX ASPHALT WATERWAY At				
		Per Square Yard				
358.	2	GATE BOX ADJUSTED At				
		Per Each				
402.1	80	DENSE GRADE CRUSHED STONE FOR SUB-BASE At				
		Per Ton				
415.2	350	PAVEMENT FINE MILLING At				
		Per Square Yard				
440.	90	CALCIUM CHLORIDE FOR ROADWAY DUST CONTROL At				
		Per Pound				

Hard Copy Submissions Will Not Be Accepted  
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BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
443.	2	WATER FOR ROADWAY DUST CONTROL				
		At				
		Per Mega Gallon				
450.23	65	SUPERPAVE SURFACE COURSE – 12.5 (SSC – 12.5)				
		At				
		Per Ton				
450.31	55	SUPERPAVE INTERMEDIATE COURSE – 12.5 (SIC – 12.5)				
		At				
		Per Ton				
450.42	90	SUPERPAVE BASE COURSE – 37.5 (SBC – 37.5)				
		At				
		Per Ton				
450.611	11	SUPERPAVE BRIDGE SURFACE COURSE – 12.5 POLYMER (SSC-B - 9.5 - P)				
		At				
		Per Ton				
450.711	11	SUPERPAVE BRIDGE PROTECTIVE COURSE – 12.5 POLYMER (SPC-B - 9.5 - P)				
		At				
		Per Ton				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
451.	5	HMA FOR PATCHING				
		At				
		Per Ton				
452.	70	ASPHALT EMULSION FOR TACK COAT				
		At				
		Per Gallon				
453.	700	HMA JOINT ADHESIVE				
		At				
		Per Foot				
472.	10	TEMPORARY ASPHALT PATCHING				
		At				
		Per Ton				
506.	225	GRANITE CURB TYPE VB – STRAIGHT				
		At				
		Per Foot				
509.	20	GRANITE TRANSITION CURB FOR PEDESTRIAN CURB RAMPS – STRAIGHT				
		At				
		Per Foot				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
580.2	15	TIMBER CURB REMOVED AND RESET				
		At				
		Per Foot				
620.13	55	GUARDRAIL, TL-3 (SINGLE FACED)				
		At				
		Per Foot				
620.33	25	GUARDRAIL – CURVED, TL-3 (SINGLE FACED)				
		At				
		Per Foot				
627.1	1	TRAILING ANCHORAGE				
		At				
		Per Each				
627.12	2	ROUNDED END UNIT				
		At				
		Per Each				
627.83	1	GUARDRAIL TANGENT END TREATMENT, TL-3				
		At				
		Per Each				

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BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
628.24	3	TRANSITION TO BRIDGE RAIL At				
		Per Each				
628.241	1	MODIFIED TRANSITION TO BRIDGE RAIL At				
		Per Each				
630.	45	HIGHWAY GUARD REMOVED AND RESET At				
		Per Foot				
630.2	140	HIGHWAY GUARD REMOVED AND DISCARDED At				
		Per Foot				
632.1	2	GUARDRAIL POST - WOOD At				
		Per Each				
657.	200	TEMPORARY FENCE At				
		Per Foot				

Hard Copy Submissions Will Not Be Accepted  
Use form provided on Projectdog.com

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
697.1	2	SILT SACK At				
		Per Each				
698.1	426	GEOTEXTILE FABRIC FOR STABILIZATION At				
		Per Square Yard				
698.4	5	GEOTEXTILE FABRIC FOR PERMANENT EROSION CONTROL At				
		Per Square Yard				
702.	16	HOT MIX ASPHALT SIDEWALK OR DRIVEWAY At				
		Per Ton				
715.	1	RURAL MAIL BOX REMOVED AND RESET At				
		Per Each				
748.	1	MOBILIZATION At				
		Per Lump Sum				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
751.	25	LOAM FOR ROADSIDES At				
		Per Cubic Yard				
755.45	605	WETLAND RESTORATION At				
		Per Square Yard				
755.74	24	PPESC MONITOR At				
		Per Hour				
755.75	24	WETLAND SPECIALIST At				
		Per Hour				
755.76	1	WETLAND AND CONSTRUCTION MONITORING REPORTS At				
		Per Lump Sum				
765.	10	SEEDING At				
		Per Square Yard				

Hard Copy Submissions Will Not Be Accepted  
 Use form provided on Projectdog.com

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
765.442	170	SEEDING – ROADSIDE RIVERBANK – PART SHADE MIX At				
		Per Square Yard				
767.121	300	SEDIMENT CONTROL BARRIER At				
		Per Foot				
767.9	200	JUTE MESH At				
		Per Square Yard				
769.	200	PAVEMENT MILLING MULCH UNDER GUARDRAIL At				
		Per Foot				
776.521	2	MAPLE – RED 8-10 FEET / #15 At				
		Per Each				
777.036	2	OAK – NORTHERN RED 1.5-2 INCH CALIPER At				
		Per Each				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
790.719	2	DOGWOOD – SILKY 2-3 FEET / #3 At				
		Per Each				
794.331	12	SUMAC SHRUB – FRAGRANT-GRO- LOW 2-3 FEET / #2 At				
		Per Each				
801.32	10	3 INCH ELECTRICAL CONDUIT – TYPE NM (DOUBLE) At				
		Per Foot				
801.42	70	4 INCH ELECTRICAL CONDUIT TYPE NM (DOUBLE) At				
		Per Foot				
801.461	135	3 TO 4 INCH ELECTRICAL CONDUIT – TYPE NM (6 BANK) At				
		Per Foot				
804.3	75	2 INCH ELECTRICAL CONDUIT TYPE NM – PLASTIC – (UL) At				
		Per Foot				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
810.3	40	3 INCH ELECTRICAL CONDUIT TYPE NM – PLASTIC (UL) – CONCRETE ENCASED At				
		Per Foot				
810.42	40	4 INCH ELECTRICAL CONDUIT – TYPE NM – PLASTIC (UL) (DOUBLE) – CONCRETE ENCASED At				
		Per Foot				
811.95	2	VERIZON HANDHOLE 24x36x24 At				
		Per Each				
811.96	2	ELECTRIC HANDHOLE 17x30x17 At				
		Per Each				
813.812	1	ELECTRIC SERVICE RISER – STA 13+44 RT At				
		Per Each				
813.813	1	ELECTRICAL SERVICE RISER – STA 13+80 RT At				
		Per Each				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
825.01	1	SERVICE CONNECTION FOR PUMP STATION At				
		Per Lump Sum				
832.	6	WARNING – REGULATORY AND ROUTE MARKER – ALUMINUM PANEL (TYPE A) At				
		Per Square Foot				
851.1	540	TRAFFIC CONES FOR TRAFFIC MANAGEMENT At				
		Per Day				
852.	300	SAFETY SIGNING FOR TRAFFIC MANAGEMENT At				
		Per Square Foot				
853.1	2	PORTABLE BREAKAWAY BARRICADE TYPE III At				
		Per Each				
853.2	75	TEMPORARY BARRIER (TL-2) At				
		Per Foot				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
853.22	105	STEEL BARRIER REMOVED AND DISCARDED				
		At				
		Per Foot				
856.12	1080	PORTABLE CHANGEABLE MESSAGE SIGN				
		At				
		Per Day				
859.	27,000	REFLECTORIZED DRUM				
		At				
		Per Day				
859.1	1080	REFLECTORIZED DRUM WITH SEQUENTIAL FLASHING WARNING LIGHTS				
		At				
		Per Day				
866.104	460	4 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)				
		At				
		Per Foot				
867.104	460	4 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)				
		At				
		Per Foot				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
874.51	2	MISCELLANEOUS SIGNS REMOVED AND DISCARDED At				
		Per Each				
901.	83	4000 PSI, 1.5 INCH, 565 CEMENT CONCRETE At				
		Per Cubic Yard				
945.10	761	DRILLED MICROPILES At				
		Per Foot				
948.60	1	MICROPILE VERIFICATION LOAD TEST At				
		Per Each				
948.61	2	MICROPILE PROOF LOAD TEST At				
		Per Each				
983.	333	DUMPED RIPRAP At				
		Per Ton				

BID ITEMS (Continued)

Item No.	Approx. Qty.	Item Description	Unit Price		Amount	
			Dollars	Cents	Dollars	Cents
986.	3	MODIFIED ROCKFILL At				
		Per Ton				
990.1	1	COFFERDAM STRUCTURE NO. H-12-024 At				
		Per Lump Sum				
991.1	1	CONTROL OF WATER – STRUCTURE NO. H-12-024 At				
		Per Lump Sum				
992.32	1	TEMPORARY SUPPORTS FOR PIPING At				
		Per Lump Sum				
994.01	1	TEMPORARY PROTECTIVE SHIELDING, BRIDGE NO. H-12-024 At				
		Per Lump Sum				
995.01	1	BRIDGE STRUCTURE, BRIDGE NO. H-12-024 At				
		Per Lump Sum				



accepted by the Owner, the undersigned, also agrees to comply with the provisions of Section 1.14 "Liquidated Damages" and Table A of the Agreement.

As provided in the INFORMATION FOR BIDDERS, the bidder hereby agrees that he will not withdraw this BID, within 90 consecutive calendar days after the actual date of the opening of Bids, and that, if the Owner shall accept this BID, the bidder will duly execute and acknowledge the AGREEMENT and furnish, duly executed and acknowledged, the required CONTRACT BONDS within fourteen (14) consecutive calendar days after notification that the AGREEMENT and other Contract Documents are ready for signature.

Should the bidder fail to execute any of his agreements as hereinabove set forth, the Owner shall have the right to retain as liquidated damages, the Bid Security attached in the sum of (5 percent of Total Bid) \_\_\_\_\_ Dollars, (\$ \_\_\_\_\_) which shall become the Owner's property for the delay and additional expense to the Owner caused thereby. If a bid bond was given, it is agreed that the amount thereof shall be paid as liquidated damages to the Owner by the Surety. (Bidder must fill in this blank.)

The bidder hereby acknowledges the receipt of, and has included in this BID, the following Addenda:

(To be filled in by Bidder, if Addendums are issues.)

Addendum No. \_\_\_\_\_, dated \_\_\_\_\_

The bidder, by submittal of this BID, agrees with the Owner that the amount of the bid security deposited with this BID fairly and reasonably represents the amount of damages the Owner will suffer due to the failure of the bidder to fulfill his agreements as above provided.

(SEAL)

\_\_\_\_\_ L.S.  
(Name of Bidder)

By \_\_\_\_\_  
(Signature and title of authorized representative)

\_\_\_\_\_  
(Business address)

\_\_\_\_\_  
(City and State)

Date \_\_\_\_\_

The bidder is a corporation, incorporated in the State (or Commonwealth) of \_\_\_\_\_ a partnership - an individual (Bidder must add and delete as necessary to make this sentence read correctly.)

(Note: If the bidder is a corporation, affix corporate seal and give below the names of its president treasurer, and general manager, if any; if a partnership, give full names and residential addresses of all partners; and if an individual, give residential address, if different from business address.)

The required names and addresses of all persons interested in the foregoing Bid, as Principals, are as follows:

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

(Add supplementary page if necessary)

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**CERTIFICATE OF AUTHORIZATION  
FOR  
BIDDING REPRESENTATIVE**

(Note: Bidder must complete for certification of authorized representative signing Bid.)

At a duly authorized meeting of the Board of Directors of the

\_\_\_\_\_ held on \_\_\_\_\_,  
(Name of Corporation) (Date)

at which all the Directors were present or waived notice, it was voted that

\_\_\_\_\_ (Name of Authorized Representative) \_\_\_\_\_ (Title)

of this company shall be, and hereby is, authorized to execute bidding documents, contracts and bonds in the name and on behalf of said company, and to affix the corporate seal thereto, and such execution of any contract obligation in this company's name on its behalf of such

\_\_\_\_\_ under seal of the company shall be valid and binding upon this company.  
(Title)

A true copy

ATTEST

\_\_\_\_\_  
(Clerk)

Place of Business

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

I hereby certify that I am the clerk of the \_\_\_\_\_  
(Name of Corporation)

\_\_\_\_\_, that \_\_\_\_\_  
(Name of Authorized Representative)

is the duly elected \_\_\_\_\_ of said company, and that the  
(Title)

above vote has not been amended or rescinded and remains in full force and effect as of the date of this contract.

Corporate Seal

\_\_\_\_\_  
(Clerk)

**STATEMENT OF BIDDERS' QUALIFICATIONS**

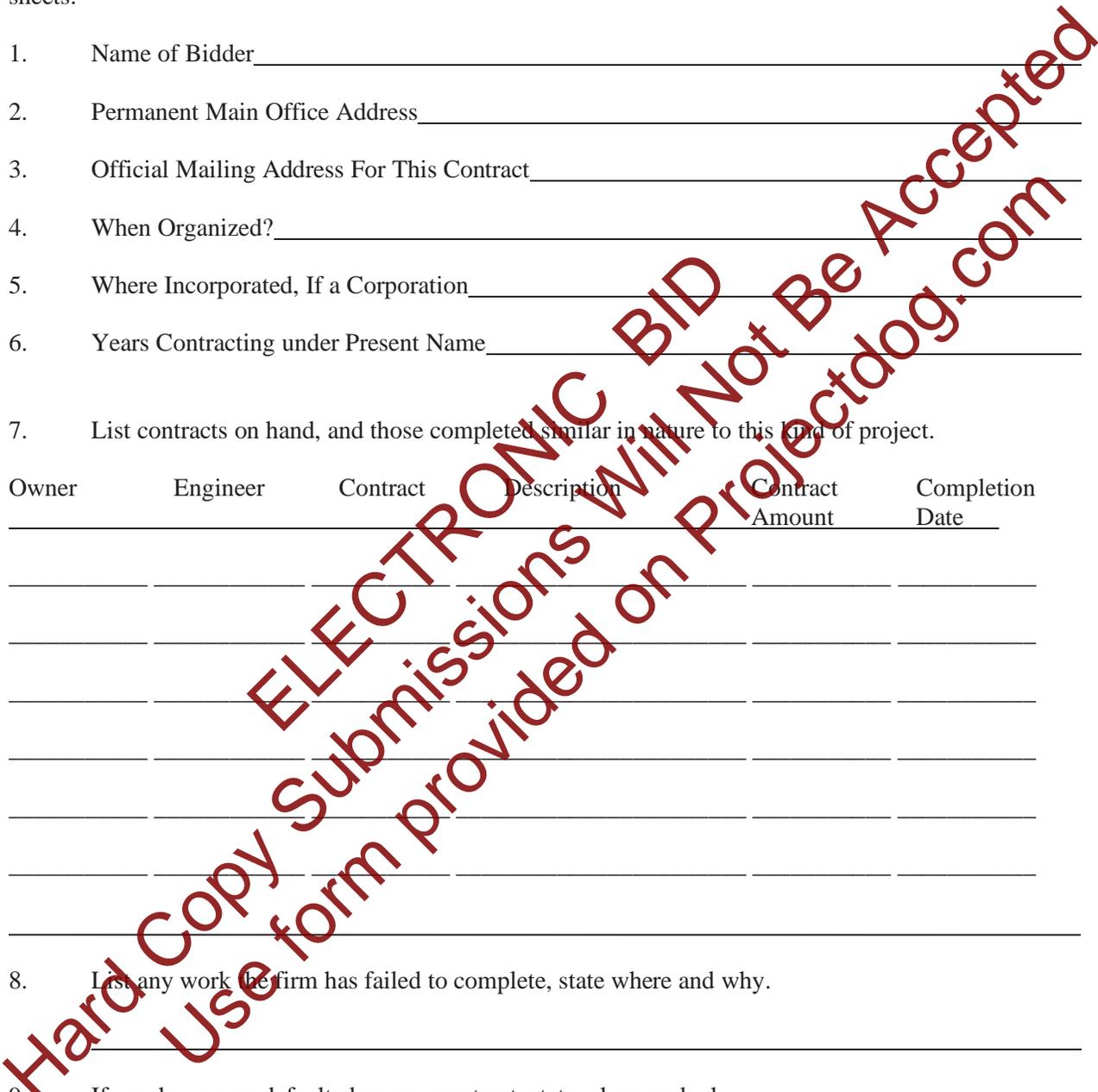
The following shall accompany the bid and is required as evidence of the bidder's qualifications to perform the work, as bid upon, in accordance with the contract drawings and specifications. This statement must be notarized. All questions must be answered. Additional data may be submitted on separate attached sheets.

- 1. Name of Bidder \_\_\_\_\_
- 2. Permanent Main Office Address \_\_\_\_\_
- 3. Official Mailing Address For This Contract \_\_\_\_\_
- 4. When Organized? \_\_\_\_\_
- 5. Where Incorporated, If a Corporation \_\_\_\_\_
- 6. Years Contracting under Present Name \_\_\_\_\_

7. List contracts on hand, and those completed similar in nature to this kind of project.

Owner	Engineer	Contract Description	Contract Amount	Completion Date
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

- 8. List any work the firm has failed to complete, state where and why.  
\_\_\_\_\_
- 9. If you have ever defaulted on any contract, state where and why.  
\_\_\_\_\_



10. List full names and residences of all principals (i.e.: Officers, Directors, Partners, Owners) interested in this bid.

<u>Name</u>	<u>Residence</u>	<u>Title</u>	<u>Firm</u>

11. State name(s) and qualifications of resident supervisor(s) for this project.

12. List major equipment available for this project and identify ownership or rental.

13. Will you furnish a detailed financial statement and other information, requested by the Owner?

14. List bank references for verifying financial ability of your company.

<u>Name</u>	<u>Address</u>

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15. The undersigned hereby authorized and requests any person, firm or corporation, to furnish all information requested by the Owner and/or its designated agents relative to the recitals comprising this Statement of the Bidder's Qualifications.

Dated at \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_.

\_\_\_\_\_  
(Name of Bidder)

By: \_\_\_\_\_

\_\_\_\_\_  
(Title)

State of \_\_\_\_\_

County of \_\_\_\_\_

\_\_\_\_\_ being duly sworn in person, deposes and says  
that he is \_\_\_\_\_ of \_\_\_\_\_,  
(Title) (Name of Bidder)

that he is the firm's duly authorized agent to execute these contract documents, and that the answers to the foregoing questions and all statements therein contained are correct and true.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_.

(SEAL)

\_\_\_\_\_  
(Notary Public)

\_\_\_\_\_  
(My Commission Expires)

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**STATEMENT OF PROPOSED SUBCONTRACTORS**

The following shall accompany the bid and is required as evidence of the bidder's qualifications to perform the work as bid upon, in accordance with the contract drawings and specifications. The Bidder must state the names and appurtenant information of all major subcontractors he proposed to use to complete the work as bid upon. Additional data may be submitted on separate attached sheets.

If subcontractors are not to be used to complete the Work and/or any portion thereof, as herein bid upon, the Bidder must acknowledge by writing "NONE" \_\_\_\_\_.

Description of Work \_\_\_\_\_  
\_\_\_\_\_

Approximate percentage of Total Bid \_\_\_\_\_  
\_\_\_\_\_

Proposed Subcontractor, Name \_\_\_\_\_  
\_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Description of Work \_\_\_\_\_  
\_\_\_\_\_

Approximate percentage of Total Bid \_\_\_\_\_  
\_\_\_\_\_

Proposed Subcontractor, Name \_\_\_\_\_  
\_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Description of Work \_\_\_\_\_  
\_\_\_\_\_

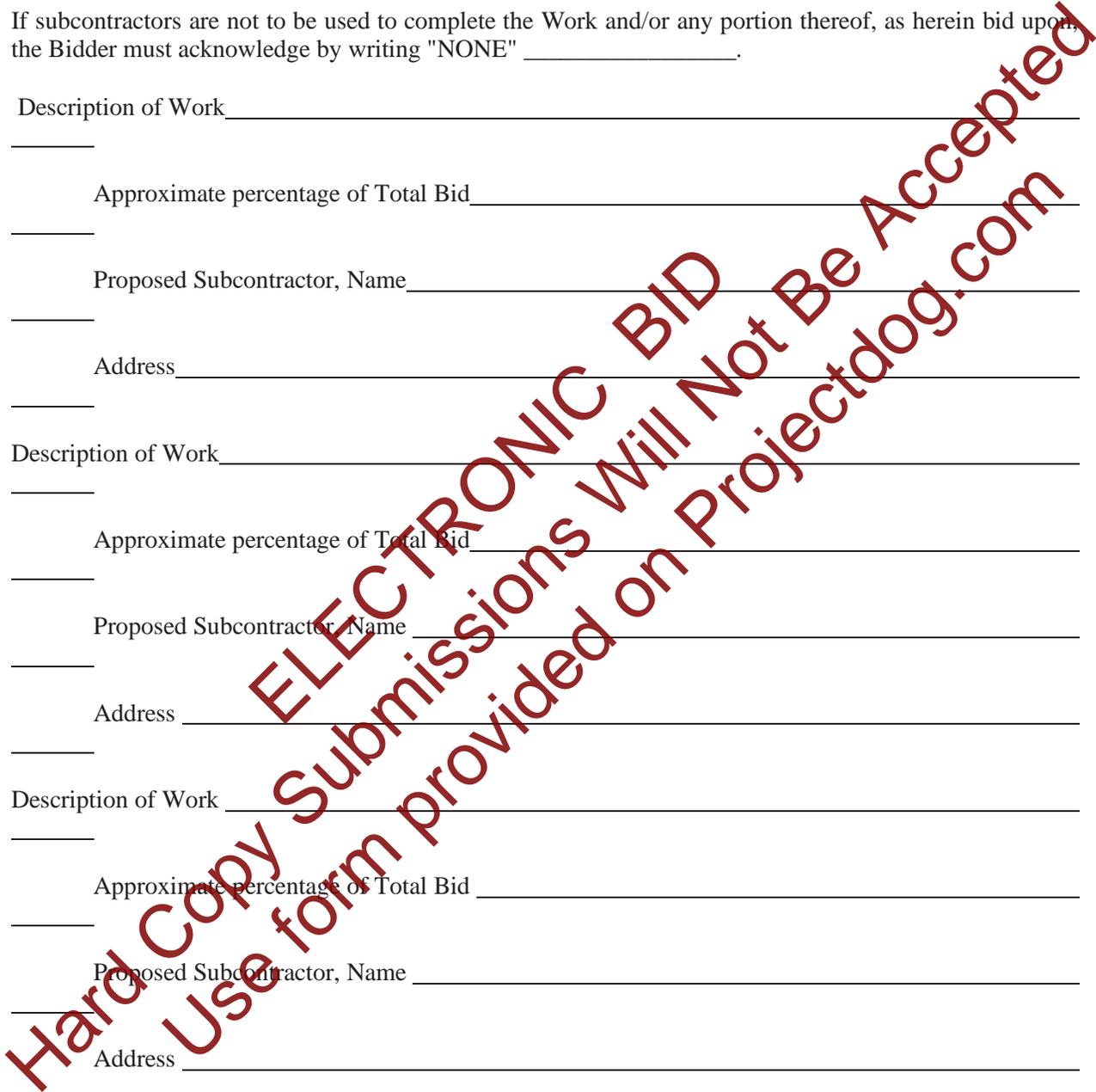
Approximate percentage of Total Bid \_\_\_\_\_  
\_\_\_\_\_

Proposed Subcontractor, Name \_\_\_\_\_  
\_\_\_\_\_

Address \_\_\_\_\_  
\_\_\_\_\_

Bidder to insert description of work, percentage of Total BID, and subcontractors' names as may be required.

This is to certify that all names of the above-mentioned subcontractors are submitted with full knowledge and consent of the respective parties.



The Bidder warrants that none of the proposed subcontractors have any conflict of interest as respects this contract.

Date \_\_\_\_\_ Bidder \_\_\_\_\_  
(Name of Bidder)

By \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(Business Address)

\_\_\_\_\_  
(City and State)

**ELECTRONIC BID**  
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**LABOR HARMONY AND OSHA 10 CERTIFICATION**

The undersigned certifies that they will conform to and provide documentation for the requirements as stated in MGL c. 30, §39S(a) as follows:

The bidder certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; and that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and that all employees to be employed in the work subject to this bid have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration.

\_\_\_\_\_  
Name of Contractor/Business

\_\_\_\_\_  
Signature of Authorized Representative of Contractor/Business

\_\_\_\_\_  
Date

**ELECTRONIC BID**  
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**CERTIFICATE OF NON - COLLUSION**

Any person submitting a bid under this section shall, on such bid, certify the following: The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation, or other business, or legal entity.

\_\_\_\_\_  
Name of Contractor/Business

\_\_\_\_\_  
Signature of Authorized Representative of Contractor/Business

\_\_\_\_\_  
Date

**TAX COMPLIANCE CERTIFICATION**

Pursuant to MGL c. 62C, §49A, I certify under the penalties of perjury that, to the best of my knowledge and belief, I am in compliance with all laws of the Commonwealth relating to taxes, reporting of employees and contractors and withholding and remitting child support, and, subject to the conditions stated above, the contracting agency confirms with the Massachusetts Department of Revenue (DOR) that the person is in good standing with respect to all returns due and taxes payable to DOR as of the date of confirmation.

\_\_\_\_\_  
Name of Contractor/Business

\_\_\_\_\_  
Signature of Authorized Representative of Contractor/Business

\_\_\_\_\_  
Social Security or Federal Identification Number

\_\_\_\_\_  
Date

**END OF SECTION**

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**SECTION 00400**

**BID BOND**

KNOW ALL MEN BY THESE PRESENTS, that we the undersigned (Insert Name of Bidder) \_\_\_\_\_, as Principal, and (Insert Name of Surety) \_\_\_\_\_, as Surety, are hereby held and firmly bound and obligated unto the City of Haverhill, Massachusetts, as Owner, in the sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_), as liquidated damages for payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that whereas the Principal has submitted to the City of Haverhill, Massachusetts a certain Bid attached hereto and hereby made a part hereof, to enter into a contract in writing, hereinafter referred to as the "AGREEMENT" and/or "Contract", for "City of Haverhill, MA, Rosemont Street Bridge over Little River, Bridge No. H-12-024 (CFF), Contract No. IFB006.25".

NOW THEREFORE,

- (a) If said BID shall be rejected or withdrawn as provided in the INFORMATION FOR BIDDERS attached hereto or, in the alternative,
- (b) If said BID shall be accepted and the Principal shall duly execute and deliver the form of AGREEMENT attached hereto and shall furnish the specified bonds for the faithful performance of the AGREEMENT and/or Contract and for the payment for labor and materials furnished for the performance of the AGREEMENT and/or Contract,

then this obligation shall be void, otherwise it shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder in no event shall exceed the amount of this obligation.

The Surety, for value received, hereby agrees that the obligations of said Surety and its bond shall in no way be impaired or affected by any extensions of the time with which such BID may be accepted, and said Surety does hereby waive notice of any such extensions.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, have duly executed this bond on the

\_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_.

(SEAL)

\_\_\_\_\_ L.S.  
(Name of Principal)

BY: \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(Name of Surety (Seal)

BY: \_\_\_\_\_  
(Signature and Title)

BY: \_\_\_\_\_  
Attorney-In-Fact

Sealed and delivered in  
the presence of:

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

IMPORTANT: Surety Companies executing BONDS must appear on the U.S. Treasury Department's most current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts and be authorized to transact business in the state where the PROJECT is located.

If the Bond is signed on behalf of the Surety by an Attorney-In-Fact, there should be attached, a duly certified copy of his power of attorney showing his authority to sign such Bond.

**END OF SECTION**

**SECTION 00500**

**CONTRACT AGREEMENT  
CITY OF HAVERHILL, MASSACHUSETTS  
ROSEMONT STREET BRIDGE OVER LITTLE RIVER  
BRIDGE NO. H-12-024 (CFF)  
CONTRACT NO. IFB006.25**

THIS AGREEMENT, is executed this \_\_\_\_\_ day of \_\_\_\_\_ in the year Two Thousand and [ ] (herein referred to as the "AGREEMENT") by and between the City of Haverhill, Massachusetts party of the first part, and \_\_\_\_\_ (Name of Contractor) party of the second part.

WITNESSETH, that the parties to these presents, each in consideration of the undertakings, promises, and agreements on the part of the other herein contained, have undertaken, promised, and agreed and do hereby undertake, promise, and agree, the party of the first part for itself, its successors and assigns, and the party of the second part for himself and his heirs, executors, administrators, successors and assigns, as follows:

- |      |   |      |   |
|------|---|------|---|
| 1.01 | Definitions                                   | 1.27 | Changes Not to Affect Bonds                   |
| 1.02 | The Contract Documents                        | 1.28 | Claims for Damages                            |
| 1.03 | Obligations and Liability of Contractor       | 1.29 | Abandonment of Work or Other Default          |
| 1.04 | Authority of the Engineer                     | 1.30 | Prices for Work                               |
| 1.05 | Supervision of Work                           | 1.31 | Moneys May Be Retained                        |
| 1.06 | Insurance                                     | 1.32 | Formal Acceptance                             |
| 1.07 | Patents                                       | 1.33 | Progress Estimates                            |
| 1.08 | Compliance with Laws                          | 1.34 | Partial Acceptance                            |
| 1.09 | Provisions Required by Law Deemed<br>Inserted | 1.35 | Final Estimate and Payment                    |
| 1.10 | Permits                                       | 1.36 | Liens   |
| 1.11 | Not to Sublet or Assign                       | 1.37 | Claims  |
| 1.12 | Delay by Owner                                | 1.38 | Application of Moneys Retained                |
| 1.13 | Time for Completion                           | 1.39 | No Waiver                                     |
| 1.14 | Liquidated Damages                            | 1.40 | Liability of Owner                            |
| 1.15 | Night, Saturday, Sunday and Holiday Work      | 1.41 | Guarantee                                     |
| 1.16 | Employ Competent Persons                      | 1.42 | Return of Drawings                            |
| 1.17 | Employ Sufficient Labor and Equipment         | 1.43 | Cleaning Up                                   |
| 1.18 | Intoxicating Liquors and/or Drugs             | 1.44 | Legal Address of Contractor                   |
| 1.19 | Access to Work                                | 1.45 | Headings                                      |
| 1.20 | Examination of Work                           | 1.46 | Modification or Termination                   |
| 1.21 | Defective Work, Etc.                          | 1.47 | Direct Labor cost                             |
| 1.22 | Protection Against Water and Storm            | 1.48 | Massachusetts Tax Laws                        |
| 1.23 | Right to Materials                            | 1.49 | Minority Business                             |
| 1.24 | Changes                                       | 1.50 | Termination for Convenience                   |
| 1.25 | Extra Work                                    | 1.51 | Equal Employment Opportunity                  |
| 1.26 | Extension of Time on Account of Extra Work    | 1.52 | Unlawful Conduct and Participation in Boycott |

**1.01 DEFINITIONS**

Wherever the words hereinafter defined or pronouns used in their stead occur in the Contract Documents, they shall have the following meaning indicated which shall be applicable to both the singular and plural thereof:

ADDENDA - Written or graphic instruments prior to the opening of Bids which Clarify, correct or change the Bidding Requirements or Contract Documents.

AGREEMENT - the written contract between Owner and Contractor covering the Work to be performed.

"AS DIRECTED," "AS ORDERED," "AS REQUESTED," "AS REQUIRED", "AS PERMITTED," or words of like import are used, it shall be understood that the direction, order, request, requirement, or permission of the Engineer is intended.

"APPROVED," "ACCEPTABLE," "SUITABLE," "SATISFACTORY," and words of like import shall mean approved by, acceptable to, suitable to, or satisfactory to the Engineer.

APPLICATION FOR PAYMENT - Form used by Contractor in requesting progress or final payments, format to be acceptable to the Engineer.

BID - The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

BIDDER - Any person, firm or corporation submitting a bid for the work.

CHANGE ORDER - A document recommended by the Engineer, which is signed by the Contractor and Owner authorizing the addition, deletion or revision in the Work, or adjustment in the Contract Price or Contract Time, issued on or after the effective date of the Agreement.

CONTRACTOR - The person, firm or corporation with whom the Owner has entered into the Agreement.  
Contract Bonds - Bid, Performance, and Labor and Materials Bonds and other instruments of security furnished by the Contractor and his surety in accordance with the Contract Documents.

CONTRACT DOCUMENTS - The Agreement, Addenda, Bid, Post Bid documentation submitted prior to the Notice Award, The Notice to Proceed, Bonds, General Conditions, Supplementary Conditions, The Specifications, the Drawings, all written Amendments, Change Orders, Field Orders, and Engineers written interpretations and clarifications.

CONTRACT PRICE - The total monies payable to the Contractor under the terms and conditions of the Contract Documents.

CONTRACT TIME - The number of calendar days stated in the Contract Documents for the completion of the Work.

CONSTRUCTION SUPERINTENDENT - That person designated by the Contractor to carry out the provisions of the Contract.

DATUM OR LEVELS - The figures given in the Contract and Specifications or upon the Drawings after

the word elevation or abbreviation of it, shall mean the distance in feet above mean sea level, the base of the State in which the Work is located and the United States Geodetic Survey (U.S.G.S.).

DRAWINGS - The part of the Contract Drawings which show the characteristics and Scope of the Work to be performed and which have been prepared or approved by the Engineer.

EARTH - Wherever used as the name of an excavated material or material to be excavated, shall mean all kinds of material other than rock as defined in this section.

ELEVATION - The figures given on the Drawings or in the other Contract Documents after the word "elevation" or abbreviation of it shall mean the distance in feet above the datum adopted by the Engineer.

ENGINEER - The person, firm or corporation duly appointed by the Owner to undertake the duties and powers herein assigned to the Engineer, acting either directly or through duly authorized representatives. (For this Contract, BETA Group, Inc.)

FIELD ORDER - A written order issued by the Engineer which orders minor changes in the Work which do not involve a change in the Contract Price or an extension of the Contract time.

GENERAL REQUIREMENTS - Sections of Division 1 of the Specifications.

"HEREIN," "HEREINAFTER," "HEREUNDER," and words of like import shall be deemed to refer to the Contract Documents.

NOTICE OF AWARD - The written notice of the acceptance of the Bid from the Owner to the successful Bidder.

NOTICE TO PROCEED - Written communication issued by the Owner to the Contractor authorizing him to proceed with the Work and establishing the date of commencement of the Work.

OWNER - The public body or authority, corporation, association, firm or person with whom the Contractor has entered into the Agreement and for whom the Work is to be provided.

PROJECT OR CONTRACT - The undertaking to be performed in the Contract Documents.

PROJECT REPRESENTATIVE - The authorized representative of the owner who is assigned to the project site or any part thereof.

**ROCK** - wherever used as the name of an excavated material to be excavated, shall mean only boulders and pieces of concrete and masonry exceeding 1 cu. yd. in volume, or igneous, sedimentary, metamorphic, and conglomerate rock which, in the opinion of the Engineer, requires, for its removal, drilling and blasting, wedging, sledging, barring, or breaking up with a power-operated tool. No soft or disintegrated rock which can be removed with a hand pick or power-operated excavator or shovel, no loose, shaken, or previously blasted rock or broken stone in rock fillings, or elsewhere, and no rock exterior to the maximum limits of measurement allowed, which may fall into the excavation, will be measured or allowed as "rock."

**SHOP DRAWINGS** - All drawings, diagrams, schedules and other data or information prepared for and submitted by the Contractor, to illustrate portions of the Work.

**SPECIFICATIONS** - The portions of the Contract documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

**SUBCONTRACTOR** - An individual, firm or corporation, approved by the Owner and Engineer having a direct contract with the Contractor or with any other Sub-Contractor for the performance of a part of the Work on the Project.

**SUBSTANTIAL COMPLETION** - Shall mean either that the Work required by the Contract has been completed except for Work having a contract price of less than one percent of the then adjusted total Contract Sum, or substantially all of the Work has been completed and opened to public use except for minor incomplete or unsatisfactory Work items that do not materially impair the usefulness of the Work required by the Contract. Substantial Completion shall be conclusively determined by the Engineer after inspection of the Work.

**SUPPLEMENTARY CONDITIONS** - The part of the Contract Documents which amends or supplements the General Conditions.

**SUPPLIER** - Any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.

**WRITTEN NOTICE** - Any notice to any party of the Agreement relative to any part of this Agreement in writing and considered delivered and the service thereof completed when posted by certified or

registered mail to the said party at his last given address or delivered in person to said party or his authorized representative on the Work.

**WORK** - The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

## 1.02 THE CONTRACT DOCUMENTS

A. The Contract Documents, as defined above, are sometimes herein referred to as the "Contract". The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. In the event of any conflict or inconsistency between the provisions of the AGREEMENT and the provisions of any of the other Contract Documents, the provisions of the AGREEMENT shall prevail.

1.02.1 Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the edition of the standard specification, manual, code or laws or regulations identified in the reference. In the event a particular edition is not identified, the reference shall mean the latest amended edition in effect at the time of receipt of the Bid. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall change the duties and responsibilities of the Owner, the Contractor or the Designer, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor shall it be effective to assign to the Engineer, or any of the Engineer's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the work or any duty or authority to undertake responsibility contrary to the provisions of the AGREEMENT.

## 1.03 OBLIGATIONS AND LIABILITY OF CONTRACTOR

1.03.1 The Contractor shall do all the work and perform and furnish all the labor, services, materials, equipment, plant, machinery, apparatus, appliances, tools, supplies and all other things (except as otherwise expressly provided herein) necessary and as herein specified for the proper performance and completion of the Work in the manner and within the time hereinafter specified, in strict accordance with the Drawings,

Specifications and other Contract Documents, in conformity with the directions and to the satisfaction of the Engineer, and at the prices herein agreed upon therefor.

1.03.2 All parts of the Work and all fixtures, equipment, apparatus and other items indicated on the Drawings and not mentioned in the Specifications, or vice versa, and all work and material usual and necessary to make the work complete in all its parts, including all incidental work necessary to make it complete and satisfactory and ready for use and operation, whether or not they are indicated on the Drawings or mentioned in the Specifications, shall be furnished and executed the same as if they were called for both by the Drawings and by the Specifications.

1.03.3 The Contractor shall coordinate his operations with those of any other contractors who may be employed on other work of the Owner, shall avoid interference therewith, and shall cooperate in the arrangements for storage of materials and equipment.

1.03.4 The Contractor shall conduct his work so as to interfere as little as possible with private business and public travel. Wherever and whenever necessary or required, he shall maintain fences, furnish watchmen, maintain lights, and take such other precaution as may be necessary to protect life and property.

1.03.5 The Contractor shall indemnify and save harmless the Owner and the Engineer and their officers, agents, servants and employees, from and against any and all claims, demands, suits, proceedings, liabilities, judgments, awards, losses, damages, costs and expenses, including attorneys' fees, on account of bodily injury, sickness, disease or death sustained by any person or persons or injury or damage to or destruction of any property, directly or indirectly arising out of, relating to or in connection with the Work, whether or not due or claimed to be due in whole or in part to the active, passive or concurrent negligence or fault of the Contractor, his officers, agents, servants or employees, any of his subcontractors, or any of their respective officers, agents, servants or employees and/or any other person or persons, and whether or not such claims, demands, suits or proceedings are just, unjust, groundless, false or fraudulent; and the Contractor shall and does hereby assume and agrees to pay for the defense of all such claims, demands, suits and proceedings, provided, however, that the Contractor shall not be required to indemnify the Engineer, his officers, agents, servants or employees, against any such damages occasioned solely by defects in maps, plans, drawings, designs or specifications prepared, acquired or used by the Engineer and/or solely by the negligence or fault of the Engineer; and provided further, that the Contractor shall not be required to indemnify the Owner,

his officers, agents, servants or employees, against any such damages occasioned solely by acts or omissions of the Owner other than supervisory acts or omissions of the Owner in the Work.

1.03.6 The Contractor shall have complete responsibility for the Work and the protection thereof, and for preventing injuries to persons and damage to the Work and property and utilities on or about the Work, until final completion and final acceptance thereof. He shall in no way be relieved of his responsibility by and right of the Engineer to give permission or directions relating to any part of the Work, by any such permission or directions given, or by failure of the Engineer to give such permission or directions. The Contractor shall bear all costs, expenses, losses and damages on account of the quantity or character of the Work or the nature of the land (including but not limited to subsurface conditions) in or under or on which the Work is done being different from that indicated or shown in the Contract Documents or from what was estimated or expected, or on account of the weather, elements, or other causes.

1.03.7 The Contractor shall conduct his operations so as not to damage existing structures or work installed either by him or by other contractors. In case of any such damage resulting from his operations, he shall repair and make good as new the damaged portions at his own expense with the consent of the damaged party. In the event that consent is not given, the Contractor shall continue liable for the damage caused.

1.03.8 The Contractor shall be as fully responsible to the Owner for the acts and omissions of his subcontractors, their officers, agents, servants and employees as he is for his own acts and omissions and those of his own officers, agents, servants and employees.

1.03.9 Should the Contractor sustain any loss, damage or delay through any act or omission of any other contractor or any subcontractor of any such other contractor, the Contractor shall have no claim against the Owner therefor, other than for an extension of time, but shall have recourse solely to such other contractor or subcontractor.

1.03.10 If any other contractor or any subcontractor of any such other contractor shall suffer or claim to have suffered loss, damage or delay by reason of the acts or omissions of the contractor or of any of his subcontractors, the Contractor agrees to assume the defense against any such claim and to reimburse such other contractor or subcontractor for such loss or damage.

1.03.11 The Contractor agrees to and does hereby indemnify and save harmless the Owner from and against any and all claims by such other contractors or subcontractors alleging such loss, damage or delay from and against any and all claims, demands, suits, proceedings, liabilities, judgments, awards, losses, damages, costs and expenses, including attorneys' fees, arising out of, relating to or resulting from such claims.

1.03.12 The Contractor shall promptly pay all federal, state and local taxes which may be assessed against him in connection with the Work or his operations under the AGREEMENT and/or the other Contract Documents, including, but not limited to, taxes attributable to the purchase of material and equipment, to the performance of services, and the employment of persons in the prosecution of the Work.

1.03.13 Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material

1.03.13.1 The Owner shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specification or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. The Owner shall not be responsible for any such materials brought to the site by the Contractor, Subcontractors, Suppliers or anyone else for whom the Contractor is responsible.

1.03.13.2 To the fullest extent permitted by Laws and Regulations, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Engineer, Engineer's Consultants and the officers, directors, employees, agents other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from such hazardous condition, provided that: (i) any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) nothing in this subparagraph shall obligate the Owner to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

#### 1.04 AUTHORITY OF THE ENGINEER

1.04.1 The Engineer shall be the sole judge of the intent and meaning of the Drawings and Specifications and his decisions thereon and his interpretation thereof shall be final, conclusive and binding on all parties.

1.04.2 The Engineer shall be the Owner's representative during the life of the Contract and he shall observe the Work in progress on behalf of the Owner. He shall have authority (1) to act on behalf of the Owner to the extent expressly provided in the Contract or otherwise in writing; (2) to determine the amount, quality, acceptability and fitness of all work, materials and equipment required by the Contract; and (3) to decide all questions which arise in relation to the Work, the execution thereof, and the fulfillment of the Contract.

1.04.3 The Contractor shall proceed without delay to perform the work as directed, instructed, determined or decided by the Engineer and shall comply promptly with such directions, instructions, determinations or decisions. If the Contractor has any objection thereto he may, within ten (10) days of having received any such direction, instruction, determination or decision, require that any such direction, instruction, determination or decision be put in writing and within ten (10) days after receipt of any such writing he may file a written protest with the Owner stating clearly and in detail his objections, the reasons therefor, and the nature and amount of additional compensation, if any, to which he claims he will be entitled thereby. A copy of such protest shall be filed with the Engineer at the same time it is filed with the Owner. Unless the Contractor requires that any such direction, instruction, determination or decision be put in writing within ten (10) days of having received such direction, instruction, determination or decision and unless the Contractor files such written protest with the Owner and Engineer within such ten (10) day period, he shall be deemed to have waived all grounds for protest of such direction, instruction, determination, or decision and all claims for additional compensation or damages occasioned thereby, and shall further be deemed to have accepted such direction, instruction, determination, or decision as being fair, reasonable, and finally determinative of his obligations and rights under the Contract.

#### 1.05 SUPERVISION OF WORK

1.05.1 The Contractor shall be solely responsible for supervision of the Work, shall give the work the constant attention necessary to ensure the expeditious and orderly progress thereof, and shall cooperate with the Engineer in every possible way.

1.05.2 At all times, the Contractor shall have his agent on the Work a competent superintendent capable of reading and thoroughly understanding the Drawings and Specifications, with full authority to execute the directions of the Engineer without delay and to supply promptly such labor, services, materials, equipment, plant, apparatus, appliances, tools, supplies and other items as may be required. Such superintendent shall not

be removed from the Work without the prior written consent of the Engineer. If, in the opinion of the Engineer, the superintendent or any successor proves incompetent, the Contractor shall replace him with another person approved by the Engineer; such approval, however, shall in no way relieve or diminish the Contractor's responsibility for supervision of the Work.

1.05.3 Whenever the Contractor or his agent or superintendent is not present on any part of the Work where it may be necessary to give directions or instructions with respect to such work, such directions or instructions may be given by the Engineer to and shall be received and obeyed by the designated foreman or any other person in charge of the particular work involved.

## 1.06 INSURANCE

1.06.1 Before starting and until final completion and acceptance of the Work and expiration of the guarantee period provided for in the AGREEMENT the Contractor shall procure and maintain insurance of the types specified in paragraphs (1) to (11), inclusive, below, and to the limits for this insurance specified in Table A at the end of this section. All insurance shall be obtained from companies satisfactory to the Owner and Engineer.

1.06.2 Insurance shall be in such forms as will protect the Contractor from all claims and liability for damages for bodily and personal injury, including accidental death, and for property damage, which may arise from operations under the Contract, whether such operations be by himself, his subcontractors, or by anyone directly or indirectly employed or engaged by him.

1.06.3 The City of Haverhill, Massachusetts (Owner) and the Engineer shall be named as an "additionally insured".

1.06.4 All insurance policies provided by the Contractor shall include a "Waiver of Subrogation" endorsement for the Owner, Engineer and/or other third party entity.

1.06.5 The following types of insurance shall be provided on all policies:

1.06.5.1 Workmen's Compensation and Employer's Liability Insurance.

1.06.5.2 General Liability coverage, including Bodily Injury Insurance for operations and completed operations and Contractor's Protective Bodily Injury Insurance.

1.06.5.3 General Liability coverage, including Property Damage Insurance for operations and completed

operations and Contractor's Protective Property Damage Insurance, each including coverage for injury to or destruction of wires or pipes and similar property and appurtenant apparatus and the collapse of or structural injury to any building or structure except those on which work under the Contract is being done. Blasting and explosion coverage shall be obtained if there is a need for blasting under the Contract, and no blasting shall be performed until such insurance has been secured.

1.06.5.4 Bodily Injury Insurance covering the operation of all motor vehicles owned by the Contractor.

1.06.5.5 Personal Injury Insurance to cover claims for personal injury and including claims brought by employees.

1.06.5.6 Property Damage Insurance covering the operation of all motor vehicles owned by the Contractor.

1.06.5.7 Insurance to cover bodily injuries and property damage resulting from the use of motor vehicles not owned by the Contractor, while such vehicles are being operated in connection with the prosecution of the Work.

1.06.5.8 Contractual Liability Insurance covering the liability assumed by the Contractor under the fifth paragraph of that subsection titled "Obligations and Liability of Contractor" of this AGREEMENT.

1.06.5.9 Owner's/Contractor's Protective Liability and Property Damage Insurance to protect the Owner and the Engineer against claims for Property damage and for bodily injuries, including accidental death, caused by the operations of the Contractor or his subcontractors on the Work. The policy shall indicate the Owner and the Engineer as the named insured. A copy of the policy shall be furnished to the Owner and a Certificate of Insurance shall be furnished to the Engineer.

1.06.5.10 Excess/Umbrella Liability Coverage shall be provided in accordance with the minimum limits stated in Table A.

1.06.5.11 Builders' Risk Insurance with an "All Risk" Installation Floater covering loss by fire and extended coverage in the completed value form in the amount of the total insurable value of all structures, materials, and equipment to be built and installed. The insurance shall be obtained from a company satisfactory to the Owner. The policy shall indicate Owner, the Contractor, all subcontractors, and the Engineer as the named insured with loss payable to the Owner as Trustee. The policy shall provide for a 30-day notice to the Owner of cancellation or restrictive amendment. A copy of the policy shall be furnished to the Owner and a Certificate of Insurance shall be furnished to the Engineer. The insurance shall be obtained before the work is started and shall be maintained until the date of completion of the work as stated in the final estimate,

or until the Owner occupies or otherwise take possession of the structure, whichever occurs first.

1.06.6 All policies shall be so written that the Owner will be notified in writing of cancellation or restrictive amendment at least 30 days prior to the effective date of such cancellation or amendment.

1.06.7 Certificates from the Contractor's insurance carriers stating the coverage provided, the limits of liability, and expiration dates shall be filed in triplicate with the Owner before operations are begun.

1.06.8 Certificates from the contractor naming the Owner, City of Haverhill, Massachusetts and the Engineer as additionally insured must be received by the Owner prior to initiating the work.

1.06.9 Renewal certificates must be furnished by the Contractor prior to the expiration date of any of the initial insurances.

1.06.10 No insurance required or furnished hereunder shall in any way relieve the Contractor of or diminish any of his responsibilities, obligations and liabilities under the Contract.

#### 1.07 PATENTS

1.07.1 The Contractor's attention is directed to the following "Patent Indemnity Clause" illustrating the format and/or required wording therefore which shall be used by all manufacturers and/or suppliers, as deemed necessary by the Owner and Engineer, as an Indemnification and Hold Harmless Agreement.

1.07.2 This Agreement shall be accepted and approved in form by the Owner and Engineer prior to the approval and/or installation of the product.

#### PATENT INDEMNIFICATION

"In consideration for their purchase and use of the (Name of product and/or equipment) manufactured by (name of Manufacturer) and for other good and valuable consideration, (Name of Manufacturer) agrees to defend and hold harmless (Name of Contractor), BETA Group, Inc., and the (Name of Owner), and their employees and agents, from and against any liability, loss, cost, expense or damage including reasonable attorneys' and accountants' fees incurred by these entities in defending or prosecuting any claim for such liability, loss, cost, expense or damage resulting or arising out of a claim that the use of the above mentioned product and/or equipment delivered hereunder directly infringes any United States Patent, provided that (Name of

Manufacturer) is given authority, information, and assistance for the defense of such suit, and (Name of Manufacturer) shall pay all damages and costs assessed against the above named entities for the use of such produce and/or equipment provided, however, that this indemnification shall not apply to equipment of (Name of Contractor) design, and provided further that if the use of such product and/or equipment is enjoined in any suit, (Name of Manufacturer) shall at its own expense and its option either procure for (name of Contractor) the right to continue the normal use of such produce and/or equipment, replace said product and/or equipment, modify said equipment or refund the purchase price thereof; and provided further that (Name of Manufacturer) indemnity as to use shall not apply to infringement resulting from the use of the produce and/or equipment delivered hereunder in combination with other items where use of the product and/or equipment per se does not constitute infringement."

#### 1.08 COMPLIANCE WITH LAWS

1.08.1 The Contractor shall keep himself fully informed of all existing and future federal, state, and local laws, ordinances, rules, and regulations affecting those engaged or employed on the Work, the materials and equipment used in the Work or the conduct of the Work, and of all orders, decrees and other requirements of bodies of tribunals having any jurisdiction or authority over the same. If any discrepancy or inconsistency is discovered in the Drawings, Specifications or other Contract Documents in relation to any such law, ordinance, rule, regulation, order, decree or other requirement, the Contractor shall forthwith report the same to the Engineer in writing. The Contractor shall at all times observe and comply with, and cause all his agents, with all such existing and future laws, ordinances, rules, regulations, orders, decrees and other requirements, and he shall protect, indemnify and save harmless the Owner, its officers, agents, servants and employees, from and against any and all claims, demands, suits, proceedings, liabilities, judgements, penalties, losses, damages, costs and expenses, including attorneys' fees, arising from or based upon any violation or claimed violation of any such law, ordinance, rule, regulation, order, decree or other requirement, whether committed by the Contractor or any of his agents, servants, employees or subcontractors.

#### 1.09 PROVISIONS REQUIRED BY LAW DEEMED INSERTED

1.09.1 Each and every provision of law and clause required by law to be inserted in the Contract shall be deemed to be inserted herein, and the Contract shall be

read and enforced as though they were included herein. If through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party, the Contract shall forthwith be physically amended to make such insertion.

#### 1.10 PERMITS

1.10.1 The Contractor shall, at his own expense, take out and maintain all necessary permits from the county, municipal, or other public authorities; shall give the notices required by law; and shall post all bonds and pay all fees and charges incident to the due and lawful prosecution of the Work.

#### 1.11 NOT TO SUBLET OR ASSIGN

1.11.1 The Contractor shall constantly give his personal attention to the faithful prosecution of the Work, shall keep the same under his personal control, shall not assign the Contract or sublet the Work or any part thereof without the previous written consent of the Owner, and shall not assign any of the moneys payable under the Contract, or his claim thereto, unless by and with the like written consent of the Owner and the Surety on the Contract Bonds. Any assignment or subletting in violation hereof shall be void and unenforceable.

1.11.2 The Contractor shall not sublet or assign work to a subcontractor(s), for a total in excess of fifty (50) percent of the Contract Price, without prior written approval of the Owner and Engineer.

1.11.3 The Contractor shall be fully responsible to the Owner for the acts and omissions of his subcontractors, suppliers, and of persons either directly or indirectly employed by them as he is for the acts and omissions of persons directly employed by him.

1.11.4 The Contractor shall cause appropriate provisions, and applicable State or Federal regulations, to be inserted in all subcontractors relative to the work to bind subcontractors to the Contractor by the terms of the Contract Documents insofar as applicable to the work of subcontractors, and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents.

1.11.5 The Contractor's attention is directed to the fact that nothing contained in this Contract shall create any contractual relation between any subcontractor and the Owner.

#### 1.12 DELAY BY OWNER

1.12.1 The Owner may delay the beginning of the Work or any part thereof if the necessary lands or rights-of-way for such work shall not have been obtained. The

Contractor shall have no claim for additional compensation or damages on account of such delay, but shall be entitled only to any extension of time as hereinafter provided.

#### 1.13 TIME FOR COMPLETION

1.13.1 The rate of progress shall be such that the Work shall be performed and completed in accordance with the Contract before the expiration of the time limit stipulated in Table A at the end of this section, except as otherwise expressly provided herein.

1.13.2 It is agreed that the rate of progress herein required has been purposely made low enough to allow for the ordinary and foreseeable delays incident to construction work of this character. No extension of time will be given for ordinary or foreseeable delays, inclement weather, or accidents and the occurrence of such will not relieve the Contractor from the necessity of maintaining this rate of progress and completing the Work within the stipulated time limit.

1.13.3 If delays are caused by acts of God, acts of Government, unavoidable strikes, extra work, or other cause or contingencies clearly beyond the control or responsibility of the Contractor, the Contractor may be entitled to additional time to perform and complete the Work, provided that the Contractor shall, within ten (10) days from the beginning of such delay notify the Owner in writing, with a copy to the Engineer, of the cause and particulars of the delay. Upon receipt of such notification, the Owner shall review and evaluate the cause and extent of the delay. If, under the terms of the AGREEMENT, the delay is properly excusable, the Owner will, in writing, appropriately extend the time for completion of the Work. (This paragraph will be interpreted to include delays in receipt of equipment provided that the Contractor placed his order and submitted shop drawings for such equipment promptly after execution of the Contract, that he has shown due diligence in following the progress of the order, and that the time required for delivery is in accordance with conditions generally prevailing in the industry.) The Contractor agrees that he shall not have or assert any claim for nor shall he be entitled to any additional compensation or damages on account of such delays.

1.13.4 The time in which the Work is to be performed and completed is of the essence of this AGREEMENT.

#### 1.14 LIQUIDATED DAMAGES

1.14.1 In case the Contractor fails to complete the Work satisfactorily on or before the date of completion fixed herein or as duly extended as hereinbefore provided, the Contractor agrees that the Owner shall deduct from the payments due the Contractor each

month the sum set forth in Table A at the end of this section for each calendar day of delay, which sum is agreed upon not as a penalty, but as fixed and liquidated damages for each day of such delay. If the payments due the Contractor are less than the amount of such liquidated damages, said damages shall be deducted from any other moneys due or to become due the Contractor, and, in case such damages shall exceed the amount of all moneys due or to become due the Contractor, the Contractor or his Surety shall pay the balance to the Owner.

#### 1.15 NIGHT, SATURDAY, SUNDAY AND HOLIDAY WORK

1.15.1 No work shall be done at night, on Saturday on Sunday or on a holiday except (1) usual protective work, such as pumping and the tending of lights, (2) work done in case of emergency threatening injury to persons or property, or (3) if all of the conditions set forth in the next paragraph below are met.

1.15.2 No work other than that included in (1) and (2) above shall be done at night except when (a) in the sole judgment of the Owner, the work will be of advantage to the Owner and can be performed satisfactorily at night, (b) the work will be done by a crew organized for regular and continuous night work, and (c) in the sole judgment of the Owner and Engineer, adequate noise prevention measures are incorporated into the Work by the Contractor to minimize any noise impact within the work area and (d) the Owner has given written permission for such night work. The Contractor is responsible for obtaining all permits and approvals required.

#### 1.16 EMPLOY COMPETENT PERSONS

1.16.1 The Contractor shall employ only competent persons on the Work and shall not employ persons or means which may cause strikes, work stoppages or any disturbances by persons employed by the Contractor, any subcontractor, the Owner, the Engineer or any other contractor. Whenever the Engineer notifies the Contractor in writing that in his opinion any person on the Work is incompetent, unfaithful, disorderly, or otherwise unsatisfactory, or not employed in accordance with the provisions of the Contract, such person shall be discharged from the Work and shall not again be employed on it, except with the written consent of the Engineer.

#### 1.17 EMPLOY SUFFICIENT LABOR AND EQUIPMENT

1.17.1 If in the sole judgment of the Engineer the Contractor is not employing sufficient labor, plant, equipment or other means to complete the Work within the time specified, the Engineer may, after giving

written notice, require the Contractor to employ such additional labor, plant, equipment and other means as the Engineer deems necessary to enable the Work to progress properly.

#### 1.18 INTOXICATING LIQUORS AND/OR DRUGS

1.18.1 The Contractor shall not sell and shall neither permit nor suffer the introduction and/or use of intoxicating liquors and/or drugs upon or about the Work.

#### 1.19 ACCESS TO WORK

1.19.1 The Owner, the Engineer, and their officers, agents, servants and employees may at any and all times and for any and all purposes, enter upon the Work and the site thereof and the premises used by the Contractor, and the Contractor shall at all times provide safe and proper facilities therefor.

#### 1.20 EXAMINATION OF WORK

1.20.1 The Engineer shall be furnished by the Contractor with every reasonable facility for examining and inspecting the Work and for ascertaining that the Work is being performed in accordance with the requirements and intent of the Contract, even to the extent of requiring the uncovering or taking down portions of furnished work by the Contractor.

1.20.2 Should the work thus uncovered or taken down prove satisfactory, the cost of uncovering or taking down and the replacement thereof shall be considered as extra work unless the original work was done in violation of the Contract in point of time or in the absence of the Engineer or his inspector and without his written authorization, which case said cost shall be borne by the Contractor. Should the work uncovered or taken down prove unsatisfactory, said cost shall likewise borne by the Contractor.

1.20.3 Examination of inspection of the Work shall not relieve the Contractor of any of his obligations to perform and complete the Work as required by the Contract.

#### 1.21 DEFECTIVE WORK, ETC.

1.21.1 Until acceptance and during the applicable guarantee period thereafter, the Contractor shall promptly, without charge, repair, correct or replace work, equipment, materials, apparatus or parts thereof which are defective, damaged or unsuitable or which in any way fail to comply with or be in strict accordance with the provisions and requirements of the Contract or applicable guarantee and shall pay to the Owner all

resulting costs, expenses, losses or damages suffered by the Owner.

1.21.2 If any material, equipment, apparatus or other items brought upon the site for use or incorporation in the Work, or selected for the same, is rejected by the Engineer as unsuitable or not in conformity with the Specifications or any of the other Contract Documents, the Contractor shall forthwith remove such materials, equipment, apparatus and other items from the site of the Work and shall at his own cost and expense make good and replace the same and any material furnished by the Owner which shall be damaged or rendered defective by the handling or improper installation by the Contractor, his agents, servants, employees or subcontractors.

#### 1.22 PROTECTION AGAINST WATER AND STORM

1.22.1 The Contractor shall take all precautions necessary to prevent damage to the Work by storms or by water entering the site of the Work directly or through the ground. In case of damage by storm or water, the Contractor shall at his own cost and expense make such repairs or replacements or rebuild such parts of the Work as the Engineer may require in order that the finished Work may be completed as required by the Contract.

#### 1.23 RIGHT TO MATERIALS

1.23.1 Nothing in the Contract shall be construed as vesting in the Contractor any right of property in the materials, equipment, apparatus and other items furnished after they have been installed or incorporated in or attached or affixed to the Work or the site, but all such materials, equipment, apparatus and other items shall, upon being so installed, incorporated, attached or affixed, become the property of the Owner. Nothing in this subsection shall relieve the Contractor of his duty to protect and maintain all such materials, equipment, apparatus and other items.

#### 1.24 CHANGES

1.24.1 The Owner, through the Engineer, may make changes in the Work and in the Drawings and Specifications therefor by making alterations therein, additions thereto or omissions therefrom. All work resulting from such changes shall be performed and furnished under the pursuant to the terms and conditions of the Contract. If such changes result in an increase or decrease in the Work to be done hereunder, or increase or decrease the quantities thereof, adjustment in compensation shall be made therefor at the unit prices stipulated in the Contract for such work, except that if unit prices are not stipulated for such work, compensation for additional or increased work shall be made as provided hereinafter under the subsection titled "Extra Work"; and for eliminated or decreased work the

Contractor shall allow the Owner a reasonable credit as determined by the Engineer.

1.24.2 Except in an emergency endangering life or property, no change shall be made unless in pursuance of a written order from the Engineer authorizing the change, and no claim for additional compensation shall be valid unless the change is so ordered.

1.24.3 The Contractor agrees that he shall neither have nor assert any claim for or be entitled to any additional compensation for damages or for loss of anticipated profits on work that is eliminated.

#### 1.25 EXTRA WORK

1.25.1 The Contractor shall perform any extra work (work in connection with the Contract but not provided for herein) when and as ordered in writing by the Engineer, at the unit prices stipulated in the Contract for such work or, if none are so stipulated, whether (a) at the price agreed upon before such work is commenced and named in the written order for such work, or (b) if the Engineer so elects, for the reasonable cost of such work, as determined by the contractor and approved by the Engineer, plus a percentage of such cost, as set forth below. No extra work shall be paid for unless specifically ordered as such in writing by the Engineer.

1.25.2 The Contractor shall submit claim for any extra work within fourteen (14) calendar days of performing said extra work.

1.25.3 The cost of extra work done under (b) above shall include the reasonable cost to the Contractor of materials used and equipment installed, common and skilled labor, and foremen, and the fair rental of all machinery and equipment used on the extra work for the period of such use.

1.25.4 At the request of the Engineer, the Contractor shall furnish itemized statements for the cost of the extra work ordered as above and give the Engineer access to all records, accounts, bills and vouchers and correspondence relating thereto.

1.25.5 The Contractor may include in the cost of extra work the amounts of additional premiums, if any, (other than premiums on bonds) paid on the required insurance on account of such extra work, of Social Security or other direct assessments upon the Contractor's payroll by Federal or other properly authorized public agencies, and of other approved assessments when such assessments are not normally included in payments made by the Contractor directly to his employees, but in fact are, and are customarily recognized as, part of the cost of doing work.

1.25.6 The fair rental hourly rate for all machinery and equipment shall be based upon the most recent edition of "Rental Rate Blue Book" published by Equipment Watch or a similar publication approved by the Engineer. Hourly rental rates for machinery and equipment shall be developed by dividing the monthly Blue Book rates by 176 hours per month plus Estimated Hourly Operating Costs (FHWA rate). Rate Adjustment tables shall be utilized for equipment model year and region of operation. If said extra work requires the use of machinery or equipment not already on the site of the Work the cost of transportation, not exceeding a distance of 100 miles, of such machinery or equipment to and from the Work shall be added to the fair monthly rental; provided, however, that this shall not apply to machinery or equipment already required to be furnished under the terms of the Contract.

1.25.7 The Contractor shall not include in the cost of extra work any cost or rental of small tools, building, or any portion of the time of the Contractor, his superintendent, or his office and engineering staff.

1.25.8 To the cost of extra work done by the Contractor's own forces under (b) above (determined as stated above), the Contractor may add 15 percent to cover his overhead, use of capital, the premium on the Bonds as assessed upon the amount of this extra work, and profit.

1.25.9 In the case of extra work done under (b) by a subcontractor the subcontractor shall compute, as above, his cost for the extra work, to which he may add 15 percent as in the case of the Contractor. The Contractor shall be allowed an additional 5 percent of the subcontractor's initial cost for the extra work prior to the 15 percent adjustment, to cover the costs of the Contractor's overhead use of capital, the premium on the Bonds as assessed upon the amount of this work, and profit. Said subcontractor's cost must be reasonable and approved by the Engineer.

1.25.10 If extra work is done under (b) above, the Contractor and/or subcontractor shall keep daily records of such extra work. The daily record shall include the names of men employed, the nature of the work performed, and hours worked, materials and equipment incorporated, and machinery or equipment used, if any, in the prosecution of such extra work. This daily record, to constitute verification that the work was done, must be signed both by the Contractor's authorized representative and by the Engineer. A separate daily record shall be submitted for each Extra Work Order.

## 1.26 EXTENSION OF TIME ON ACCOUNT OF EXTRA WORK

1.26.1 When extra work is ordered near the completion of the Contract or at any time during the progress of the Work which unavoidably increases the time for the completion of the Work, and extension of time shall be granted as hereinbefore provided.

## 1.27 CHANGES NOT TO AFFECT BONDS

1.27.1 It is distinctly agreed and understood that any changes made in the Work or the Drawings or Specifications therefor (whether such changes increase or decrease the amount thereof or the time required for its performance) or any changes in the manner of time of payments made by the Owner to the Contractor, or any other modifications of the Contract, shall in no way annul, release, diminish or affect the liability of the Surety on the CONTRACT BONDS given by the Contractor, it being the intent hereof that notwithstanding such changes the liability of the Surety on said bonds continue and remain in full force and effect.

## 1.28 CLAIMS FOR DAMAGES

1.28.1 If the Contractor makes claim for any damages alleged to have been sustained by breach of contract or otherwise, he shall, within ten (10) days after occurrence of the alleged breach or within ten (10) days after such damages are alleged to have been sustained, whichever date is the earlier, file with the Engineer a written, itemized statement of the details of the alleged breach and the details and amount of the alleged damages. The Contractor agrees that unless such statement is made and filed as so required, his claim for damages shall be deemed waived, invalid and unenforceable, and that he shall not be entitled to any compensation for any such alleged damages. Within ten (10) days after the timely filing of such statement, the Engineer shall file with the Owner a copy of the statement, together with his recommendations for action by the Owner.

1.28.2 The Contractor shall not be entitled to claim any additional compensation for damages by reason of any direction instruction, determination or decision of the Engineer, nor shall any such claims be considered, unless the Contractor shall have complied in all respects with the Article titled "Authority of the Engineer", including, but not limited to the filing of a written protest in the manner and within the time therein provided.

## 1.29 ABANDONMENT OF WORK OR OTHER DEFAULT

1.29.1 If the Work shall be abandoned, or any part thereof shall be sublet without previous written consent of the Owner, or the Contract or any moneys payable

hereunder shall be assigned otherwise than as herein specified, or if at any time the Engineer shall be of the opinion, and shall so certify in writing, that the conditions herein specified as to rate of progress are not being complied with, or that the Work or any part thereof is being unnecessarily or unreasonably delayed, or that the Contractor has violated or is in default under any of the provisions of the Contract, or if the Contractor becomes bankrupt or insolvent or goes or is put into liquidation or dissolution, either voluntarily or involuntarily, or petitions for an arrangement or reorganization under the Bankruptcy Act, or makes a general assignment for the benefit of creditors or otherwise acknowledges insolvency, the happening of any of which shall be and constitute a default under the Contract, the Owner may notify the Contractor in writing, with a copy of such notice mailed to the Surety, to discontinue all Work or any part thereof; thereupon the Contractor shall discontinue such Work or such part thereof as the Owner may designate; and the Owner may, upon giving such notice, by contract or otherwise as it may determine, complete the Work or such part thereof and charge the entire cost and expense of so completing the Work or such part thereof to the Contractor. In addition to the said entire cost and expense of completing the Work, the Owner shall be entitled to reimbursement from the Contractor and the Contractor agrees to pay to the Owner any losses, damages, costs and expenses, including attorney's fees, sustained or incurred by the Owner by reason of any of the foregoing causes. For the purposes of such completion the Owner may for itself or for any Contractors employed by the Owner take possession of and use or cause to be used any and all materials, equipment, plant, machinery, appliances, tools, supplies and such other items of every description that may be found or located at the site of the Work.

1.29.2 All costs, expenses, losses, damages, attorney's fees and any and all other charges incurred by the Owner under this subsection shall be charged against the Contractor and deducted and/or paid by the Owner out of any moneys due of payable or to become due or payable under the Contract to the Contractor; in computing the amounts chargeable to the Contractor the Owner shall not be held to a basis of the lowest prices for which the completion of the Work or any part thereof might have been accomplished, but all sums actually paid or obligated therefor to effect its prompt completion shall be charged to and against the account of the Contractor. In case the costs, expenses, losses, damages, attorney's fees and other charges together with all payments theretofore made to or for the account of the Contractor are less than the sum which would have been payable under the Contract if the Work had been properly performed and completed by the Contractor, the Contractor shall be entitled to receive the difference, and, in case such costs, expenses, losses, damages,

attorneys' fees and other charges, together with all payments theretofore made to or for the account of the Contractor, shall exceed the said sum, the Contractor shall pay the amount of the excess to the Owner.

### 1.30 PRICES FOR WORK

1.30.1 The Owner shall pay and the Contractor shall receive the prices stipulated in the BID made a part hereof as full compensation for everything performed and furnished and for all risks and obligations undertaken by the Contractor under and as required by the Contract.

### 1.31 MONEYS MAY BE RETAINED

1.31.1 The Owner may at any time retain from any moneys which would otherwise be payable hereunder so much thereof as the Owner may deem necessary to complete the Work hereunder and to reimburse it for all costs, expenses, losses, damage and damages chargeable to the Contractor hereunder, in accordance with the States General Laws.

### 1.32 FORMAL ACCEPTANCE

1.32.1 This Agreement constitutes an entire contract for one whole and complete Work or result. Fixing of the date of completion and acceptance of the Work or a specified part thereof shall only be effective when accomplished by a writing specifically so stating and signed by the Owner.

### 1.33 PROGRESS ESTIMATES

1.33.1 Once a month, except as hereinafter provided, the Engineer shall make an estimate in writing of the total amount and value of the work done to the first of the month by the Contractor. The Owner shall retain a percentage of such estimated value, as set forth in Table A at the end of this section, as part security for fulfillment of the Contract by the Contractor and shall deduct from the balance all previous payments made to the Contractor, all sums chargeable against the Contractor and all sums to be retained under the provisions of the Contract.

1.33.2 Estimates of lump-sum items shall be based on a schedule dividing each such item into its appropriate component parts together with a quantity and a unit price for each part so that the sum of the products of prices and quantities will equal the Contract price for the item. This schedule must be submitted by the Contractor for and must have the approval of the Engineer before the first estimate becomes due.

1.33.3 If the Engineer determines that the progress of the Work will be benefited by the delivery to the site of certain materials and equipment, when available, in

advance of actual requirement therefor and if such materials and equipment are delivered and properly stored, protected and insured as determined by the Engineer, the cost to the Contractor or subcontractor as established by invoices or other suitable vouchers satisfactory to the Engineer, less the retained percentages as above provided, may be included in the progress estimates; provided always that there be duly executed and delivered by the Contractor to the Engineer at the same time a Bill of Sale in form satisfactory to the Owner, transferring and assigning to the Owner full ownership and title to such materials or equipment.

1.33.4 The Owner shall pay monthly to the Contractor in accordance with General Laws Chapter 30, Section 39, as amended:

1.33.4.1 Within fifteen (15) days (twenty-four (24) days in the case of the Commonwealth) after receipt from the Contractor, at the place designated by the Owner if such a place is so designated, of a periodic estimate requesting payment of the amount due for the preceding month, the Owner will make periodic payment to the Contractor for the work performed during the preceding month and for the materials not incorporated in the work but delivered and suitably stored at the site (or at some location agreed upon in writing) to which the Contractor has title or to which a subcontractor has title and has authorized the Contractor to transfer title to the Owner, less (1) a retention based on its estimate of the fair value of its claims against the Contractor and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section 39F and less (3) a retention not exceeding five percent of the approved amount of the periodic payment. After the receipt of a periodic estimate requesting final payment and within 65 days after (a) the Contractor fully completes the work or substantially completes the work so that the value of the work remaining to be done is, in the estimate of the awarding authority, less than one percent of original contract price, or (b) the Contractor substantially completes the work and the Owner takes possession for occupancy, whichever occurs first, the Owner shall pay the Contractor the entire balance due on the contract less (1) a retention based on its estimate of the fair value of its claims against the Contractor and of the cost of completing the incomplete and unsatisfactory items of work and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section 39 F, or based on the record of payments by the Contractor to the subcontractors under this contract if such record of payment indicates that the Contractor has not paid subcontractors as provided in section 39 F. If the Owner fails to make payment as herein provided, there shall be added to each such payment daily interest at the rate of three percentage points above the rediscount rate than

charged by the Federal Reserve Bank of Boston commencing on the first day after said payment is due and continuing until payment delivered or mailed to the Contractor; provided, that no interest shall be due, in any event, on the amount due on periodic estimate for final payment until 15 days (24 days in the case of the Commonwealth) after receipt of such a periodic estimate from the Contractor, at the place designated by the Owner if such a place is so designated. The Contractor agrees to pay to each subcontractor a portion of any such interest in accordance with the amount due each subcontractor.

1.33.4.2 Forthwith after the Contractor receives payment on account of a periodic estimate, the Contractor shall pay to each subcontractor the amount paid for the labor performed and the materials furnished by that subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the Contractor.

1.33.4.3 Not later than the 65th day after each subcontractor substantially completes his work in accordance with the plans and specifications, the entire balance due under the subcontract less amounts retained by the Owner as the estimated cost of completing the incomplete and unsatisfactory items of work, shall be due the subcontractor; and the Owner shall pay that amount to the Contractor. The Contractor shall forthwith pay to the subcontractor the full amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the Contractor.

1.33.4.4 Each payment made by the Owner to the Contractor pursuant to subparagraphs (2) and (3) of this paragraph for the labor performed and the materials furnished by a subcontractor shall be made to the Contractor for the account of that subcontractor; and the Owner shall take reasonable steps to compel the Contractor to make each such payment to each such subcontractor. If the Owner has received a demand for direct payment from a subcontractor for any amount which has already been included in a payment to the Contractor or which is to be included in a payment to the Contractor for payment to the subcontractor as provided in subparagraphs (2) and (3), the Owner shall act upon the demand as provided in this section.

1.33.4.5 If, within 70 days after the subcontractor has substantially completed the subcontract work, the subcontractor has not received from the Contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the Contractor, less any amount retained by the Owner as the estimated cost of completing the incomplete and unsatisfactory items of work, the subcontractor may demand direct payment of that balance from the Owner. The demand shall be by a sworn statement delivered to

or sent by certified mail to the Owner, and a copy shall be delivered to or sent by certified mail to the Contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the 70th day after the subcontractor has substantially completed the subcontract work. Within ten days after the subcontractor has delivered or so mailed the demand to the Owner and delivered or so mailed a copy to the Contractor, the Contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the Owner and a copy shall be delivered to or sent by certified mail to the subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the Contractor and of the amount due for each claim made by the Contractor against the subcontractor.

1.33.4.6 Within 15 days after receipt of the demand by the Owner, but in no event prior to the 17th day after substantial completion of the subcontract work, the Owner shall make direct payment to the subcontractor of the balance due under the subcontract including any amount due for extra labor and materials furnished to the Contractor, less any amount (i) retained by the Owner as the estimated cost of completing the incomplete or unsatisfactory items of work, (ii) specified in any court proceedings barring such payment, or (iii) disputed by the Contractor in the sworn reply; provided, that the Owner shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (5). The Owner shall make further direct payments to the subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

1.33.4.7 The Owner shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (6) in an interest-bearing joint account in the names of the Contractor and the subcontractor in a bank in Massachusetts selected by the Owner or agreed upon by the Contractor and the subcontractor and shall notify the Contractor and the subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the Contractor and the subcontractor or as determined by decree of a court of competent jurisdiction.

1.33.4.8 All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to

subparagraph (7) shall be made out of amounts payable to the Contractor at the time of receipt of a demand for direct payment from a subcontractor and out of amounts which later become payable to the Contractor and in the order of receipt of such demands from subcontractors. All direct payments shall discharge the obligation of the Owner to the Contractor to the extent of such payment.

1.33.4.9 The Owner shall deduct from payments to a Contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (7), are sufficient to satisfy all unpaid balances of demands for direct payment received from subcontractors. All such amounts shall be earmarked for such direct payments, and the subcontractors shall have a right in such deductions prior to any claims against such amounts by creditors of the Contractor.

1.33.4.10 If the subcontractor does not receive payment as provided in subparagraph (2) or if the Contractor does not submit a periodic estimate for the value of the labor or materials performed or furnished by the subcontractor and the subcontractor does not receive payment for same when due less the deductions provided for in subparagraph (2), the subcontractor may demand direct payment by following the procedure in subparagraph (5) and the Contractor may file a sworn reply as provided in that same subparagraph. A demand made after the first day of the month following that for which the subcontractor seeks payment shall be valid even if delivered or mailed prior to the time payment was due on a periodic estimate from the Contractor. Thereafter the Owner shall proceed as provided in subparagraph (6), (7), (8), and (9).

1.33.4.11 "Subcontractor" as used in subparagraph 10, shall mean a person who files a sub-bid and receives a subcontract as a result of that filed sub-bid or who is approved by the Owner in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the Contractor.

#### 1.34 PARTIAL ACCEPTANCE

1.34.1 The Owner may, at any time in a written order to the Contractor (1) declare that he intends to use a specified part of the Work which in his opinion is sufficiently complete, in accordance with the Contract Documents, to permit its use; (2) enclose a tentative list of items remaining to be completed or corrected, and (3) fix the date of acceptance of that specified part of the Work.

1.34.2 Within 45 days after acceptance under this subsection, the Engineer shall make an estimate in writing of the amount and value of the part of the Work so accepted. The Owner shall pay said amount to the Contractor after deducting therefrom all previous payments, all charges against the Contractor as provided

for hereunder, and all amounts to be retained under the provisions of the Contract, said payment to be made at the time of the next monthly progress estimate.

1.34.3 Acceptance by the Owner under this subsection shall not relieve the Contractor of any obligations under the Contract Documents except to the extent agreed upon in writing between the Owner and the Contractor.

1.34.4 The Owner shall have the right to exclude the Contractor from any part of the Work which has been accepted, but the Owner will allow the Contractor reasonable access thereto to complete or correct items on the tentative list.

### 1.35 FINAL ESTIMATE AND PAYMENT

1.35.1 As soon as practicable (but not more than sixty-five (65) days after final completion of the Work), the Engineer shall make a final estimate in writing of the quantity of Work done under the Contract and the amount earned by the Contractor.

1.35.2 The Owner shall pay to the Contractor the entire amount found by the Engineer to be earned and due hereunder after deducting therefrom all previous payments, all charges against the Contractor as provided for hereunder, and all amounts to be retained under the provisions of the Contract. Except as in this subsection otherwise provided, such payment shall be made not later than fifteen (15) days after but in no event before, the expiration of the time within which claims for labor performed or materials or equipment furnished must be filed under the applicable Lien Law, or, if such time is not specified by law, the expiration of thirty (30) days after the completion of the Engineer's final estimate.

1.35.3 All quantities shown on progress estimates and all prior payments shall be subject to correction in the final estimate and payment as determined by the Engineer.

1.35.4 The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor under or by virtue of this Agreement; and upon satisfactory completion of the work performed under this Agreement, as a condition before final payment under this Agreement or as a termination settlement under this Agreement the Contractor shall execute and deliver to the Owner a release of all claims against the Owner arising under or by virtue of, this Agreement, except claims which are specifically exempted by the Contractor to be set forth herein. Unless otherwise provided in this Agreement, by State law or otherwise expressly agreed to by the parties to this Agreement, any payment, including final payment under this Agreement or settlement upon termination of this Agreement shall

not constitute a waiver of the Owner's claims against the Contractor or his sureties under this Agreement or applicable Performance and Labor and Materials Bonds.

### 1.36 LIENS

1.36.1 If at any time any notices of lien are filed and labor performed or materials or equipment manufactured, furnished, or delivered to or for the Work, the Contractor shall, at its own cost and expense, promptly discharge, remove or otherwise dispose of the same, and until such discharge, removal or disposition, the Owner shall have the right to retain from any moneys payable hereunder an amount which, in its sole judgement, it deems necessary to satisfy such liens and pay the costs and expenses, including attorneys' fees, of defending any actions brought to enforce the same, or incurred in connection therewith or by reason thereof.

### 1.37 CLAIMS

1.37.1 If at any time there be any evidence of any claims for which the Contractor is or may be liable or responsible hereunder, the Contractor shall promptly settle or otherwise dispose of the same, and until such claims are settled or disposed of, the Owner may retain from any moneys which would otherwise be payable hereunder so much thereof as, in its sole judgement, it may deem necessary to settle or otherwise dispose of such claims and to pay the costs and expenses, including attorney's fees, of defending any actions brought to enforce such claims, or incurred in connection therewith or by reason thereof.

### 1.38 APPLICATION OF MONEYS RETAINED

1.38.1 The Owner may apply any moneys retained hereunder to reimburse itself for any and all costs, expenses, losses, damage and damages, liabilities, suits, judgements and awards incurred, suffered or sustained by the Owner and chargeable to the Contractor hereunder or as determined hereunder.

### 1.39 NO WAIVER

1.39.1 Neither the inspection by the Owner or the Engineer, nor any order, measurement, approval, determination, decision or certificate by the Engineer, nor any order by the Owner for the payment of money, nor any payment for or use, occupancy, possession or acceptance of the whole or any part of the Work by the Owner, nor any extension of time, nor any other act or omission of the Owner or of the Engineer shall constitute or be deemed to be an acceptance of any defective or improper work, materials, or equipment nor operate as a waiver of any requirement or provision of the Contract, nor of any remedy, power or right of or herein reserved to the Owner, nor of any right to

damages for breach of contract. Any and all rights and/or remedies provided for in the Contract are intended and shall be construed to be cumulative; and, in addition to each and every other right and remedy provided for herein or by law, the Owner shall be entitled as of right to a writ of injunction against any breach or threatened breach of the Contract by the Contractor, by his subcontractors or by any other person or persons.

#### 1.40 LIABILITY OF OWNER

1.40.1 No person, firm or corporation, other than the Contractor who signed this Contract as such, shall have any interest herein or right hereunder. No claim shall be made or be valid either against the Owner or any agent of the Owner and neither the Owner nor any agent of the Owner shall be liable for or be held to pay any money, except as herein provided. The acceptance by the Contractor of the payment as fixed in the final estimate shall operate as and shall be a full and complete release of the Owner and of every agent of the Owner of and from any and all claims, demands, damages and liabilities of, by or to the Contractor for anything done or furnished for or arising out of or relating to or by reason of the Work or for or on account of any act or neglect of the Owner or of an agent of the Owner or of any other person, arising out of, relating to or by reason of the Work, except the claim against the Owner for the unpaid balance, if any there be, of the amounts retained as herein provided.

#### 1.41 GUARANTEE

1.41.1 The Contractor guarantees that the Work and services to be performed under the Contract, and all workmanship, materials and equipment performed, furnished, used or installed in the construction of the same, shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Drawings, Specifications, and other Contract Documents, that the strength of all parts of all manufactured equipment shall be adequate and as specified and that the performance test requirements of the Contract shall be fulfilled. This guarantee shall be for a period of one year from and after the date of completion and acceptance of the Work as stated in the final estimate. If part of the Work is accepted in accordance with that subsection of this AGREEMENT titled "Partial Acceptance", the guarantee for that part of the Work shall be for a period of one year from the date fixed for such acceptance.

1.41.2 If at any time within the said period of guarantee any part of the Work requires repairing, correction or replacement, the Owner may notify the Contractor in writing to make the required repairs, correction, or replacements. If the Contractor neglects to commence making such repairs, correction, or

replacements to the satisfaction of the Owner within three (3) days from the date of receipt of such notice, or having commenced fails to prosecute such Work with diligence, the Owner may employ other persons to make the same, and all direct and indirect costs of making said repairs, correction or replacements, including compensation for additional professional services, shall be paid by the Contractor.

#### 1.42 RETURN OF DRAWINGS

1.42.1 All Drawings furnished by the Owner or the Engineer to the Contractor may be used only in connection with the prosecution of the Work and shall be returned by the Contractor upon completion of the Work.

#### 1.43 CLEANING UP

1.43.1 The Contractor at all times shall keep the site of the Work free from rubbish and debris caused by his operations under the Contract. When the Work has been completed, the Contractor shall remove from the site of the Work all of his plant, machinery, tools, construction equipment, temporary work, and surplus materials so as to leave the Work and the site clean and ready for use.

#### 1.44 LEGAL ADDRESS OF CONTRACTOR

1.44.1 The Contractor's business address and his office at or near the site of the Work are both hereby designated as places to which communications shall be delivered. The depositing of any letter, notice, or other communication in a postpaid wrapper directed to the Contractor's business address in a post office box regularly maintained by the Post Office Department or the delivery at either designated address of any letter, notice, or other communication by mail or otherwise shall be deemed sufficient service thereof upon the Contractor, and the date of such service shall be the date of receipt. The first-named address may be charged at any time by an instrument in writing, executed and acknowledged by the Contractor delivered to the Engineer. Service of any notice, letter, or other communication upon the Contractor personally shall likewise be deemed sufficient service.

#### 1.45 HEADINGS

1.45.1 The headings or titles of any section, subsection, paragraph, provision, or part of the Contract Documents shall not be deemed to limit or restrict the content, meaning or effect of such section, subsection, paragraph, provision or part.

#### 1.46 MODIFICATION OR TERMINATION

1.46.1 Except as otherwise expressly provided herein, the Contract may not be modified or terminated except in writing signed by the parties hereto.

1.47 DIRECT LABOR COST

1.47.1 Direct labor cost percentage for change orders shall be \_\_\_\_ percent. (Direct labor cost percent shall be established following award and prior to execution of the Contract).

Section 999 (b) (3) and (4) of the Internal Revenue Code of 1954, as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Massachusetts General Laws.

1.48 MASSACHUSETTS TAX LAWS

1.48.1 The Contractor shall provide a statement that indicates compliance with all the requirements of Massachusetts General Law Chapter 62C.

1.49 MINORITY BUSINESS

1.49.1 The goal for minority business enterprise (MBE/WBE) participation for this contract is a minimum of zero percent (0%) MBE and zero percent (0%) WBE participation, on the basis of the total dollars paid. The Contractor shall take all affirmative steps necessary to achieve this goal, and shall provide reports documenting the portion of contract and subcontract dollars paid to minority businesses, and its efforts to achieve the goals, with each invoice submitted or at such greater intervals as specified by the (Insert client name). The Contractor shall require similar reports from its subcontractors.

1.50 TERMINATION FOR CONVENIENCE

1.50.1 This Agreement may be terminated by the Owner upon not less than seven days' written notice for the Owner's convenience. In the case of termination for convenience, the Owner shall be responsible for amounts due the Contractor for work performed through the date of termination, provided that the Contractor shall submit a request for payment in accordance with the provisions hereof. The Contractor shall have no other claim for payments due with respect to such termination including any claim for lost profits with respect to the balance of the project.

1.51 EQUAL EMPLOYMENT OPPORTUNITY, ANTIDISCRIMINATION AND AFFIRMATIVE ACTION

1.51.1 The Contractor shall not discriminate against or exclude any person from participation herein on grounds of race, religion, color, sex, age, or national origin; and that it shall take affirmative actions to insure that applicants are employed, and that employees are treated during their employment, without regard to race, religion, color, sex, age, handicapped status, or national origin.

1.52 UNLAWFUL CONDUCT AND PARTICIPATION IN BOYCOTT

1.52.1 The Contractor shall not participate in or cooperate with an international boycott, as defined in

IN WITNESS WHEREOF, the parties to this AGREEMENT have hereunto set their hands and seals, and have executed, or caused to be executed by their duly authorized officials, the AGREEMENT in Four (4) copies, each of which shall be deemed an original, as of the day and year first above-written.

City of Haverhill:

For the Contractor:

\_\_\_\_\_  
Mayor Date  
Melinda E. Barrett

\_\_\_\_\_  
Signature Date

\_\_\_\_\_  
Steven S. Bucuzzo Date  
Purchasing Director

\_\_\_\_\_  
Print Name & Title

\_\_\_\_\_  
Department Head

Certified as to Availability of Funding  
Pursuant to M.G.L. c. 44, §31(c)

\_\_\_\_\_  
Corporate Secretary  
Print Name:

\_\_\_\_\_  
Angel Perkins  
Director of Finance & City Auditor

Approved as to Form:

\_\_\_\_\_  
City Solicitor Date

\_\_\_\_\_  
Print Name

**CERTIFICATE OF OWNER'S LEGAL COUNSEL**

I, the undersigned, \_\_\_\_\_ the duly authorized and acting legal representative of the \_\_\_\_\_, acting herein through its \_\_\_\_\_, do hereby certify as follows:

I have examined the foregoing contract and surety bonds and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with the terms, conditions, and provisions thereof.

By: \_\_\_\_\_  
(Signature)

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

\_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, State, Postal code)

**Auditor's/Accountant's Certification**

Pursuant to M.G.L. c.44, s31C, I certify that an appropriation has been made in the total amount of the contract.

\_\_\_\_\_  
(Signature)

\_\_\_\_\_

**CERTIFICATE OF ACKNOWLEDGMENT OF CONTRACTOR IF A CORPORATION  
For AGREEMENT**

State of \_\_\_\_\_ )

County \_\_\_\_\_ )

ON THIS \_\_\_\_\_ DAY OF \_\_\_\_\_, 20 \_\_\_\_\_, BEFORE ME  
PERSONALLY

came \_\_\_\_\_ to me known, who being me duly

sworn, did depose and say as follows:

That he resides at \_\_\_\_\_

and is the \_\_\_\_\_

of \_\_\_\_\_

the corporation described in and which executed the foregoing instrument; that he knows the corporate seal of said corporation; that the seal affixed to the foregoing instrument is such corporate seal and it was so affixed by order of the Board of Directors of said corporation; and that by the like order he signed thereto his name and official designation.

\_\_\_\_\_  
Notary Public

(Seal)

My commission expires \_\_\_\_\_

**TABLE A**

Agreement Subsection Reference	Item	Minimum limits
1.06	Workman's Compensation and Employer's Liability Insurance	As required by the law of the State of Massachusetts
1.06	General Liability including Contractor's Protective, Completed Operations and Contractual Liability	<p>Bodily Injury/Property Damage including C.U. Coverage</p> <hr/> <p><b>\$1,000,000</b> (Each Occurrence)</p> <hr/> <p><b>\$2,000,000</b> (Aggregate)</p> <hr/> <p>Blasting and explosion coverage shall be obtained if there is a need for blasting under the contract.</p>
1.06	Personal Injury Insurance	<b>\$2,000,000</b> (Aggregate)
1.06	Automobile Liability including coverage for owned, hired or borrowed vehicles	<p>Bodily Injury/Property Damage</p> <hr/> <p><b>\$1,000,000</b> Combined Single Limit (Each Occurrence)</p>
1.06	Owner's/Contractor's Protective (OCP) Liability & Property Damage	<p>Bodily Injury/Property Damage</p> <hr/> <p><b>\$3,000,000</b> (Each Occurrence)</p> <p><b>\$3,000,000</b> (Aggregate)</p>
1.06	Excess/Umbrella Liability Coverage	<p><b>\$5,000,000</b> (Each Occurrence)</p> <p><b>\$5,000,000</b> (Aggregate)</p>
1.06	Builder's Risk Insurance (If Applicable)	Total insurable value of all structures, materials, and equipment to be built and installed.
1.13	a) Time of Completion - Total Contract	Within <b>550 consecutive calendar days</b> after the date specified in the Notice to Proceed
1.14	Liquidated Damages for each consecutive calendar day of delay in completion time	\$500.00
1.33	Percentage of Progress Estimates to be Retained	5%

**END OF SECTION**

**SECTION 00600**

**CONTRACT BONDS**

**PERFORMANCE BOND**

(NOTE: This Bond is issued simultaneously with the attached Labor and Materials Bond in favor of the Owner.)

KNOW ALL MEN BY THESE PRESENTS:

That we, \_\_\_\_\_  
(an individual, a partnership, a corporation)

duly organized under the Laws of the State (or Commonwealth) of \_\_\_\_\_,

and having a usual place of business at \_\_\_\_\_,

\_\_\_\_\_

as Principal, and \_\_\_\_\_, a corporation duly organized

under the Laws of the State (or Commonwealth) of \_\_\_\_\_,

and duly authorized to do business in the Commonwealth of Massachusetts,

and having a usual place of business at \_\_\_\_\_

as Surety, are holden and stand firmly bound and obligated unto the City of Haverhill, Massachusetts, as obligee, in the sum of

\_\_\_\_\_ lawful money of the United States of America, to and for the true payment whereof we bind ourselves and, each of us, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal, be means of a written AGREEMENT (which together with the Contract Documents in said AGREEMENT referred to are collectively sometimes referred to as the "Contract") dated \_\_\_\_\_, has entered into a contract with the said obligee for "City of Haverhill, MA, Rosemont Street Bridge over Little River, Bridge No. H-12-024 (CFF), Contract No. IFB006.25" in the City of Haverhill, Massachusetts, a copy of which agreement is attached hereto and by references made a part hereof.

NOW THEREFORE, THE CONDITION of this obligation is such that if the Principal shall well and truly keep and fully and faithfully perform all of the terms and conditions of said AGREEMENT and of the "Contract Documents" referred to in said AGREEMENT (which collectively are hereinafter and in

said AGREEMENT sometimes referred to as the "Contract") and all modifications thereof on the Principal's part to be performed, this obligation shall be void; otherwise it shall remain in full force and effect.

Whenever the said Principal shall be, and declared by the Owner to be, in default under the said Contract,

the Owner having performed the Owner's obligations thereunder Surety, for value received, shall promptly remedy the default, or, at the option of the Owner, shall promptly:

- (a) Complete the said AGREEMENT and/or Contract in accordance with its terms and conditions, or
- (b) Obtain a bid or bids for submission to and the approval of the Owner for completing the said AGREEMENT and/or Contract and any modifications thereof in accordance with the terms and conditions thereof, and upon determination by the Owner and the Surety of the lowest responsible and acceptable bidder, arrange for a contract between such bidder and the Owner, and make available to the Owner as the work progresses (even though there should be default or a succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less a sum that shall be equal to the difference between the Contract price as fixed and provided in said AGREEMENT and/or Contract or any modifications thereof to be paid thereunder to the Principal and the amount previously paid by the Owner to and/or for the account of and/or chargeable against the Principal, but not exceeding (including other costs and damages for which the Surety may be liable hereunder) the amount set forth in the first paragraph hereof.

The Surety, for value received, agrees further that no changes in, omissions from, or alterations, modifications or additions to the terms and provisions of said AGREEMENT and/or Contract or the Work to be performed thereunder, and that no extensions of time given or changes made in the manner or time of making payments thereunder, shall in any way effect the Surety's obligations on this bond, except to the extent the amount of said bond is increased by such changes and the Surety hereby waives notice of any such changes, omissions, alterations, modifications, additions or extensions.

No right of action shall accrue on this Bond to or for the use of any persons other than the Owner named herein or the heirs, executors, administrators, successors and assigns of the Owner.

IN WITNESS WHEREOF, we have hereunto set our hands and seals to \_\_\_\_\_  
\_\_\_\_\_ counterparts of this bond, this \_\_\_\_\_ day of \_\_\_\_\_,  
in the year Two Thousand and \_\_\_\_\_.

\_\_\_\_\_  
Principal (SEAL)

\_\_\_\_\_  
Principal (SEAL)

\_\_\_\_\_  
Principal (SEAL)

\_\_\_\_\_  
Surety (SEAL)

\_\_\_\_\_  
Surety (SEAL)

NOTE:

If the Principal (Contractor) is a partnership, the Bond should be signed by each of the partners.

If the Principal (Contractor) is a corporation, the Bond should be signed in its correct corporate name by its duly authorized officer or officers.

If this Bond is signed on behalf of the Surety by an attorney-in-fact, there should be attached to it a duly certified copy of his power of attorney showing his authority to sign such Bonds.

There should be executed an appropriate number of counterparts of the Bond corresponding to the number of counterparts of the AGREEMENT.

Date of Bond must not be prior to the date of Contract.

**Important**

Surety Companies executing BONDS must appear on the U.S. Treasury Department's most current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts and be authorized to transact business in the state where the PROJECT is located.

The attention of the Surety Companies and Principal executing this Performance Bond is Directed to the fact that said Bond shall remain in full effect throughout the life of any guaranty or warranty periods stipulated in the Contract Documents and/or Agreement.

LABOR AND MATERIALS BOND

(NOTE: This Bond is issued simultaneously with the attached Performance Bonds in favor of the Owner.)

KNOW ALL MEN BY THESE PRESENTS:

That we, \_\_\_\_\_  
(an individual, a partnership, a corporation)

duly organized under the Laws of the State (or Commonwealth) of \_\_\_\_\_,

having a usual place of business at \_\_\_\_\_,

\_\_\_\_\_

as Principal, and \_\_\_\_\_ a corporation duly organized

under the Laws of the State (or Commonwealth) of \_\_\_\_\_,

and duly authorized to do business in the Commonwealth of Massachusetts,

and having a usual place of business at \_\_\_\_\_,

as Surety, are holden and stand firmly bound and obligated unto the City of Haverhill, Massachusetts, as obligee, in the sum of

\_\_\_\_\_ lawful money of the United States of America, to and for the true payment whereof we bind ourselves and, each of us, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal, be means of a written AGREEMENT (which together with the Contract Documents in said AGREEMENT referred to are collectively sometimes referred to as the "Contract") dated \_\_\_\_\_, has entered into a contract with the said obligee for "City of Haverhill, MA, Rosemont Street Bridge over Little River, Bridge No. H-12-024 (CFE), Contract No. IFB006.25" in the City of Haverhill, Massachusetts, a copy of which agreement is attached hereto and by references made a part hereof.

NOW, THEREFORE, THE CONDITION of this obligation is such, that if the Principal shall promptly make payments to all claimants as hereinafter defined, for all labor performed or furnished and for all materials and equipment furnished for or used in or in connection with the Work called for by said AGREEMENT and/or Contract and any modifications thereof, including lumber used but not incorporated in said Work, and for the rental or hire of vehicles, tools and other appliances and equipment furnished for or used in connection with said Work, this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

- (a) A claimant is defined as one having a direct contract with the Principal or with a subcontractor of the Principal for labor, materials and/or equipment used or reasonably required for use in the performance of the said Work, labor and materials being construed to include that part of

water, gas, power, light, heat, oil, gasoline, telephone service or rental or equipment directly applicable to the said AGREEMENT and/or Contract and any modifications thereof.

- (b) The above named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials or equipment were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.
- (c) No suit or action shall be commenced hereunder by any claimant.

Unless claimant, other than one having a direct contract with the Principal, shall have given written notice to any two of the following: the Principal, the Owner, or the Surety above named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials or equipment for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials or equipment were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner or Surety at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the said Work is located, save that such service need not be made by a public officer;

After the expiration of one (1) year following the date on which the Principal ceased work on said AGREEMENT and/or Contract and any modifications thereof, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof, such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the State in which the said Work, or any part thereof, is situated, or in the United States District Court for the district in which the said Work, or any part thereof, is situated, and not elsewhere.

- (d) The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics liens which may be filed of record against said AGREEMENT and/Contract or said Work, whether or not claim for the amount of such lien be presented under and against this bond.

The surety, for value received, agrees further that no changes in, omissions from, or alterations, modifications or additions to the terms and provisions of said AGREEMENT and/or Contract or the Work to be performed thereunder, and that no extensions of time given or changes made in the manner or time of making payments thereunder, shall in any way affect the Surety's obligations on this Bond, except to the extent the amount of said bond is increased by such changes and the Surety hereby waives notice of any such changes, omissions, alterations, modifications, additions or extensions.

IN WITNESS WHEREOF, we have hereunto set our hands and seals to \_\_\_\_\_  
counterparts of this Bond, this \_\_\_\_\_ day of \_\_\_\_\_, in  
the year Two Thousand and \_\_\_\_\_.

\_\_\_\_\_  
Principal (SEAL)

\_\_\_\_\_  
Principal (SEAL)

\_\_\_\_\_  
Principal (SEAL)

\_\_\_\_\_  
Surety (SEAL)

\_\_\_\_\_  
Surety (SEAL)

**NOTE:**

If the Principal (Contractor) is a partnership, the Bond should be signed by each of the partners.

If the Principal (Contractor) is a corporation, the Bond should be signed in its correct corporate name by its duly authorized officer or officers.

If this Bond is signed on behalf of the Surety by an attorney-in-fact, there should be attached to it a duly certified copy of his power of attorney showing his authority to sign such Bonds.

There should be executed an approximate number of counterparts of the Bond corresponding to the number of counterparts of the AGREEMENT.

Date of Bond must not be prior to the date of Contract.

**Important**

Surety Companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the PROJECT is located.

The attention of the Surety Companies and Principal executing this Labor and Materials Bond is directed to the fact that said Bond shall remain in full effect throughout the life of any guaranty or warranty periods stipulated in the Contract Documents and/or Agreement.

**CERTIFICATE OF ACKNOWLEDGMENT OF CONTRACTOR IF A CORPORATION  
For CONTRACT BONDS**

State of \_\_\_\_\_

County of \_\_\_\_\_

On this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_, before  
me personally came \_\_\_\_\_ to me known, who being by me duly  
sworn, did depose and say as follows:

That he resides at \_\_\_\_\_

and is the \_\_\_\_\_

of \_\_\_\_\_

the corporation described in and which executed the foregoing instrument; that he knows the corporate seal of said corporation; that the seal affixed to the foregoing instrument is such corporate seal and it was so affixed by order of the Board of Directors of said corporation; and that by the like order he signed thereto his name and official designation.

\_\_\_\_\_  
Notary Public (Seal)

My commission expires \_\_\_\_\_

**STATE TAX CERTIFICATE**

Pursuant to M.G.L., Ch. 62C, sec. 49A, I certify under the penalties of perjury that I, to the best of my knowledge and belief, have filed all state tax returns and paid all state taxes required under law.

\_\_\_\_\_  
Social Security Number \*  
Or Federal Identification Number \*

\_\_\_\_\_  
Signature of Individual or  
Corporate Name

by: \_\_\_\_\_  
Corporate Office (if applicable)

\* Submission of a Social Security Number or a Federal Identification Number is voluntary.

**END OF SECTION**

## **SECTION 00650**

### **ADDENDUM NO. 1 TO CONTRACT UNDER FEDERAL AWARDS**

**NOTICE:** The Contract, Purchase Order, or Agreement to which this Addendum is attached is made using federal assistance provided to the CITY OF HAVERHILL (“City” or “Owner”) the American Rescue Plan Act’s State and Local Fiscal Recovery Fund.

The City is funding this Contract, Purchase Order, or Agreement, in whole or in part, through a Federal award identified as ALN: 21.027 and FAIN: SLFRP3777.

The following contractual provisions are hereby incorporated into the Contract, Purchase Order, or Agreement, where applicable. In the event of any conflict between the below provisions and other provisions of this Contract, Purchase Order, or Agreement, the provisions in this Addendum shall control.

In the event of any inconsistency between the Davis-Bacon Wage Rates and any prevailing wage rates published by the Commonwealth of Massachusetts and applicable to this Contract / Agreement, the higher of the two wages shall apply.

#### **INDEX**

1. Remedies for Breach of Contractual Agreement; Sanctions and Penalties.
2. Termination for Cause and Convenience.
3. Clean Air Act.
4. Debarment and Suspension (Executive Orders 12549 and 12689).
5. Procurement of recovered materials (2 C.F.R. § 200.323).
6. Prohibition on certain telecommunications and video surveillance services or equipment (2 C.F.R. § 200.216).
7. Domestic preferences for procurements (2 C.F.R. § 200.322).
8. Equal Employment Opportunity Clause.
9. Davis-Bacon Act/Prevailing Wage.
10. Contract Work Hours and Safety Standards.
11. Byrd Anti-Lobbying Amendment (31 U.S.C. 1352).
12. Rights to inventions made under a contract or agreement.

## 1. REMEDIES FOR BREACH OF CONTRACTUAL AGREEMENT; SANCTIONS AND PENALTIES

APPLICABILITY: This provision shall apply in the event that the Contract or Purchase Order exceeds the Simplified Acquisition Threshold. See 2 CFR § 200 App. II(A).

It is hereby understood and mutually agreed, by and between the Contractor and the Owner, that the date of beginning and the time for completion of the work to be done hereunder are ESSENTIAL CONDITIONS of the Contract; and it is further mutually understood and agreed that the work embraced in this Contract shall be commenced on a date to be specified in the "Notice to Proceed".

The Contractor agrees that said work shall be prosecuted regularly, diligently and uninterruptedly at such rate of progress as will ensure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the Owner, that the time for the completion of the work described herein is a reasonable time for the completion of the same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

If the said Contractor shall neglect, fail or refuse to complete the work within the time herein specified, or any extension thereof granted by the Owner, then the Contractor does hereby agree, as a partial consideration for the awarding of this Contract, to pay the Owner the amount specified in the Contract, not as a penalty but as liquidated damages for such Breach of Contract as hereinafter set forth, for each and every calendar day the Contractor shall be in default after the time stipulated in the Contract for completing the work.

The said amount of liquidated damages is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would sustain in such event and said amount shall be retained from time to time by the Owner from current periodic estimates.

It is further agreed that time is of the essence of each and every portion of this Contract and of any specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract as additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this Contract. Provided, that the Contractor shall not be charged with liquidated damages or any excess cost when the Owner determines that the Contractor is without fault and the Contractor's reasons for the time extensions are acceptable to the Owner; provided further, that the Contractor shall not be charged with liquidated damages or an excess cost when the delay in completion of the work is due to:

- (a) Any preference, priority or allocation order duly issued by the government;
- (b) Unforeseeable cause beyond the control and without fault of negligence of the Contractor, including, but not restricted to, acts of God or the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and severe weather; or
- (c) Any delays of subcontractors or suppliers occasioned by any of the causes specified in subsections (a) and (b) of this article.

PROVIDED FURTHER, that the Contractor shall within ten (10) days from the beginning of such delay, unless the Owner shall grant a further period of time prior to the date of final settlement of the Contract, notify the Owner, in writing, of the causes of the delay, who shall ascertain the facts and extent of the delay and notify the Contractor within a reasonable time of its decision in the matter. The amount of liquidated damages for this project shall be Five Hundred Dollars (\$500.00) per consecutive calendar day.

## **2. TERMINATION FOR CAUSE AND CONVENIENCE**

**APPLICABILITY:** This provision shall apply in the event that the Contract or Purchase Order exceeds \$10,000.00. See 2 CFR 200 App. II(B).

Where Contract exceeds \$10,000.00, the Owner may terminate this Contract by providing the Contractor and the Surety (if any there be) with ten (10) days written notice specifying the reasons for termination, as outlined below:

Violation of any of the provisions of this Contract by the Contractor or any of their subcontractors;

A determination by the Owner that the Contractor has engaged in fraud, waste, mismanagement, misuse of funds, or criminal activity with any funds provided by this Contract;

Failure of the Contractor, for any reason, to fulfill in a timely and proper manner their obligations under this Contract, including compliance with applicable Federal, State and/or local law or regulations, and such procedures or guidelines as may be established;

In the event if any such termination, the Surety shall have the right to take over and perform the Contract; provided, however, that if the Surety does not commence performance within ten (10) days from the date of the mailing to such Surety of notice of termination, the Owner may take over the work and prosecute the same to completion at the expense of the Contractor, and the Contractor and their Surety shall be liable to the Owner for any excess cost occasioned by the Owner thereby, and in such event the Owner may take possession of and utilize in completing the work, such materials, appliances and plants as may be on the site of the work and necessary therefore.

If the Owner determines that a continuation of work on the project would endanger the life, health or safety of those working or living at or near the project site, or that immediate action is necessary to protect public funds and/or property, the Owner may suspend work or terminate this agreement by providing notice to the Contractor in the form of a telegram, mailgram, hand-carried letter, or other appropriate written means.

In addition, notwithstanding anything to the contrary in the Contract, the Owner may also terminate this Contract for its conveniences, including due to the lack of sufficient funds to complete the work. In such event, the Owner shall provide written notice of termination to the Contractor, and the Contractor shall thereupon cease all work other than work that is required to make the work and surrounding property safe, and the Owner shall pay the Contractor for all work performed in accordance with the terms of the Contract up to the date of the Contract, provided the Contractor shall not be entitled to any termination (or similar) damages or other costs and expenses that may be associated with a termination for convenience.

## **3. CLEAN AIR ACT**

**APPLICABILITY:** This provision shall apply in the event that the Contract or any subgrant thereunder is a sum in excess of \$150,000.00.  
See 2 CFR § 200 App. II(G)

Contractor shall 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). Contractor further acknowledges and understands that Contractor shall be required to report any violations of said acts to the Federal awarding agency and the Regional Office of the Environmental Protection Agency.

**4. DEBARMENT AND SUSPENSION (EXECUTIVE ORDERS 12549 AND 12689)**

APPLICABILITY: This provision shall apply to all Contracts.

Contractor certifies that neither Contractor nor any employer or subcontractor is a party listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), “Debarment and Suspension.” SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

**5. PROCUREMENT OF RECOVERED MATERIALS (2 C.F.R. § 200.323)**

APPLICABILITY: This provision shall all apply to all Contracts.  
See 2 CFR § 200 App. II(J); 2 CFR § 200.323.

Contractor acknowledges and understands that, in performing the work specified under this contract, Contractor shall be required to comply with Section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds \$10,000 or the value of the quantity acquired during the preceding fiscal year exceeded \$10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

**6. PROHIBITION ON CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT (2 C.F.R. § 200.216)**

APPLICABILITY: This provision shall all apply to all Contracts.  
See 2 CFR § 200 App. II(K); 2 CFR § 200.216.

Contractor certifies that it shall not procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115–232, section 889, covered telecommunications equipment is 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.

**7. DOMESTIC PREFERENCES FOR PROCUREMENTS (2 C.F.R. § 200.322)**

**APPLICABILITY:** This provision shall all apply to all Contracts.  
See 2 CFR § 200 App. II(L); 2 CFR § 200.322.

(a) As appropriate and to the extent consistent with law, the non-Federal entity should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award.

(b) For purposes of this section:

(1) “Produced in the United States” means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.

(2) “Manufactured products” means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

**8. EQUAL EMPLOYMENT OPPORTUNITY CLAUSE**

**APPLICABILITY:** This provision shall apply in the event that the Contract meets the definition of “federally assisted construction contract” as set forth at 41 CFR § 60–§1.3, where not otherwise provided under 41 CFR Part 60.  
See 2 CFR § 200 App. II(C).

All contracts that meet the definition of “federally assisted construction contract” set forth at 41 CFR § 60–1.3.

During the performance of this Contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following:

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. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

- (2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.
- (3) The Contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the Contractor's legal duty to furnish information.
- (4) The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the Contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- (5) The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
- (6) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
- (7) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
- (8) The Contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance:

**9. DAVIS-BACON ACT**

APPLICABILITY: This provision shall apply to all prime construction contracts in excess of \$2,000.00 utilizing federal funding. See 2 CFR § 200 App. II(D). Davis-Bacon rates do not apply to projects funded solely with ARPA funds.

**DAVIS-BACON/PREVAILING WAGE**

The Contractor acknowledges that the decision to award this contract is conditioned upon Contractor's acceptance of the wage determination, and upon continuing compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"), if applicable. Pursuant to the Davis-Bacon Act and/or G.L. c.149 §§ 26-27H, Contractors are required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in the Secretary of Labor's wage determinations, incorporated into this Contract and enclosed as "Attachment A." Contractor further acknowledges and understands that Contractor shall be required to pay wages not less than once a week.

**DAVIS-BACON/PREVAILING WAGE CERTIFICATION**

Contractor certifies that Contractor and all subcontractors shall provide certified payroll affidavits verifying compliance with G.L. c.149 §§ 26-27H, the federal Davis Bacon Act, and any other related acts that are applicable to the project.

\_\_\_\_\_  
Signature of Contractor's authorized official

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

\_\_\_\_\_  
Name (printed)

\_\_\_\_\_  
Title (printed)

## **10. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT**

**APPLICABILITY:** This provision shall apply in the event that the contract is awarded for a sum exceeding \$100,000.00 and involves the employment of mechanics or laborers.

Where the Contract: (1) is awarded for a sum exceeding \$100,000; and (2) will involve the employment of mechanics or laborers, the Contractor shall comply with the Contract Work Hours and Safety Standards Act, 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5).

Pursuant to 40 U.S.C. 3702 of the Contract Work Hours and Safety Standards Act, Contractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 shall apply construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

## **11. BYRD ANTI-LOBBYING; COPELAND “ANTI-KICKBACK” ACT (40 U.S.C. § 3145)**

**APPLICABILITY:** This provision shall all apply to all Contracts. In the event that the Contract is for a sum exceeding \$100,000.00, the Contractor shall also certify and file the Byrd Anti-Lobbying Amendment Certification.

### **BYRD ANTI-LOBBYING AMENDMENT**

Contractor certifies that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352.

Contractor further understands and acknowledges that it shall disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures shall be forwarded from tier to tier up to the non-Federal award.

### **COPELAND “ANTI-KICKBACK” ACT**

Contractor acknowledges and understands that the awarding of this contract is conditioned upon Contractor's compliance with the Federal Copeland “Anti-Kickback” Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, “Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States”). The Act provides that each Contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

**BYRD ANTI-LOBBYING AMENDMENT:**  
**REQUIRED CERTIFICATION FOR AWARDS EXCEEDING \$100,000**

The undersigned certifies, to the best of their knowledge and belief, that:

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 an 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.

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 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.<sup>1</sup>

The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all contractors shall certify and disclose accordingly.

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 section 1352, title 31, U.S. Code. 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.

Bidder certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the bidding party understands and agrees that the provisions of 31 U.S.C. Ch. 38, Administrative Remedies for False Claims and Statements, apply to this certification and disclosure, if any.

\_\_\_\_\_  
Signature of Contractor's authorized official

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

\_\_\_\_\_  
Name (printed)

\_\_\_\_\_  
Title (printed)

**12. RIGHTS TO INVENTIONS MADE UNDER A CONTRACT OR AGREEMENT**

**APPLICABILITY:** This provision shall apply in the event that the Contract is funded by a Federal award meeting the definition of "funding agreement" under 37 CFR § 401.2(a). A "funding agreement" is "any contract, grant, or cooperative agreement entered into between any Federal agency... and

<sup>1</sup> Standard Form-LLL available at <https://www.grants.gov/web/grants/forms/post-award-reporting-forms.html>.

any contractor for the performance of experimental, developmental, or research work funded in whole or in part by the Federal government.”

In the event that this Contract is funded by a Federal award meeting the definition of “funding agreement” under 37 C.F.R. § 401.2(a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that “funding agreement,” the recipient or subrecipient must comply with the requirements of 37 C.F.R. Part 401, “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements,” and any implementing regulations issued by the awarding agency.

**END OF SECTION**

**ATTACHMENT A  
TO ADDENDUM NO. 1**

**DAVIS-BACON/PREVAILING WAGE  
WAGE RATES**



MAURA HEALEY  
Governor

KIM DRISCOLL  
Lt. Governor

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:** City of Haverhill, MA  
**Contract Number:** IFB006.25 **City/Town:** HAVERHILL  
**Description of Work:** Replace existing bridge with new single span bridge with a span of 36 feet.

**Job Location:** 143 Rosemont St, Haverhill, MA 01830

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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 updated wage schedule must be provided to all contractors, including general and sub-contractors, working on the construction project.
- This annual update requirement is generally not applicable to 27F "rental of equipment" contracts. For such contracts, the prevailing wage rates issued by DLS shall remain in effect for the duration of the contract term. However, if the prevailing wage rate sheet issued does not contain wage rates for each year covered by the contract term, the Awarding Authority must request updated rate sheets from DLS and provide them to the contractor to ensure the correct rates are being paid throughout the duration of the contract. Additionally, if an Awarding Authority exercises an option to renew or extend the contract term, they must request updated rate sheets from DLS and provide them to the contractor.
- 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>	06/01/2024	\$39.28	\$9.65	\$18.40	\$0.00	\$67.33
	12/01/2024	\$40.61	\$9.65	\$18.40	\$0.00	\$68.66
	06/01/2025	\$42.00	\$9.65	\$18.40	\$0.00	\$70.05
	12/01/2025	\$43.38	\$9.65	\$18.40	\$0.00	\$71.43
	06/01/2026	\$44.82	\$9.65	\$18.40	\$0.00	\$72.87
	12/01/2026	\$46.26	\$9.65	\$18.40	\$0.00	\$74.31
	06/01/2027	\$47.71	\$9.65	\$18.40	\$0.00	\$75.76
	12/01/2027	\$49.16	\$9.65	\$18.40	\$0.00	\$77.21
	06/01/2028	\$50.66	\$9.65	\$18.40	\$0.00	\$78.71
	12/01/2028	\$52.16	\$9.65	\$18.40	\$0.00	\$80.21
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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
ASPHALT RAKER <i>LABORERS - ZONE 2</i>	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
	12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71
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"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
BARCO-TYPE JUMPING TAMPER <i>LABORERS - ZONE 2</i>	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
	12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER <i>LABORERS - ZONE 2</i>	06/01/2024	\$39.28	\$9.65	\$18.40	\$0.00	\$67.33
	12/01/2024	\$40.61	\$9.65	\$18.40	\$0.00	\$68.66
	06/01/2025	\$42.00	\$9.65	\$18.40	\$0.00	\$70.05
	12/01/2025	\$43.38	\$9.65	\$18.40	\$0.00	\$71.43
	06/01/2026	\$44.82	\$9.65	\$18.40	\$0.00	\$72.87
	12/01/2026	\$46.26	\$9.65	\$18.40	\$0.00	\$74.31
	06/01/2027	\$47.71	\$9.65	\$18.40	\$0.00	\$75.76
	12/01/2027	\$49.16	\$9.65	\$18.40	\$0.00	\$77.21
	06/01/2028	\$50.66	\$9.65	\$18.40	\$0.00	\$78.71
	12/01/2028	\$52.16	\$9.65	\$18.40	\$0.00	\$80.21
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)	08/01/2024	\$64.50	\$11.49	\$23.59	\$0.00	\$99.58
BRICKLAYERS LOCAL 3 (LYNN)	02/01/2025	\$65.80	\$11.49	\$23.59	\$0.00	\$100.88
	08/01/2025	\$67.95	\$11.49	\$23.59	\$0.00	\$103.03
	02/01/2026	\$69.30	\$11.49	\$23.59	\$0.00	\$104.38
	08/01/2026	\$71.50	\$11.49	\$23.59	\$0.00	\$106.58
	02/01/2027	\$72.90	\$11.49	\$23.59	\$0.00	\$107.98

**Apprentice - BRICK/PLASTER/CEMENT MASON - Local 3 Lynn**

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.25	\$11.49	\$23.59	\$0.00	\$67.33
2	60	\$38.70	\$11.49	\$23.59	\$0.00	\$73.78
3	70	\$45.15	\$11.49	\$23.59	\$0.00	\$80.23
4	80	\$51.60	\$11.49	\$23.59	\$0.00	\$86.68
5	90	\$58.05	\$11.49	\$23.59	\$0.00	\$93.13

**Effective Date - 02/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.90	\$11.49	\$23.59	\$0.00	\$67.98
2	60	\$39.48	\$11.49	\$23.59	\$0.00	\$74.56
3	70	\$46.06	\$11.49	\$23.59	\$0.00	\$81.14
4	80	\$52.64	\$11.49	\$23.59	\$0.00	\$87.72
5	90	\$59.22	\$11.49	\$23.59	\$0.00	\$94.30

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
BULLDOZER/GRADER/SCRAPER <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"						
CAISSON & UNDERPINNING BOTTOM MAN <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"						
CAISSON & UNDERPINNING LABORER <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"						
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>	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71	
For apprentice rates see "Apprentice- LABORER"						
CARPENTER <i>CARPENTERS -ZONE 2 (Eastern Massachusetts)</i>	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

**Classification**

**Effective Date   Base Wage   Health   Pension   Supplemental Unemployment   Total Rate**

**Apprentice - CARPENTER - Zone 2 Eastern MA**

**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

**Effective Date - 03/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$22.33	\$9.83	\$1.73	\$0.00	\$33.89
2	45	\$22.33	\$9.83	\$1.73	\$0.00	\$33.89
3	55	\$27.29	\$9.83	\$3.40	\$0.00	\$40.52
4	55	\$27.29	\$9.83	\$3.40	\$0.00	\$40.52
5	70	\$34.73	\$9.83	\$16.51	\$0.00	\$61.07
6	70	\$34.73	\$9.83	\$16.51	\$0.00	\$61.07
7	80	\$39.70	\$9.83	\$18.24	\$0.00	\$67.77
8	80	\$39.70	\$9.83	\$18.24	\$0.00	\$67.77

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

CARPENTER WOOD FRAME	10/01/2024	\$26.65	\$7.02	\$4.80	\$0.00	\$38.47
CARPENTERS-ZONE 3 (Wood Frame)	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

**Classification**

**Effective Date    Base Wage    Health    Pension    Supplemental Unemployment    Total Rate**

**Apprentice - CARPENTER (Wood Frame) - Zone 3**

**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

**Effective Date - 10/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$16.65	\$7.02	\$0.00	\$0.00	\$23.67
2	60	\$16.65	\$7.02	\$0.00	\$0.00	\$23.67
3	65	\$18.04	\$7.02	\$1.00	\$0.00	\$26.06
4	70	\$19.43	\$7.02	\$1.00	\$0.00	\$27.45
5	75	\$20.81	\$7.02	\$4.80	\$0.00	\$32.63
6	80	\$22.20	\$7.02	\$4.80	\$0.00	\$34.02
7	85	\$23.59	\$7.02	\$4.80	\$0.00	\$35.41
8	90	\$24.98	\$7.02	\$4.80	\$0.00	\$36.80

**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 BRICKLAYERS LOCAL 3 (LYNN)	01/01/2024	\$49.33	\$13.00	\$23.57	\$1.30	\$87.20
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**Apprentice - CEMENT MASONRY/PLASTERING - Eastern Mass (Lynn)**

**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**

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CHAIN SAW OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
	12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71
For apprentice rates see "Apprentice- LABORER"						
CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES <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"						
COMPRESSOR OPERATOR <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"						
DELEADER (BRIDGE) <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

**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**

DEMO: ADZEMAN	06/10/2024	\$45.53	\$9.65	\$18.40	\$0.00	\$73.58
LABORERS - ZONE 2	12/02/2024	\$47.00	\$9.65	\$18.40	\$0.00	\$75.05
	06/02/2025	\$48.50	\$9.65	\$18.40	\$0.00	\$76.55
	12/01/2025	\$50.00	\$9.65	\$18.40	\$0.00	\$78.05
	06/01/2026	\$51.55	\$9.65	\$18.40	\$0.00	\$79.60
	12/07/2026	\$53.05	\$9.65	\$18.40	\$0.00	\$81.10
	06/07/2027	\$54.65	\$9.65	\$18.40	\$0.00	\$82.70
	12/06/2027	\$56.25	\$9.65	\$18.40	\$0.00	\$84.30
	06/05/2028	\$57.93	\$9.65	\$18.40	\$0.00	\$85.98
	12/04/2028	\$59.60	\$9.65	\$18.40	\$0.00	\$87.65

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DEMO: BACKHOE/LOADER/HAMMER OPERATOR <i>LABORERS - ZONE 2</i>	06/10/2024	\$46.53	\$9.65	\$18.40	\$0.00	\$74.58
	12/02/2024	\$48.00	\$9.65	\$18.40	\$0.00	\$76.05
	06/02/2025	\$49.50	\$9.65	\$18.40	\$0.00	\$77.55
	12/01/2025	\$51.00	\$9.65	\$18.40	\$0.00	\$79.05
	06/01/2026	\$52.55	\$9.65	\$18.40	\$0.00	\$80.60
	12/07/2026	\$54.05	\$9.65	\$18.40	\$0.00	\$82.10
	06/07/2027	\$55.65	\$9.65	\$18.40	\$0.00	\$83.70
	12/06/2027	\$57.25	\$9.65	\$18.40	\$0.00	\$85.30
	06/05/2028	\$58.93	\$9.65	\$18.40	\$0.00	\$86.98
	12/04/2028	\$60.60	\$9.65	\$18.40	\$0.00	\$88.65
For apprentice rates see "Apprentice- LABORER"						
DEMO: BURNERS <i>LABORERS - ZONE 2</i>	06/10/2024	\$46.28	\$9.65	\$18.40	\$0.00	\$74.33
	12/02/2024	\$47.75	\$9.65	\$18.40	\$0.00	\$75.80
	06/02/2025	\$49.25	\$9.65	\$18.40	\$0.00	\$77.30
	12/01/2025	\$50.75	\$9.65	\$18.40	\$0.00	\$78.80
	06/01/2026	\$52.30	\$9.65	\$18.40	\$0.00	\$80.35
	12/07/2026	\$53.80	\$9.65	\$18.40	\$0.00	\$81.85
	06/07/2027	\$55.40	\$9.65	\$18.40	\$0.00	\$83.45
	12/06/2027	\$57.00	\$9.65	\$18.40	\$0.00	\$85.05
	06/05/2028	\$58.68	\$9.65	\$18.40	\$0.00	\$86.73
	12/04/2028	\$60.35	\$9.65	\$18.40	\$0.00	\$88.40
For apprentice rates see "Apprentice- LABORER"						
DEMO: CONCRETE CUTTER/SAWYER <i>LABORERS - ZONE 2</i>	06/10/2024	\$46.53	\$9.65	\$18.40	\$0.00	\$74.58
	12/02/2024	\$48.00	\$9.65	\$18.40	\$0.00	\$76.05
	06/02/2025	\$49.50	\$9.65	\$18.40	\$0.00	\$77.55
	12/01/2025	\$51.00	\$9.65	\$18.40	\$0.00	\$79.05
	06/01/2026	\$52.55	\$9.65	\$18.40	\$0.00	\$80.60
	12/07/2026	\$54.05	\$9.65	\$18.40	\$0.00	\$82.10
	06/07/2027	\$55.65	\$9.65	\$18.40	\$0.00	\$83.70
	12/06/2027	\$57.25	\$9.65	\$18.40	\$0.00	\$85.30
	06/05/2028	\$58.93	\$9.65	\$18.40	\$0.00	\$86.98
	12/04/2028	\$60.60	\$9.65	\$18.40	\$0.00	\$88.65
For apprentice rates see "Apprentice- LABORER"						
DEMO: JACKHAMMER OPERATOR <i>LABORERS - ZONE 2</i>	06/10/2024	\$46.28	\$9.65	\$18.40	\$0.00	\$74.33
	12/02/2024	\$47.75	\$9.65	\$18.40	\$0.00	\$75.80
	06/02/2025	\$49.25	\$9.65	\$18.40	\$0.00	\$77.30
	12/01/2025	\$50.75	\$9.65	\$18.40	\$0.00	\$78.80
	06/01/2026	\$52.30	\$9.65	\$18.40	\$0.00	\$80.35
	12/07/2026	\$53.80	\$9.65	\$18.40	\$0.00	\$81.85
	06/07/2027	\$55.40	\$9.65	\$18.40	\$0.00	\$83.45
	12/06/2027	\$57.00	\$9.65	\$18.40	\$0.00	\$85.05
	06/05/2028	\$58.68	\$9.65	\$18.40	\$0.00	\$86.73
	12/04/2028	\$60.35	\$9.65	\$18.40	\$0.00	\$88.40
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DEMO: WRECKING LABORER <i>LABORERS - ZONE 2</i>	06/10/2024	\$45.53	\$9.65	\$18.40	\$0.00	\$73.58
	12/02/2024	\$47.00	\$9.65	\$18.40	\$0.00	\$75.05
	06/02/2025	\$48.50	\$9.65	\$18.40	\$0.00	\$76.55
	12/01/2025	\$50.00	\$9.65	\$18.40	\$0.00	\$78.05
	06/01/2026	\$51.55	\$9.65	\$18.40	\$0.00	\$79.60
	12/07/2026	\$53.05	\$9.65	\$18.40	\$0.00	\$81.10
	06/07/2027	\$54.65	\$9.65	\$18.40	\$0.00	\$82.70
	12/06/2027	\$56.25	\$9.65	\$18.40	\$0.00	\$84.30
	06/05/2028	\$57.93	\$9.65	\$18.40	\$0.00	\$85.98
	12/04/2028	\$59.60	\$9.65	\$18.40	\$0.00	\$87.65
For apprentice rates see "Apprentice- LABORER"						
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>	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 - 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

**Effective Date - 03/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$25.99	\$13.00	\$0.78	\$0.00	\$39.77
2	40	\$25.99	\$13.00	\$0.78	\$0.00	\$39.77
3	45	\$29.24	\$13.00	\$16.71	\$0.00	\$58.95
4	45	\$29.24	\$13.00	\$16.71	\$0.00	\$58.95
5	50	\$32.49	\$13.00	\$17.21	\$0.00	\$62.70
6	55	\$35.74	\$13.00	\$17.72	\$0.00	\$66.46
7	60	\$38.99	\$13.00	\$18.23	\$0.00	\$70.22
8	65	\$42.24	\$13.00	\$18.74	\$0.00	\$73.98
9	70	\$45.49	\$13.00	\$19.24	\$0.00	\$77.73
10	75	\$48.74	\$13.00	\$19.76	\$0.00	\$81.50

**Notes :**  
 App Prior 1/1/03; 30/35/40/45/50/55/65/70/75/80

**Apprentice to Journeyworker Ratio:2:3\*\*\***

ELEVATOR CONSTRUCTOR ELEVATOR CONSTRUCTORS LOCAL 4	01/01/2022	\$65.62	\$16.03	\$20.21	\$0.00	\$101.86
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**Apprentice - ELEVATOR CONSTRUCTOR - Local 4**

**Effective Date - 01/01/2022**

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 ELEVATOR CONSTRUCTORS LOCAL 4	01/01/2022	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
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For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"

FENCE & GUARD RAIL ERECTOR (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)"

FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY OPERATING ENGINEERS LOCAL 4	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 OPERATING ENGINEERS LOCAL 4	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>	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>	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)"						
FLOORCOVERER <i>FLOORCOVERERS LOCAL 2168 ZONE 1</i>	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

**Classification**

**Effective Date   Base Wage   Health   Pension   Supplemental Unemployment   Total Rate**

**Apprentice - FLOORCOVERER - Local 2168 Zone I**

**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

**Effective Date - 03/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$25.98	\$8.83	\$1.76	\$0.00	\$36.57
2	45	\$25.98	\$8.83	\$1.76	\$0.00	\$36.57
3	55	\$31.75	\$8.83	\$3.52	\$0.00	\$44.10
4	55	\$31.75	\$8.83	\$3.52	\$0.00	\$44.10
5	70	\$40.41	\$8.83	\$16.75	\$0.00	\$65.99
6	70	\$40.41	\$8.83	\$16.75	\$0.00	\$65.99
7	80	\$46.18	\$8.83	\$18.51	\$0.00	\$73.52
8	80	\$46.18	\$8.83	\$18.51	\$0.00	\$73.52

Notes: Steps are 750 hrs.

**Apprentice to Journeyworker Ratio:1:1**

FORK LIFT/CHERRY PICKER OPERATING ENGINEERS LOCAL 4	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"

GENERATOR/LIGHTING PLANT/HEATERS OPERATING ENGINEERS LOCAL 4	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) GLAZIERS LOCAL 35 (ZONE 2)	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	06/01/2024	\$56.03	\$15.30	\$16.40	\$0.00	\$87.73
OPERATING ENGINEERS LOCAL 4	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) SHEETMETAL WORKERS LOCAL 17 - A	08/01/2024	\$57.94	\$14.75	\$28.12	\$2.98	\$103.79
	02/01/2025	\$59.69	\$14.75	\$28.12	\$2.98	\$105.54
	08/01/2025	\$61.54	\$14.75	\$28.12	\$2.98	\$107.39
	02/01/2026	\$63.49	\$14.75	\$28.12	\$2.98	\$109.34

For apprentice rates see "Apprentice- SHEET METAL WORKER"

HVAC (ELECTRICAL CONTROLS) 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"

HVAC (TESTING AND BALANCING - AIR) SHEETMETAL WORKERS LOCAL 17 - A	08/01/2024	\$57.94	\$14.75	\$28.12	\$2.98	\$103.79
	02/01/2025	\$59.69	\$14.75	\$28.12	\$2.98	\$105.54
	08/01/2025	\$61.54	\$14.75	\$28.12	\$2.98	\$107.39
	02/01/2026	\$63.49	\$14.75	\$28.12	\$2.98	\$109.34

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (TESTING AND BALANCING -WATER) <i>PIPEFITTERS LOCAL 537 (Local 138)</i>	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 (Local 138)</i>	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>	06/01/2024	\$39.28	\$9.65	\$18.40	\$0.00	\$67.33
	12/01/2024	\$40.61	\$9.65	\$18.40	\$0.00	\$68.66
	06/01/2025	\$42.00	\$9.65	\$18.40	\$0.00	\$70.05
	12/01/2025	\$43.38	\$9.65	\$18.40	\$0.00	\$71.43
	06/01/2026	\$44.82	\$9.65	\$18.40	\$0.00	\$72.87
	12/01/2026	\$46.26	\$9.65	\$18.40	\$0.00	\$74.31
	06/01/2027	\$47.71	\$9.65	\$18.40	\$0.00	\$75.76
	12/01/2027	\$49.16	\$9.65	\$18.40	\$0.00	\$77.21
	06/01/2028	\$50.66	\$9.65	\$18.40	\$0.00	\$78.71
	12/01/2028	\$52.16	\$9.65	\$18.40	\$0.00	\$80.21
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>	09/01/2024	\$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

**Apprentice - ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Boston**

**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

**Effective Date - 09/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.17	\$14.75	\$14.32	\$0.00	\$59.24
2	60	\$36.20	\$14.75	\$15.37	\$0.00	\$66.32
3	70	\$42.24	\$14.75	\$16.43	\$0.00	\$73.42
4	80	\$48.27	\$14.75	\$17.49	\$0.00	\$80.51

**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**

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
JACKHAMMER & PAVING BREAKER OPERATOR LABORERS - ZONE 2	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
	12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71

For apprentice rates see "Apprentice- LABORER"

LABORER LABORERS - ZONE 2	06/01/2024	\$38.53	\$9.65	\$18.40	\$0.00	\$66.58
	12/01/2024	\$39.86	\$9.65	\$18.40	\$0.00	\$67.91
	06/01/2025	\$41.25	\$9.65	\$18.40	\$0.00	\$69.30
	12/01/2025	\$42.63	\$9.65	\$18.40	\$0.00	\$70.68
	06/01/2026	\$44.07	\$9.65	\$18.40	\$0.00	\$72.12
	12/01/2026	\$45.51	\$9.65	\$18.40	\$0.00	\$73.56
	06/01/2027	\$46.96	\$9.65	\$18.40	\$0.00	\$75.01
	12/01/2027	\$48.41	\$9.65	\$18.40	\$0.00	\$76.46
	06/01/2028	\$49.91	\$9.65	\$18.40	\$0.00	\$77.96
	12/01/2028	\$51.41	\$9.65	\$18.40	\$0.00	\$79.46

**Apprentice - LABORER - Zone 2**

**Effective Date - 06/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$23.12	\$9.65	\$18.40	\$0.00	\$51.17
2	70	\$26.97	\$9.65	\$18.40	\$0.00	\$55.02
3	80	\$30.82	\$9.65	\$18.40	\$0.00	\$58.87
4	90	\$34.68	\$9.65	\$18.40	\$0.00	\$62.73

**Effective Date - 12/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$23.92	\$9.65	\$18.40	\$0.00	\$51.97
2	70	\$27.90	\$9.65	\$18.40	\$0.00	\$55.95
3	80	\$31.89	\$9.65	\$18.40	\$0.00	\$59.94
4	90	\$35.87	\$9.65	\$18.40	\$0.00	\$63.92

**Notes:**

**Apprentice to Journeyworker Ratio:1:5**

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LABORER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY &amp; HIGHWAY)</i>	06/01/2024	\$38.53	\$9.65	\$17.80	\$0.00	\$65.98
	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 <i>LABORERS - ZONE 2</i>	06/01/2024	\$38.53	\$9.65	\$18.40	\$0.00	\$66.58
	12/01/2024	\$39.86	\$9.65	\$18.40	\$0.00	\$67.91
	06/01/2025	\$41.25	\$9.65	\$18.40	\$0.00	\$69.30
	12/01/2025	\$42.63	\$9.65	\$18.40	\$0.00	\$70.68
	06/01/2026	\$44.07	\$9.65	\$18.40	\$0.00	\$72.12
	12/01/2026	\$45.51	\$9.65	\$18.40	\$0.00	\$73.56
	06/01/2027	\$46.96	\$9.65	\$18.40	\$0.00	\$75.01
	12/01/2027	\$48.41	\$9.65	\$18.40	\$0.00	\$76.46
	06/01/2028	\$49.91	\$9.65	\$18.40	\$0.00	\$77.96
12/01/2028	\$51.41	\$9.65	\$18.40	\$0.00	\$79.46	

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LABORER: CEMENT FINISHER TENDER <i>LABORERS - ZONE 2</i>	06/01/2024	\$38.53	\$9.65	\$18.40	\$0.00	\$66.58
	12/01/2024	\$39.86	\$9.65	\$18.40	\$0.00	\$67.91
	06/01/2025	\$41.25	\$9.65	\$18.40	\$0.00	\$69.30
	12/01/2025	\$42.63	\$9.65	\$18.40	\$0.00	\$70.68
	06/01/2026	\$44.07	\$9.65	\$18.40	\$0.00	\$72.12
	12/01/2026	\$45.51	\$9.65	\$18.40	\$0.00	\$73.56
	06/01/2027	\$46.96	\$9.65	\$18.40	\$0.00	\$75.01
	12/01/2027	\$48.41	\$9.65	\$18.40	\$0.00	\$76.46
	06/01/2028	\$49.91	\$9.65	\$18.40	\$0.00	\$77.96
	12/01/2028	\$51.41	\$9.65	\$18.40	\$0.00	\$79.46
For apprentice rates see "Apprentice- LABORER"						
LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER <i>LABORERS - ZONE 2</i>	06/03/2024	\$38.62	\$9.65	\$17.76	\$0.00	\$66.03
	12/02/2024	\$39.95	\$9.65	\$17.76	\$0.00	\$67.36
	06/02/2025	\$41.34	\$9.65	\$17.76	\$0.00	\$68.75
	12/01/2025	\$42.72	\$9.65	\$17.76	\$0.00	\$70.13
	06/01/2026	\$44.16	\$9.65	\$17.76	\$0.00	\$71.57
	12/07/2026	\$45.60	\$9.65	\$17.76	\$0.00	\$73.01
	06/07/2027	\$47.05	\$9.65	\$17.76	\$0.00	\$74.46
	12/06/2027	\$48.50	\$9.65	\$17.76	\$0.00	\$75.91
	06/05/2028	\$50.00	\$9.65	\$17.76	\$0.00	\$77.41
	12/04/2028	\$51.50	\$9.65	\$17.76	\$0.00	\$78.91
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER <i>LABORERS - ZONE 2</i>	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
	12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71
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)"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LABORER: MULTI-TRADE TENDER <i>LABORERS - ZONE 2</i>	06/01/2024	\$38.53	\$9.65	\$18.40	\$0.00	\$66.58
	12/01/2024	\$39.86	\$9.65	\$18.40	\$0.00	\$67.91
	06/01/2025	\$41.25	\$9.65	\$18.40	\$0.00	\$69.30
	12/01/2025	\$42.63	\$9.65	\$18.40	\$0.00	\$70.68
	06/01/2026	\$44.07	\$9.65	\$18.40	\$0.00	\$72.12
	12/01/2026	\$45.51	\$9.65	\$18.40	\$0.00	\$73.56
	06/01/2027	\$46.96	\$9.65	\$18.40	\$0.00	\$75.01
	12/01/2027	\$48.41	\$9.65	\$18.40	\$0.00	\$76.46
	06/01/2028	\$49.91	\$9.65	\$18.40	\$0.00	\$77.96
	12/01/2028	\$51.41	\$9.65	\$18.40	\$0.00	\$79.46
For apprentice rates see "Apprentice- LABORER"						
LABORER: TREE REMOVER <i>LABORERS - ZONE 2</i>	06/01/2024	\$38.53	\$9.65	\$18.40	\$0.00	\$66.58
	12/01/2024	\$39.86	\$9.65	\$18.40	\$0.00	\$67.91
	06/01/2025	\$41.25	\$9.65	\$18.40	\$0.00	\$69.30
	12/01/2025	\$42.63	\$9.65	\$18.40	\$0.00	\$70.68
	06/01/2026	\$44.07	\$9.65	\$18.40	\$0.00	\$72.12
	12/01/2026	\$45.51	\$9.65	\$18.40	\$0.00	\$73.56
	06/01/2027	\$46.96	\$9.65	\$18.40	\$0.00	\$75.01
	12/01/2027	\$48.41	\$9.65	\$18.40	\$0.00	\$76.46
	06/01/2028	\$49.91	\$9.65	\$18.40	\$0.00	\$77.96
	12/01/2028	\$51.41	\$9.65	\$18.40	\$0.00	\$79.46
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>	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
	12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71
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>	08/01/2024	\$49.32	\$11.49	\$21.62	\$0.00	\$82.43
	02/01/2025	\$50.36	\$11.49	\$21.62	\$0.00	\$83.47
	08/01/2025	\$52.08	\$11.49	\$21.62	\$0.00	\$85.19
	02/01/2026	\$53.16	\$11.49	\$21.62	\$0.00	\$86.27
	08/01/2026	\$54.92	\$11.49	\$21.62	\$0.00	\$88.03
	02/01/2027	\$56.04	\$11.49	\$21.62	\$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 - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.66	\$11.49	\$21.62	\$0.00	\$57.77
2	60	\$29.59	\$11.49	\$21.62	\$0.00	\$62.70
3	70	\$34.52	\$11.49	\$21.62	\$0.00	\$67.63
4	80	\$39.46	\$11.49	\$21.62	\$0.00	\$72.57
5	90	\$44.39	\$11.49	\$21.62	\$0.00	\$77.50

**Effective Date - 02/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.18	\$11.49	\$21.62	\$0.00	\$58.29
2	60	\$30.22	\$11.49	\$21.62	\$0.00	\$63.33
3	70	\$35.25	\$11.49	\$21.62	\$0.00	\$68.36
4	80	\$40.29	\$11.49	\$21.62	\$0.00	\$73.40
5	90	\$45.32	\$11.49	\$21.62	\$0.00	\$78.43

**Notes:**

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**Apprentice to Journeyworker Ratio:1:3**

MARBLE MASONS, TILELAYERS & TERRAZZO MECH	08/01/2024	\$64.52	\$11.49	\$23.56	\$0.00	\$99.57
BRICKLAYERS LOCAL 3 - MARBLE & TILE	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 - 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

**Effective Date - 02/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.91	\$11.49	\$23.56	\$0.00	\$67.96
2	60	\$39.49	\$11.49	\$23.56	\$0.00	\$74.54
3	70	\$46.07	\$11.49	\$23.56	\$0.00	\$81.12
4	80	\$52.66	\$11.49	\$23.56	\$0.00	\$87.71
5	90	\$59.24	\$11.49	\$23.56	\$0.00	\$94.29

**Notes:**

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**Apprentice to Journeyworker Ratio:1:5**

<b>MECH. SWEEPER OPERATOR (ON CONST. SITES)</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>MECHANICS MAINTENANCE</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>MILLWRIGHT (Zone 2)</b> <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**

**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	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
	12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71

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"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
OTHER POWER DRIVEN EQUIPMENT - CLASS II <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"						
PAINTER (BRIDGES/TANKS) <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

**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. <i>PAINTERS LOCAL 35 - ZONE 2</i>	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 (Local 138)</i>	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

**Apprentice - PIPEFITTER Local 537 (Local 138)**

**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

**Effective Date - 03/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$27.55	\$12.70	\$9.05	\$0.00	\$49.30
2	45	\$31.00	\$12.70	\$21.80	\$0.00	\$65.50
3	60	\$41.33	\$12.70	\$21.80	\$0.00	\$75.83
4	70	\$48.22	\$12.70	\$21.80	\$0.00	\$82.72
5	80	\$55.10	\$12.70	\$21.80	\$0.00	\$89.60

**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:\*\***

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PIPELAYER LABORERS - ZONE 2	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
	12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71

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)"

PLUMBER PLUMBERS & GASFITTERS LOCAL 12 (Local 138)	09/01/2024	\$69.04	\$14.32	\$19.61	\$0.00	\$102.97
	03/02/2025	\$70.84	\$14.32	\$19.61	\$0.00	\$104.77

**Apprentice - PLUMBER/GASFITTER - Local 12 (Local 138)**

**Effective Date - 09/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$24.16	\$14.32	\$7.06	\$0.00	\$45.54
2	40	\$27.62	\$14.32	\$8.02	\$0.00	\$49.96
3	55	\$37.97	\$14.32	\$10.93	\$0.00	\$63.22
4	65	\$44.88	\$14.32	\$12.86	\$0.00	\$72.06
5	75	\$51.78	\$14.32	\$14.79	\$0.00	\$80.89

**Effective Date - 03/02/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$24.79	\$14.32	\$7.06	\$0.00	\$46.17
2	40	\$28.34	\$14.32	\$8.02	\$0.00	\$50.68
3	55	\$38.96	\$14.32	\$10.93	\$0.00	\$64.21
4	65	\$46.05	\$14.32	\$12.86	\$0.00	\$73.23
5	75	\$53.13	\$14.32	\$14.79	\$0.00	\$82.24

**Notes:** \*\* 1:2; 2:6; 3:10; 4:14; 5:19/Steps are 1 yr  
Steps are 1 yr  
Step 4 with lic\$69.00, Step5 with lic\$76.87

**Apprentice to Journeyworker Ratio:\*\***

PNEUMATIC CONTROLS (TEMP.) PIPEFITTERS LOCAL 537 (Local 138)	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"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PNEUMATIC DRILL/TOOL OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2024	\$39.28	\$9.65	\$18.40	\$0.00	\$67.33
	12/01/2024	\$40.61	\$9.65	\$18.40	\$0.00	\$68.66
	06/01/2025	\$42.00	\$9.65	\$18.40	\$0.00	\$70.05
	12/01/2025	\$43.38	\$9.65	\$18.40	\$0.00	\$71.43
	06/01/2026	\$44.82	\$9.65	\$18.40	\$0.00	\$72.87
	12/01/2026	\$46.26	\$9.65	\$18.40	\$0.00	\$74.31
	06/01/2027	\$47.71	\$9.65	\$18.40	\$0.00	\$75.76
	12/01/2027	\$49.16	\$9.65	\$18.40	\$0.00	\$77.21
	06/01/2028	\$50.66	\$9.65	\$18.40	\$0.00	\$78.71
	12/01/2028	\$52.16	\$9.65	\$18.40	\$0.00	\$80.21
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>	06/01/2024	\$39.53	\$9.65	\$18.40	\$0.00	\$67.58
	12/01/2024	\$40.86	\$9.65	\$18.40	\$0.00	\$68.91
	06/01/2025	\$42.25	\$9.65	\$18.40	\$0.00	\$70.30
	12/01/2025	\$43.63	\$9.65	\$18.40	\$0.00	\$71.68
	06/01/2026	\$45.07	\$9.65	\$18.40	\$0.00	\$73.12
	12/01/2026	\$46.51	\$9.65	\$18.40	\$0.00	\$74.56
	06/01/2027	\$47.96	\$9.65	\$18.40	\$0.00	\$76.01
	12/01/2027	\$49.41	\$9.65	\$18.40	\$0.00	\$77.46
	06/01/2028	\$50.91	\$9.65	\$18.40	\$0.00	\$78.96
12/01/2028	\$52.41	\$9.65	\$18.40	\$0.00	\$80.46	
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)"						
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"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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>	06/01/2024	\$38.78	\$9.65	\$18.40	\$0.00	\$66.83
	12/01/2024	\$40.11	\$9.65	\$18.40	\$0.00	\$68.16
	06/01/2025	\$41.50	\$9.65	\$18.40	\$0.00	\$69.55
	12/01/2025	\$42.88	\$9.65	\$18.40	\$0.00	\$70.93
	06/01/2026	\$44.32	\$9.65	\$18.40	\$0.00	\$72.37
	12/01/2026	\$45.76	\$9.65	\$18.40	\$0.00	\$73.81
	06/01/2027	\$47.21	\$9.65	\$18.40	\$0.00	\$75.26
	12/01/2027	\$48.66	\$9.65	\$18.40	\$0.00	\$76.71
	06/01/2028	\$50.16	\$9.65	\$18.40	\$0.00	\$78.21
12/01/2028	\$51.66	\$9.65	\$18.40	\$0.00	\$79.71	
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"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ROOFER (Inc.Roofing Waterproofing &Roofing Damproofg) ROOFERS LOCAL 33	08/01/2024	\$51.03	\$13.03	\$21.70	\$0.00	\$85.76
	02/01/2025	\$52.28	\$13.03	\$21.70	\$0.00	\$87.01
	08/01/2025	\$53.78	\$13.03	\$21.70	\$0.00	\$88.51
	02/01/2026	\$55.03	\$13.03	\$21.70	\$0.00	\$89.76

**Apprentice - ROOFER - Local 33**

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.52	\$13.03	\$6.52	\$0.00	\$45.07
2	60	\$30.62	\$13.03	\$21.70	\$0.00	\$65.35
3	65	\$33.17	\$13.03	\$21.70	\$0.00	\$67.90
4	75	\$38.27	\$13.03	\$21.70	\$0.00	\$73.00
5	85	\$43.38	\$13.03	\$21.70	\$0.00	\$78.11

**Effective Date - 02/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.14	\$13.03	\$6.52	\$0.00	\$45.69
2	60	\$31.37	\$13.03	\$21.70	\$0.00	\$66.10
3	65	\$33.98	\$13.03	\$21.70	\$0.00	\$68.71
4	75	\$39.21	\$13.03	\$21.70	\$0.00	\$73.94
5	85	\$44.44	\$13.03	\$21.70	\$0.00	\$79.17

**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 ROOFERS LOCAL 33	08/01/2024	\$51.28	\$13.03	\$21.70	\$0.00	\$86.01
	02/01/2025	\$52.53	\$13.03	\$21.70	\$0.00	\$87.26
	08/01/2025	\$54.03	\$13.03	\$21.70	\$0.00	\$88.76
	02/01/2026	\$55.28	\$13.03	\$21.70	\$0.00	\$90.01

For apprentice rates see "Apprentice- ROOFER"

SHEETMETAL WORKER SHEETMETAL WORKERS LOCAL 17 - A	08/01/2024	\$57.94	\$14.75	\$28.12	\$2.98	\$103.79
	02/01/2025	\$59.69	\$14.75	\$28.12	\$2.98	\$105.54
	08/01/2025	\$61.54	\$14.75	\$28.12	\$2.98	\$107.39
	02/01/2026	\$63.49	\$14.75	\$28.12	\$2.98	\$109.34

**Apprentice - SHEET METAL WORKER - Local 17-A**

**Effective Date - 08/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$24.33	\$14.75	\$6.13	\$0.00	\$45.21
2	42	\$24.33	\$14.75	\$6.13	\$0.00	\$45.21
3	47	\$27.23	\$14.75	\$12.11	\$1.63	\$55.72
4	47	\$27.23	\$14.75	\$12.11	\$1.63	\$55.72
5	52	\$30.13	\$14.75	\$13.09	\$1.75	\$59.72
6	52	\$30.13	\$14.75	\$13.34	\$1.76	\$59.98
7	60	\$34.76	\$14.75	\$14.75	\$1.94	\$66.20
8	65	\$37.66	\$14.75	\$15.73	\$2.06	\$70.20
9	75	\$43.46	\$14.75	\$17.69	\$2.30	\$78.20
10	85	\$49.25	\$14.75	\$19.15	\$2.52	\$85.67

**Effective Date - 02/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$25.07	\$14.75	\$6.13	\$0.00	\$45.95
2	42	\$25.07	\$14.75	\$6.13	\$0.00	\$45.95
3	47	\$28.05	\$14.75	\$12.11	\$1.66	\$56.57
4	47	\$28.05	\$14.75	\$12.11	\$1.66	\$56.57
5	52	\$31.04	\$14.75	\$13.09	\$1.78	\$60.66
6	52	\$31.04	\$14.75	\$13.34	\$1.79	\$60.92
7	60	\$35.81	\$14.75	\$14.75	\$1.97	\$67.28
8	65	\$38.80	\$14.75	\$15.73	\$2.09	\$71.37
9	75	\$44.77	\$14.75	\$17.69	\$2.33	\$79.54
10	85	\$50.74	\$14.75	\$19.15	\$2.56	\$87.20

**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 B) Zone 2</i>	10/01/2024	\$63.76	\$11.51	\$23.30	\$0.00	\$98.57
	03/01/2025	\$65.38	\$11.51	\$23.30	\$0.00	\$100.19

**Apprentice - SPRINKLER FITTER - Local 550 (Section B) Zone 2**

**Effective Date - 10/01/2024**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$22.32	\$11.51	\$12.90	\$0.00	\$46.73
2	40	\$25.50	\$11.51	\$13.70	\$0.00	\$50.71
3	45	\$28.69	\$11.51	\$14.50	\$0.00	\$54.70
4	50	\$31.88	\$11.51	\$15.30	\$0.00	\$58.69
5	55	\$35.07	\$11.51	\$16.10	\$0.00	\$62.68
6	60	\$38.26	\$11.51	\$16.90	\$0.00	\$66.67
7	65	\$41.44	\$11.51	\$17.70	\$0.00	\$70.65
8	70	\$44.63	\$11.51	\$18.50	\$0.00	\$74.64
9	75	\$47.82	\$11.51	\$19.30	\$0.00	\$78.63
10	80	\$51.01	\$11.51	\$20.10	\$0.00	\$82.62

**Effective Date - 03/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$22.88	\$11.51	\$12.90	\$0.00	\$47.29
2	40	\$26.15	\$11.51	\$13.70	\$0.00	\$51.36
3	45	\$29.42	\$11.51	\$14.50	\$0.00	\$55.43
4	50	\$32.69	\$11.51	\$15.30	\$0.00	\$59.50
5	55	\$35.96	\$11.51	\$16.10	\$0.00	\$63.57
6	60	\$39.23	\$11.51	\$16.90	\$0.00	\$67.64
7	65	\$42.50	\$11.51	\$17.70	\$0.00	\$71.71
8	70	\$45.77	\$11.51	\$18.50	\$0.00	\$75.78
9	75	\$49.04	\$11.51	\$19.30	\$0.00	\$79.85
10	80	\$52.30	\$11.51	\$20.10	\$0.00	\$83.91

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>	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

**Apprentice - TELECOMMUNICATION TECHNICIAN - Local 103**

**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

**Effective Date - 03/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$23.39	\$13.00	\$0.70	\$0.00	\$37.09
2	45	\$23.39	\$13.00	\$0.70	\$0.00	\$37.09
3	50	\$25.99	\$13.00	\$16.16	\$0.00	\$55.15
4	50	\$25.99	\$13.00	\$16.16	\$0.00	\$55.15
5	55	\$28.59	\$13.00	\$16.57	\$0.00	\$58.16
6	60	\$31.19	\$13.00	\$16.97	\$0.00	\$61.16
7	65	\$33.79	\$13.00	\$17.38	\$0.00	\$64.17
8	70	\$36.39	\$13.00	\$17.78	\$0.00	\$67.17
9	75	\$38.99	\$13.00	\$18.18	\$0.00	\$70.17
10	80	\$41.58	\$13.00	\$18.58	\$0.00	\$73.16

**Notes:**

**Apprentice to Journeyworker Ratio:1:1**

TERRAZZO FINISHERS	08/01/2024	\$63.44	\$11.49	\$23.59	\$0.00	\$98.52
BRICKLAYERS LOCAL 3 - MARBLE & TILE	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 - 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

**Effective Date - 02/01/2025**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.37	\$11.49	\$23.59	\$0.00	\$67.45
2	60	\$38.84	\$11.49	\$23.59	\$0.00	\$73.92
3	70	\$45.32	\$11.49	\$23.59	\$0.00	\$80.40
4	80	\$51.79	\$11.49	\$23.59	\$0.00	\$86.87
5	90	\$58.27	\$11.49	\$23.59	\$0.00	\$93.35

**Notes:**

**Apprentice to Journeyworker Ratio:1:3**

TEST BORING DRILLER <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"

TEST BORING DRILLER HELPER <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"

TEST BORING LABORER <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"						

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>	06/01/2024	\$39.28	\$9.65	\$18.40	\$0.00	\$67.33
	12/01/2024	\$40.61	\$9.65	\$18.40	\$0.00	\$68.66
	06/01/2025	\$42.00	\$9.65	\$18.40	\$0.00	\$70.05
	12/01/2025	\$43.38	\$9.65	\$18.40	\$0.00	\$71.43
	06/01/2026	\$44.82	\$9.65	\$18.40	\$0.00	\$72.87
	12/01/2026	\$46.26	\$9.65	\$18.40	\$0.00	\$74.31
	06/01/2027	\$47.71	\$9.65	\$18.40	\$0.00	\$75.76
	12/01/2027	\$49.16	\$9.65	\$18.40	\$0.00	\$77.21
	06/01/2028	\$50.66	\$9.65	\$18.40	\$0.00	\$78.71
12/01/2028	\$52.16	\$9.65	\$18.40	\$0.00	\$80.21	
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 (Local 138)</i>	09/01/2024	\$69.04	\$14.07	\$18.36	\$0.00	\$101.47
	03/02/2025	\$70.84	\$14.32	\$18.61	\$0.00	\$103.77
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						

Additional Apprentices 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. Apprentices 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.

## SECTION 00700

### GENERAL CONDITIONS

#### INSERT

- 1.01 General Provisions
- 1.02 Definitions
- 1.03 Materials and Equipment
  - A. General
  - B. Handling
  - C. Storage of Excavated Material
  - D. Inspection
  - E. Inspection Away from Site
  - F. Samples
  - G. Shop testing
- 1.04 Contractor's Shop and Working Drawings
- 1.05 Occupying Private Land
- 1.06 Interference with and Protection of Streets
- 1.07 Safety
- 1.08 Existing Facilities
  - A. Dimensions of Existing Structures
  - B. Proposed Pipe Location
  - C. Interference with Existing Works
  - D. Existing Utilities or Connections
  - E. Failure to Repair
  - F. Disturbance of Bounds
- 1.09 Work to Conform
- 1.10 Planning and Progress Schedules
- 1.11 Precautions During Adverse Weather
- 1.12 Temporary Heat
- 1.13 Electrical Energy
- 1.14 Certificates of Conformance
- 1.15 Patents
- 1.16 "Or Equal" Clause
- 1.17 Additional or Substitute Bonds
- 1.18 Separate Contracts
- 1.19 Payrolls of Contractor and Subcontractors
- 1.20 Payments by Contractor
- 1.21 "Dig Safe" Law
- 1.22 Fire Prevention and Protection
- 1.23 Dust Control
- 1.24 Disposal of Debris
- 1.25 Night, Saturday, Sunday and Holiday Work
- 1.26 Length of Work Day
- 1.27 Hurricane Protection
- 1.28 Reduction in Scope of Work

#### GENERAL PROVISIONS

The duties and obligations imposed by these General Conditions will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

Sections of Division 1, General Requirements govern the execution of the Work of all sections of the specifications.

The Specifications are written in imperative and streamlined form. This imperative language is directed to the Contractor, unless stated otherwise.

#### DEFINITIONS

Wherever the words as listed in subsection 1.01 of the AGREEMENT or pronouns used in their stead occur in the Contract Documents, they shall have the meanings as given in the AGREEMENT.

#### MATERIALS AND EQUIPMENT

##### General

Unless otherwise provided in the Contract Documents, only new materials and equipment shall be incorporated in the Work.

As soon as possible after execution of the AGREEMENT, submit to the Engineer the names and addresses of the manufacturers and suppliers of all materials and equipment proposed to be incorporated into the Work.

When shop and working drawings are required as specified below, submit, prior to the submission of such drawings, data in sufficient detail to enable the Engineer to determine whether the manufacturer and/or the supplier have the ability to furnish a product meeting the Specifications.

Submit data relating to the materials and equipment proposed to be incorporated into the Work in sufficient detail to enable the Engineer to identify and evaluate the particular product and to determine whether it conforms to the Contract requirements. Such data shall be submitted in a manner similar to that specified for submission of shop and working drawings.

##### Handling

Handle, haul, and distribute materials and all surplus materials on the different portions of the Work, required to complete the Work in accordance with the Contract Documents.

Provide suitable storage room for materials and equipment during the progress of the Work, and be responsible for the protection, loss of, or damage to materials and equipment furnished under this Contract, until the final completion and acceptance of the Work.

Pay all storage and demurrage charges by transportation companies and vendors.

#### Storage of Excavated Material

Place excavated materials and equipment to be incorporated in the Work so as not to injure any part of the Work or existing facilities and so that free access can be had at all times to all parts of the Work and to all public utility installations in the vicinity of the Work.

Materials shall be kept neatly piled and compactly stored in such locations as will cause a minimum of inconvenience to public travel and adjoining owners, tenants and occupants.

#### Inspection

All materials and equipment furnished by the Contractor to be incorporated in the Work shall be subject to the inspection of the Engineer.

No material shall be processed or fabricated for the Work or delivered to the work site without prior concurrence of the Engineer.

Facilities and labor for the storage, handling, and inspection of all materials and equipment shall be furnished by the Contractor.

Defective materials and equipment shall be removed immediately from the site of the Work.

#### Inspection away from Site

If work to be done, away from the construction site, is to be inspected on behalf of the Owner during its fabrication, manufacture, or testing, or before shipment, the Contractor shall give notice to the Engineer of the place and time where such fabrication, manufacture, testing, or shipping is to be done. Such notice shall be in writing and delivered to the Engineer in ample time, as determined solely by the Engineer, so that the necessary arrangements for the inspection can be made.

#### Samples

Submit samples of materials for tests, as the Engineer deems necessary to demonstrate conformance with the Specifications. Such samples, including concrete test

cylinders, shall be furnished, taken, stored, packed, and shipped by the Contractor as directed by the Engineer.

Furnish suitable molds for making concrete test cylinders. Except as otherwise expressly specified, the Owner shall make arrangements for, and pay for, the tests.

Pack samples so as to reach their destination in good condition, and label to indicate the material represented, the name of the building or work and location for which the material is intended, and the name of the Contractor submitting the sample. To ensure consideration of samples, notify the Engineer by letter that the samples have been shipped and properly describe the samples in the letter. Send letter of notification separate from the samples.

Submit data and samples, or place his orders, sufficiently early to permit consideration, inspection and testing before the materials and equipment are needed for incorporation in the Work. The consequences for failure to do so shall be the Contractor's sole responsibility.

In order to demonstrate the proficiency of workmen, or to facilitate the choice among several textures, types, finishes, surfaces, etc., provide such samples of workmanship of wall, floor, finish, etc., as may be required.

After review of the samples, data, etc. the materials and equipment used for the Work shall in all respects conform therewith.

#### Shop Testing

When required, furnish to the Engineer in triplicate, sworn copies of manufacturer's shop or mill tests (or reports from independent testing laboratories) relative to materials, equipment performance ratings, and concrete data.

#### CONTRACTOR'S SHOP AND WORKING DRAWINGS

Submit shop drawings to the Engineer for review and approval.

All submittals will be identified as the Engineer may require and in the number of copies also as required by the Engineer.

The data shown on the Shop Drawings will be complete regarding quantities, dimensions, specified performance and design criteria, materials and other data as particular to the Work that the Contractor proposes to provide.

## OCCUPYING PRIVATE LAND

Entering or occupying with men, tools, materials, or equipment, any land outside the rights-of-way or property of the Owner (except after written consent from the proper parties) will not be permitted. A copy of the written consent shall be given to the Engineer.

## INTERFERENCE WITH AND PROTECTION OF STREETS

Obtain permits from the governing authorities prior to obstructing any portion of a street, road, or private way. If any street, road or private way is rendered unsafe by the Contractor's operations, he shall make such repairs or provide such temporary ways or guards as ordered by the governing authorities.

Maintain streets, roads, private ways, and walks not closed in a passable and safe condition,

Provide at least 24 hours in advance, notice to the Owner, Police, Fire and School Departments in writing, with a copy to the Engineer, if the closure of a street or road is necessary. Cooperate with all Departments in the establishment of alternate routes and provide adequate detour signs, plainly marked and well lighted, in order to minimize confusion.

## SAFETY

Take all precautions and provide safeguards to prevent personal injury and property damage. Provide protection for all persons including but not limited to employees and employees of other contractors and subcontractors; members of the public; and employees, agents and representatives of the Owner, the Engineer, and regulatory agencies that may be on or about the Work. Provide protection for all public and private property including but not limited to structures, pipes, and utilities, above and below ground.

Provide and maintain all safety equipment such as fences, barriers, signs, lights, walkways, guards and fire prevention and fire-fighting equipment.

Comply with all applicable Federal, State and local laws, ordinances, rules and regulations and lawful orders of all authorities having jurisdiction for the safety of persons and protection of property.

Designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This responsible person shall have the

authority to take immediate action to correct unsafe or hazardous conditions and to enforce safety precautions and programs.

## EXISTING FACILITIES

### Dimensions of Existing Structures

Where the dimensions and locations of existing structures are of importance in the installation or connection of any part of the Work, verify such dimensions and locations in the field before the fabrication of any material or equipment which is dependent on the correctness of such information.

### Proposed Pipe Location

Exterior pipelines will be located substantially as indicated on the Drawings, but the right is reserved to the Owner, acting through the Engineer, to make such modifications in location as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings, etc., are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him for laying and jointing different or additional items where required.

Small interior piping is indicated diagrammatically on the Drawings, and the exact location is to be determined in the field. Piping shall be arranged in a neat, compact, and workmanlike manner, with a minimum of crossing and interlacing, so as not to interfere with equipment or access way, and, in general, without diagonal runs.

### Interference with Existing Works

Conduct operations so as to interfere as little as possible with existing works. Develop a program, in cooperation with the Engineer and interested officials, which shall provide for the construction and putting into service of the new works in the most orderly manner possible. This program shall be adhered to except as deviations therefrom are expressly permitted. All work of connecting with, cutting into, and reconstructing existing pipes or structures shall be planned to interfere with the operation of the existing facilities for the shortest time when the demands on the facilities best permit such interference, even though it may be necessary to work outside of normal working hours to meet these requirements. Electrical connections should be coordinated with the Owner so as to minimize disruption of normal plant operations. Before starting work which will interfere with the operation of existing facilities, perform preparatory work and see that all tools, materials and equipment are made ready and at hand.

Repair utilities damaged by the Contractors operations during the progress of the work, and be responsible for correcting all damages to existing utilities and structures at no additional expense to the Owner. Contact the proper utility or authority to correct or make any changes due to utility or other obstructions during the work but the entire responsibility and expense shall be with the Contractor.

Make such minor modifications in the work relating to existing structures as may be necessary, without additional compensation.

Submit no claim for additional compensation by reason of delay or inconvenience in adapting his operations to the need for continuous flow of sewage.

#### Existing Utilities or Connections

The location of existing underground pipes, conduits, and structures, as shown, has been collected from the best available sources. The Owner, together with its agents, does not imply nor guarantee the data and information in connection with underground pipes, conduits, structures and such other parts as to their completeness, nor their locations as indicated. The Contractor shall assume that there are existing water, sewer, gas and other utility connections to each and every building enroute, whether they appear on the drawings or not. An expense and/or delay occasioned by utilities and structures, or damage thereof, including those not shown, shall be the responsibility of the Contractor, at no additional expense to the Owner.

Above ground utilities may be present in the areas of the proposed Work. Take all necessary actions and/or precautions, including, but not limited to, utility company notification and necessary relocations (both temporary and permanent), to insure proper protection of those aboveground utilities and appurtenances to be affected by his operations. All costs associated with the aboveground utilities shall be paid by the Contractor at no additional expense to the Owner.

If and when encountered, existing utilities shall be properly supported and protected during the construction work and the Engineer shall be notified accordingly. The operation of existing utilities shall not be interrupted except with written permission of the operator and owner of such utilities. Allow ample time for all measures as may be required for the continuance of existing utility operations. Take extreme precautions to minimize disruption of utilities. Make prompt and full restitution for repairs by others for all disruptions caused by operations required to perform the Work.

Comply with all requirements of utility organizations involved.

#### Failure to Repair

Any emergency arising from the interruption of electric, telephone, gas, water, or sewer service due to the activities of the Contractor, shall be repaired by the Contractor as quickly as is possible.

If and when, in the opinion of the Owner, the Contractor is not initiating repair work as expeditiously as possible upon notification to do so, the Owner, may at his own option, make the necessary repairs using his own forces or those of others. The cost of such repairs shall be subtracted from the payments due to the Contractor.

#### Disturbance of Bounds

Replace all bounds disturbed during the construction operation, at no additional cost to the Owner. The bounds shall be relocated by a land surveyor approved by the Engineer and registered in the State that the Work is to be done.

#### WORK TO CONFORM

During its progress and on its completion, the Work shall conform to the lines, levels, and grades indicated on the Drawings or given by the Engineer and shall be built in strict accordance with the Contract Documents and the directions given from time to time by the Engineer.

All work done without instructions having been given therefore by the Engineer, without proper lines or levels, or performed during the absence of the Engineer, will not be estimated or paid for except when such work is authorized by the Engineer in writing. Work so done may be ordered uncovered or taken down, removed, and replaced at the Contractor's expense.

#### PLANNING AND PROGRESS SCHEDULES

Before starting the Work and from time to time during its progress, as the Engineer may request, the Contractor shall submit to the Engineer a written description of the methods he plans to use in doing the Work and the various steps he intends to take.

Within 14 calendar days after the date of formal execution of the AGREEMENT, the Contractor shall prepare and submit to the Engineer (a) a written schedule fixing the dates on which additional drawings, if any, will be needed by the Contractor and (b) a written schedule fixing the respective dates for the start and completion of various parts of the Work.

Each such schedule shall be subject to review from time to time during the progress of the Work.

#### PRECAUTIONS DURING ADVERSE WEATHER

During adverse weather and against the possibility thereof, take all necessary precautions so that the Work may be properly done and satisfactory in all respects. When required by the manufacturer of the material or equipment to be installed, protection shall be provided by use of tarpaulins, wood and building-paper shelters, or other suitable means.

During cold weather, materials shall be preheated, if required, and the materials and adjacent structure into which they are to be incorporated shall be made and kept sufficiently warm so that a proper bond will take place and a proper curing, aging, or drying will result. Protected spaces shall be artificially heated by suitable means that will result in a moist or dry atmosphere according to the particular requirements of the work being protected. Ingredients for concrete and mortar shall be sufficiently heated so that the mixture will be warm throughout when used.

#### TEMPORARY HEAT

If temporary heat is required for the protection of the Work, provide and install suitable heating apparatus, provide adequate and proper fuel, and shall maintain heat as required.

Temporary heating apparatus shall be installed and operated in such manner that finished work will not be damaged.

#### ELECTRICAL ENERGY

Make all necessary applications and arrangements and pay all fees and charges for electrical energy for power and light necessary for the proper completion of the Work and during its entire progress. Provide and pay for all temporary wiring, switches, connections, and meters.

Provide sufficient electric lighting so that all work may be done in a workmanlike manner when there is not sufficient daylight.

#### CERTIFICATES OF CONFORMANCE

Furnish to the Engineer, in the manner as directed and prior to actual installation, notarized certificates of conformance for all materials to be furnished under this Contract. The notarized certificates of

conformance shall state that the material to be furnished meets or exceeds all requirements specified under the Contract Documents. When so directed, the manufacturer's notarized certificates of conformance, certifying that the materials meet the requirements specified shall accompany each shipment of material. Unless otherwise specifically specified and/or directed by the Engineer, all testing of materials required under this Contract shall be provided by the Contractor at no additional expense to the Owner.

#### PATENTS

Pay, at no additional expense to the Owner, all applicable royalties and license fees associated with the materials and construction methods to be used under this Contract. Defend all suits or claims for infringements of any patent rights, and save the Owner and Engineer harmless from loss on account thereof, except that the Owner shall be responsible for any such loss when a particular process, design, or product of a particular manufacturer (s) is specifically specified with no option to the Contractor. However, if the Contractor has reason to believe that the design, process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Owner.

Refer to Specification Section 00500 Article 1.07, Patents, regarding the Contractor's responsibilities for any patent rights associated with the materials and construction methods to be used under this Contract.

#### " OR EQUAL " CLAUSE

Whenever a material or article required is specified or shown on the drawings by using the name of the proprietary product of a particular manufacturer or vendor, any material or article which will perform adequately, in the Engineer's sole judgment and/or opinion, the duties imposed by the general design may be considered equal and satisfactory providing the material or article so proposed is of equal substance. It shall not be purchased or installed without his written approval. In all cases new material shall be used in the project.

If more than one brand, name of material, device, or piece of equipment is shown or specified, each should be regarded as the equal of the other. Any other brand, make of material, device or equipment, which in the opinion of the OWNER and/or ENGINEER, is the recognized equal of that specified (considering quality, workmanship, and economy of operation), and is suitable for the purpose intended, may be accepted.

ENGINEER will be allowed a reasonable time within which to evaluate submittals for Substitute Items. ENGINEER will be the sole judge of acceptability. No "Or Equal" or Substitute Item will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any "or equal" or substitute. ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitutes proposed or submitted by CONTRACTOR and in making changes to the Contract Documents. Whether or not ENGINEER accepts a Substitute Item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed Substitute Item.

#### ADDITIONAL OR SUBSTITUTE BONDS

If at any time the Owner, for justifiable cause, shall be or become dissatisfied with any Surety or Sureties than upon the performance or payment bonds, the Contractor shall, within five (5) calendar days after notice from the Owner so to do, substitute an acceptable bond (or bonds) in such form and sum and signed by such other Surety or Sureties as may be acceptable to the Owner. The Contractor shall pay the premiums on such bonds with no additional expense to the Owner. No further payments shall be deemed due nor will be made until the new Surety or Sureties shall have furnished such as acceptable bond to the Owner.

#### SEPARATE CONTRACTS

The Owner reserves the right to let other contracts in connection with the construction of the contemplated work of this project or contiguous projects of the Owner. The Contractor, therefore, will afford any such other contractors reasonable opportunity for the introductions and storage of their materials and the execution of their work, will properly connect and coordinate his work with theirs, and will not commit or permit any act which will interfere with the performance of their work.

Coordinate operations with those of other contractors. Cooperation will be required in the arrangement for the storage of materials and in the detailed execution of the work.

It is essential that all parties interested in the project cooperate to the end that the entire project will be brought to a successful conclusion as rapidly as possible, but the Owner cannot guarantee that no interference or delay will be caused thereby. Interference and delay resulting from such cooperation shall not be basis of claims against the Owner.

#### PAYROLLS OF CONTRACTOR AND SUBCONTRACTORS

The Contractor and each of his Subcontractors shall prepare his payrolls on forms prescribed and in accordance with instructions to be furnished by the Owner. Within seven (7) days after the regular payment date of the payroll, the Contractor shall deliver to the Owner, with copies to the Engineer, a certified legible copy or copies of each such payroll. Each such payroll shall contain the statement required by the Federal Regulations issued pursuant to the "Anti-Kickback Statute", (48 Stat. 948; 18 U.S.C. 874; 40 U.S.C. 276C).

Carrying any person on his payrolls not employed by him will not be permitted. Carrying employees of a subcontractor on his payrolls will not be permitted, but such employees must be carried on the payrolls of the employing subcontractor.

Each Contractor or Subcontractor shall preserve his weekly payroll records for a period of three (3) years from the date of completion of the Contract. The payroll records shall set out accurately and completely the name, occupational classification, and hourly wage rate of each employee, hours worked by him during the payroll period and full weekly wages earned by him, and deductions made from such weekly wages and the actual weekly wages paid to him. Such payroll records shall be made available at all times for inspection by the Owner or his authorized representatives, the Engineer or by agents of the United States Department of Labor.

#### PAYMENTS BY CONTRACTOR

Pay for all traffic control, safety, transportation and utility services not later than the 20th day of the calendar month following that in which services are rendered. Reimbursable costs for services rendered, as specified in the Contract Documents, shall not be incorporated into partial payment estimates until such time that the Contractor submits to the Engineer actual paid invoices from those in which services were rendered.

## " DIG SAFE" LAW

Before proceeding with construction operations, the Contractor shall notify the State of Massachusetts Underground Plant Damage Prevention Systems (DIG SAFE at 811), and shall make such supplemental investigations, including exploratory excavations, by hand digging, as he deems necessary to uncover and determine the exact locations of utilities and structures, and shall have no claims for damages due to encountering subsurface structures or utilities in locations other than that shown on the drawings, or which were made known to the Contractor prior to construction operations. The Contractor shall be responsible and liable for all damages to the existing utilities and structures.

Before commencing with the construction of any work, identify any water main, gas main, telephone duct, electric duct, and/or other utility present which is or could be in conflict with the proposed work.

Relocation of the affected utilities shall be done as directed by the Owner and in accordance with the requirements of the utility company.

The attention of the Contractor is directed to the fact that certain utility companies may not fall under the provisions of "DIG SAFE". Individual utility company notifications by the Contractor shall be necessary to insure proper notification and protection of all existing utilities affected by this Contract.

## FIRE PREVENTION AND PROTECTION

State and municipal rules and regulations with respect to fire prevention, fire-resistant construction and fire protection shall be strictly adhered to and all work and facilities necessary therefore shall be provided and maintained by the Contractor in an approved manner.

Provide fire protection equipment such as water tanks, hoses, pumps, extinguishers, and other materials, and apparatus, for the protection of the contract work, and adjacent property. Trained personnel experienced in the operation of all fire protection equipment and apparatus shall be available on the site whenever work is in progress, and at such other times as may be necessary for the safety of the public and the work.

## DUST CONTROL

Exercise every precaution and means to prevent and control dust arising out of all construction operations from becoming a nuisance to abutting property owners

or surrounding neighborhoods. Pavements adjoining pipe trench shall be kept clean of excess materials wherever and whenever directed by the Engineer. Repeated daily dust control treatment shall be provided to satisfactorily prevent the spread of dust until permanent pavement repairs are made and until earth stockpiles have been removed, and all construction operations that might cause dust have been completed. No extra payment will be made for dust control measures, compensation shall be considered to be included in the prices stipulated for the appropriate items as listed in the Bid.

## DISPOSAL OF DEBRIS

The materials from the demolition, and those used in the construction of the Work throughout the project, shall be deposited in such a manner so as to not endanger persons or the Work, and so that free access may be had at any time to all hydrants, gates and existing equipment in the vicinity of the work. The materials shall be kept trimmed-up so as to be of as little inconvenience as possible to the public travel and plant operations. All excavated materials not approved for backfill and fill, all surplus material, and all rock and boulders resulting from the excavations, shall be removed and satisfactorily disposed of off the site by the Contractor, at no additional expense to the Owner.

The materials being removed from the pipelines and manholes during the cleaning process shall be deposited in such a manner as to not endanger the public, plant personnel or persons performing the work. Such debris deposits may be of such nature, high in biological organic contents, or chemically aggressive that they will require proper disposal in a safe, health risk free, environment. Contact the Owner and Engineer and all agencies having jurisdiction thereof, for approval of debris disposal methods and locations of disposal, prior to disposing of any or all debris removed from pipe cleaning methods. All debris shall be removed and satisfactorily disposed of off the work site, at no additional expense to the Owner.

## NIGHT, SATURDAY, SUNDAY AND HOLIDAY WORK

No work shall be done at night or on Saturdays, or Sundays or holidays without the prior written approval of the Owner and Engineer.

#### LENGTH OF WORK DAY

The Owner retains the right to restrict the Contractor to an eight-hour workday. Such restrictions shall not be the basis for damages or claims against the Owner.

The Contractor's attentions is also directed to the fact that should it be deemed necessary to perform various items of work during off-peak flow or traffic hours, early morning or late night hours, then he shall notify the Engineer a minimum of 24 hours in advance as to his intentions and reasons for the change in work hours. The Contractor shall be responsible for properly contacting and informing all involved parties of such a change in work hours. The Contractor shall not be entitled to any additional compensation from the Owner for any expenses that may be incurred by change of working hours and/or scheduling.

#### HURRICANE PROTECTION

Should hurricane warnings be issued, the Contractor shall take every practicable precaution to minimize danger to persons, to the work and to adjacent

property. These precautions shall include closing all openings; removing all loose materials, tools and/or equipment from exposed locations; and removing or securing scaffolding and other temporary work.

#### REDUCTION IN SCOPE OF WORK

The Owner reserves the right to decrease the scope of the work to be done under this Contract and to omit any work should the Owner deem it to be in the public interest to do so. To this end, the Owner reserves the right to reduce the quantity of any items or omit all of any as set forth in the BID, either prior to executing the contract or at any time during the progress of the work. The Owner further reserves the right, at anytime during the progress of the work, to restore all or part of any items previously omitted or reduced. Exercise by the Owner of the above rights shall not constitute any ground or basis of claim for damages or for anticipated profits on the work omitted.

#### END OF SECTION

## SECTION 00800

### SUPPLEMENTARY CONDITIONS

- 1.01 General
- 1.02 Limits of Normal Excavation
- 1.03 Covering Excavated Trench
- 1.04 Maintaining Trench Excavations
- 1.05 Disruption of Storm Drains
- 1.06 Precaution Against Hydraulic Uplift During Construction
- 1.07 Blasting
- 1.08 Land, Easements, and Rights-of-Way
- 1.09 Cleaning Finished Work
- 1.10 Appropriation
- 1.11 Forum and Choice of Law
- 1.12 Severability

#### 1.01 GENERAL

A. These Supplementary Conditions are requirements which amend or supplement the General Conditions specified elsewhere.

B. The duties and obligations imposed by these Supplementary Conditions will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

C. Assertion of any claim for any additional compensation or damages on account of and/or the fulfillment of these Supplementary Conditions will not be allowed.

#### 1.02 LIMITS OF NORMAL EXCAVATION

A. In determining the quantities of excavation to which unit prices shall apply, the limits of normal width and depth of excavation shall be as described below, unless other limits are indicated in the Contract Documents.

B. For pipes in trench, the normal width of the trench shall be measured between vertical planes which are a distance apart equal to the sum

of 18 inches plus 1-1/3 times the nominal inside diameter of the pipe. If the width so computed is less than 3.0 feet, a width of 3.0 feet shall be taken as the normal width for payment. The normal depth shall be measured to a distance of 0.5 feet below the bottom of the pipe in earth and 0.5 feet in rock, unless there be a cradle underneath the pipe, in which case the normal depth shall be measured to the underside of the cradle. The trench width for the cradle shall be assumed to be that specified above for pipes in the trench.

C. For concrete placed directly against undisturbed earth, the normal width and depth of the excavation for such concrete shall be measured to the neat lines of the concrete as indicated on the Drawings or as ordered.

D. For concrete placed against rock surfaces resulting from rock excavation, the normal width and depth of the excavation shall be measured to 4 inches outside the neat lines of the concrete as indicated on the Drawings or as ordered.

E. For other structures, except manholes as noted below, the normal width shall be measured between vertical planes 1.0 feet outside the neat lines of the several parts of the structure, except that the width at any elevation shall be measured as not less than the width at a lower elevation. The normal depth shall be measured to the underside of that part of the structure for which the excavation is made.

F. No additional width or depth of trenches excavated in earth or rock shall be allowed at standard circular manholes. The pay limit for rock removed outside proposed manholes shall commence one foot (1.0) outside the widest dimension of the structure or shall be the maximum connecting trench width, whichever is greater.

G. Wherever bell holes are required for jointing pipe, they shall be provided without additional compensation over and above that resulting from

### 1.03 COVERING EXCAVATED TRENCH

A. In addition to the requirements in Section 00700 titled Interference with and Protection of Streets. Cover all open excavations when construction operations are suspended at the end of the day, or in excavated trenches where work is not actually in progress. Cover shall be capable of withstanding AASHTO H20-S16 loading. This cover shall consist of steel plates or some other satisfactory cover of adequate size and strength suitably held in place to keep all traffic out of excavations, all as verified in writing by the Contractor. The cover shall be laid over the excavation until it is backfilled.

### 1.04 MAINTAINING TRENCH EXCAVATIONS

B. The length of trench opened at any time, from point where ground is being broken to completed backfill, and also the amount of space in streets or public and private lands occupied by equipment, trench, and supplies, shall not exceed the length of space considered reasonably necessary and expedient by the Engineer. In determining the length of open trench or spaces for equipment, materials, supplies and other necessities, the Engineer will consider: the nature of the lands or streets where work is being done; types and methods of construction and equipment being used; inconvenience to the public or to private parties; possible dangers; and other proper matters. All work must be constructed with a minimum inconvenience and danger to the public and all other parties concerned.

B. Whenever any trench obstructs pedestrian and vehicular traffic in or to any public street, private driveway or property entrance, or on private property, take such means as may be necessary to maintain pedestrian and vehicular traffic and access. Until such time as the work may have attained sufficient strength to support backfill, or if for any other reason it is not expedient to backfill the trench immediately, construct and maintain suitable plank crossing and bridges to carry

essential traffic in or to the street, driveway or property in question, as specified or directed.

C. Suitable signs, lights, and such items required by Police Authorities to direct traffic, shall be furnished and maintained by the Contractor at his own expense.

D. Keep streets and premises free from unnecessary obstructions, debris and all other materials. The Engineer may, at any time, order all equipment, materials, surplus from excavations, debris and all other materials lying outside that length of working space, promptly removed. Should the Contractor fail to remove such material within 24 hours after notice to remove the same, the Owner may cause any part or all of such materials to be removed by such persons as he may employ, at the Contractor's expense; and may deduct the costs thereof from payments which may be or may become, due to the Contractor under the Contract. In special cases, where public safety urgently demands it, the Owner may cause such materials to be removed at the Contractor's expense without prior notice.

### 1.05 DISRUPTION OF STORM DRAINS

A. Portions of the Work may be located in areas that are serviced by storm drains. Take extreme precaution to minimize disruption of the drains, and repair and/or make restitution for repairs by others for all disruptions caused by the construction operations.

### 1.06 PRECAUTION AGAINST HYDRAULIC UPLIFT DURING CONSTRUCTION

A. Protect all structures against hydraulic uplift until such structures have beneficially completed.

### 1.07 BLASTING AND PRE-CONSTRUCTION BLASTING SURVEY

A. Blasting will not be permitted.

#### 1.08 LAND, EASEMENTS, AND RIGHTS-OF-WAY

A. As indicated, a portion of the work may be located within easements and/or rights-of-way, obtained or which will be obtained by the Owner, through private property. On all other lands, the Contractor has no rights unless he obtains them from the proper parties as specified in Section 00700, Occupying Private Land.

B. The Contractor shall commence work upon issuance of a Notice to Proceed from the Owner. Prior to issuance of the Notice to Proceed, the Owner shall obtain all land, easements and rights-of-way necessary for carrying out and for the completion of the work to be performed pursuant to the Contract Documents, unless otherwise mutually agreed.

C. The Owner shall provide to the Contractor information which delineates and describes the lands owned and rights-of-way acquired.

D. The Contractor shall provide at his own expense and without liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities or for storage of equipment and materials.

E. If however, lands, easements or rights-of-way cannot be obtained before work on the project begins, the Contractor shall begin his work upon such land, easements or rights-of-way as have been previously acquired by the Owner, and no claims for damages whatsoever will be allowed by reason of its inability to procure the lands, easements, or rights-of-way for the said work, the Contractor shall not be entitled to make or assert a claim for damages by reason of the said delay, or to withdraw from the Contract except by consent of the Owner. Time for completion of work will be extended to such time as the Owner determines will compensate for the time lost by such delay, such determination to set forth in writing.

#### 1.09 CLEANING FINISHED WORK

A. After the work is completed, the pipes, manholes and structures shall be carefully

cleaned free of debris and dirt, broken masonry, and mortar, and left in first class condition, ready to use. All temporary or excess materials shall be disposed of off-site and the work left broom clean, to the satisfaction of the Engineer.

#### 1.10 APPROPRIATION

No contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or public work by any city or town costing more than two thousand dollars shall be deemed to have been made until the auditor or accountant or other officer of the city or town having similar duties has certified thereon that an appropriation in the amount of such contract is available therefor and that an officer or agent of the city, town or awarding authority has been authorized to execute said contract and approve all requisitions and change orders. No order to the contractor for a change in or addition to the work to be performed under a contract subject to this section, whether in the form of a drawing, plan, detail or any other written instruction, unless it is an order which the contractor is willing to perform without any increase in the contract price, shall be deemed to have been given until the auditor or accountant, or other officer of the city or town having similar duties, has certified thereon that an appropriation in the amount of such order is available therefor; but such certificate shall not be construed as an admission by the city or town of its liability to pay for such work.

#### 1.11 FORUM AND CHOICE OF LAW

This Contract and any performance herein shall be governed by and be construed in accordance with the laws of the Commonwealth of Massachusetts. Any and all proceedings or actions relating to subject matter herein shall be brought and maintained in the courts of the Commonwealth of Massachusetts or the federal district court sitting in the Commonwealth of Massachusetts, which shall have exclusive jurisdiction thereof. This paragraph shall not be construed to limit any other legal rights of the parties.

#### 1.12 SEVERABILITY

If any term or condition of this Contract or any application thereof shall to any extent be held invalid, illegal or unenforceable by a court of competent jurisdiction, the validity, legality, and enforceability of the remaining terms and conditions of this Contract shall not be deemed

affected thereby unless one or both parties would be substantially or materially prejudiced.

**END OF SECTION**

# DIVISION 1

## SECTION 1010

### SUMMARY OF WORK

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Work covered by the Contract, listing of Owner, Project location, Engineer. Sequence requirements, the Contractor's use of the premises and Owner's occupancy requirements.

##### 1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. The work in this Contract consists of furnishing all necessary labor, materials, and equipment for the replacement of the Rosemont Street Bridge over Little River. The work includes: Installing temporary cofferdams; installation of a temporary utility bridge; sewer bypass pumping; clearing and grubbing; removal of existing bridge; installing drilled micropiles; ledge excavation, tremie installation, installing new bridge; streambed restoration; providing slope protection; restoration of wetlands; drainage improvements; removing and replacing guardrail; milling and resurfacing roadway; pavement markings; signing; and the provision of safety controls and signing for construction operations and other incidental items included in the contract documents necessary to complete the Project.
  
- B. All work is more particularly indicated, shown or described in the Drawings, Specifications, and other Contract Documents.

##### 1.03 OWNER

City of Haverhill  
4 Summer St  
Haverhill, MA 01830  
Contact: John H. Pettis III, P.E., City Engineer  
Telephone: 978-374-2335

##### 1.04 PROJECT LOCATION

Rosemont Street  
Haverhill, MA

##### 1.05 ENGINEER

- A. BETA Group, Inc.  
315 Norwood Park South  
Norwood, Massachusetts 02062  
Telephone: 781-255-1982  
Fax: 781-255-1974  
Contact: Christopher W. Jones, P.E.

1.06 WORK SEQUENCE

- A. In order that Work may be conducted with minimum inconvenience to the public and, work under this Contract may be coordinated with other work which may be under construction or contemplated, and that work under the Contract may conform to conditions which it has been undertaken or conditions attached to a right-of-way or particular location for this work, the Engineer may determine the point or points and time or times when portions of work will commence or be carried on and may issue orders pertaining to the work sequence, relative to the rate of progress on several portions of the work.

1.07 CONTRACTOR USE OF PREMISES

- A. The Contractor's use of premises shall be within the limits shown on the Drawings and as defined in Section 00500 – Contract Agreement, for the performance of the Work.
  
- B. The Contractor shall assume full responsibility for security of all materials and equipment on the site, including those of his subcontractor's.
  
- C. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

**END OF SECTION**

## **SECTION 01025**

### **MEASUREMENT AND PAYMENT**

#### **PART 1 GENERAL**

##### **1.01 SCOPE**

- A. The purpose of this section is to define the basis of measurement and payment for the unit price or lump sum items listed in SECTION 00300, BID PROPOSAL.
- B. Section 9.00 of the Commonwealth of Massachusetts Highway Department (MassDOT) Standard Specifications for Highways and Bridges, 2024 Edition is hereby included in its entirety.

##### **1.02 PAYMENT ITEMS**

- A. Work Items of this Project are referenced with Items Numbers and Item Descriptions similar to those currently in use by the MassDOT, Highway Division.

##### **1.03 BASIS OF MEASUREMENT AND PAYMENT**

- A. Method of Measurement and Basis of Payment for Work Items shall be as called for under the appropriate section of the MassDOT Standard Specifications, unless modified in Sections 02500, Special Provisions and 02550, Construction Specifications.

**END OF SECTION**

## SECTION 01035

### MODIFICATION PROCEDURES

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes
  - 1. Procedures for making modifications to the Contract by change orders or other means.
- B. Related Sections
  - 1. Document 00500 - Agreement

##### 1.02 CHANGE ORDERS

- A. In general Change Orders will be issued for modification of Contract documents which will incorporate changes in the Contract requirements, including additions or deletions in the Work; for unforeseen field conditions which will necessitate changes in the Work; changes in code provisions or other requirements of federal, state or local authority requiring changes in the Work; changes in the availability of products or for incorporating new products into the work and for changes directed by the Engineer for the benefit of the Owner.
- B. Authority to execute Change Orders shall be that of the Engineer and not of the Contractor. Changes Orders will, in general, originate by a "Change Order Proposal Request" or by issuance of a "Construction Change Authorization".
- C. Unless authorized by the Engineer, no work shall be performed that is involved in the change until a formal Change Order is issued.
- D. To initiate a Change Order, the Engineer will forward a Change Order proposal request describing the proposed changes and if required, include additional or revised drawings and specifications soliciting a formal quotation of cost and time to complete the proposed Change Order work. Upon reaching mutual agreement on the cost and time, the Engineer will sign his approval of the Change Order and submit it to the Contractor for his full signature of acceptance.

##### 1.03 FIELD ORDERS

- A. The Engineer may, to avoid costly removal of, or alterations to, present on-going work, issue a Work Directive Change authorizing the Contractor to proceed, subject to later negotiation of the price of the change.

##### 1.04 PRICE AGREEMENTS

- A. Prices agreed upon to cover the Change Orders may be either by mutual acceptance of a lump sum or by unit prices as stated in the Contract bid proposal or actual direct cost plus a percentage for overhead, profit and other expenses consistent with Section 00500 – Contract Agreement.
- B. Work done by a subcontractor entitles the General Contractor a percentage of the sum of the actual direct cost, not including the subcontractor's overhead and profit, consistent with Section 00500 – Contract Agreement.

- C. Method for computing the cost of the change shall be based on the net additional increase. No overhead and profit shall be deducted from prices for changes deleting work.
- D. The Change Order form document shall indicate the net adjustment (+/-) to the total Contract price as a result thereof including extension or reduction of time when applicable.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

**END OF SECTION**

## SECTION 01050

### FIELD ENGINEERING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Survey work and other field engineering responsibilities of the Contractor.

##### 1.02 REQUIREMENTS

- A. Contractor shall be responsible for layout of the work and the establishing of lines and grades and the following.
- B. Establish elevations, lines, levels, reference marks, batter boards, etc., required during the progress of the Work. Verify such marks by instrument to confirm accuracy.
- C. Locate and protect survey control and reference points.
- D. Make, check, and be responsible for all measurements and dimensions necessary for the proper construction of the Work.
- E. Engineer will be permitted to check the lines, elevations, reference marks, batter boards, etc., set by the Contractor. The Contractor shall correct any errors found in lines, elevations, reference marks, batter boards, etc. Such a check shall not be construed as approval of the Contractor's work and shall not relieve or diminish the responsibility of the Contractor for the accurate construction and completion of the Work.
- F. Control datum for survey as shown on Drawings.

##### 1.03 QUALITY ASSURANCE

- A. Qualifications: Employ a Civil Engineer or Land Surveyor registered within the Commonwealth of Massachusetts, acceptable to the Engineer.
- B. Certifications: Submit certificate signed by the Contractor's Engineer or Land Surveyor stating elevations and locations of the Work are in conformance with the Contract Documents.

#### PART 2 PRODUCTS

NOT USED

#### PART 3 EXECUTION

NOT USED

**END OF SECTION**

## SECTION 01065

### PRICE ADJUSTMENTS FOR COST INCREASES AND DECREASES FOR FUELS, (BOTH DIESEL AND GAS), ASPHALT, CEMENT, AND STRUCTURAL AND REINFORCING STEEL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. General Provisions
- B. MGL Chapter 30 Section 38A
- C. Fuel Price Adjustment, (Both Diesel and Gas)
- D. Asphalt Price Adjustment
- E. Cement Price Adjustment
- F. Structural and Reinforcing Steel Price Adjustment

##### 1.02 GENERAL PROVISIONS

- A. The herein specified material price adjustments are required in contracts for road, bridge water and sewer projects awarded under Chapter 30, Section 39M of the Massachusetts General Laws.
- B. Material price adjustments are not required for contracts awarded under Chapter 149, Section 44A of the Massachusetts General Laws.

##### 1.03 MASSACHUSETTS GENERAL LAW CHAPTER 30 SECTION 38A

- A. Section 38A. "Contracts for road and bridge projects awarded as a result of a proposal or invitation for bids under section 39M shall include a price adjustment clause for each of the following materials: fuel, both diesel and gasoline; asphalt; concrete; and steel. Contracts for water and sewer projects awarded as a result of a proposal or invitation for bids under said section 39M shall include a price adjustment clause for fuel, both diesel and gasoline; liquid asphalt; and portland cement contained in cast-in-place concrete. A base price for each material shall be set by the awarding authority or agency and shall be included in the bid documents at the time the project is advertised. The awarding authority or agency shall also identify in the bid documents the price index to be used for each material. The price adjustment clause shall provide for a contract adjustment to be made on a monthly basis when the monthly cost change exceeds plus or minus 5 per cent."

##### 1.04 MONTHLY PRICE ADJUSTMENTS FOR DIESEL FUEL AND GASOLINE

- A. 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 Owner, depending on an increase or decrease in the average price of diesel fuel or gasoline.
- B. 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

- C. The Base Price of Diesel Fuel and Gasoline will be the price as indicated in the Massachusetts DOT Highway Division's web site:  
<https://www.mass.gov/massdot-contract-price-adjustments> for the month in which the contract was bid, which included State Tax.
- D. The Period Price will be the average of prices charged to the State, including State Tax for the bulk purchases made during each month.
- E. 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.
- F. No adjustment will be paid for work done beyond the extended completion date of any contract.
- G. 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.
- H. 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

1.05 ASPHALT PRICE ADJUSTMENT

- A. This provision applies to all projects using greater than 100 tons of hot mix asphalt (HMA) mixtures containing liquid asphalt cement as stipulated in this section.
- B. 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.
- C. Base Price
  - 1. The Base Price of liquid asphalt on a project as listed herein, 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.
- D. Period Price
  - 1. 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 Poter & 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> within two (2) business days following its receipt of the relevant issue of the "Asphalt Weekly Monitor". Potens and Partners has granted the Department the right to publish this specific asphalt price information sourced from the Asphalt Weekly Monitor. This method of period price determination was formerly called the New Asphalt Period Price Method. Separate website postings using both the New Asphalt Period Price Method and the Old Asphalt Period Price Method were discontinued after June 2013.

E. Price Adjustment Determination, Calculation, and Payment

1. 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.
2. 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.
3. The Price Adjustment applies only to the actual virgin liquid asphalt content in the mixture placed on the job in accordance with the Standard Specifications for Highways and Bridges, Division III, Section M3.11.03.
4. 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:

$$\text{Price Adjustment} = \text{Tons of HMA Placed} \times \text{Liquid Asphalt Content \%} \times \text{RAP Factor} \times (\text{Period Price} - \text{Base Price})$$

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

1.06 CEMENT PRICE ADJUSTMENT

- A. 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 this section. This Price Adjustment will occur on a monthly basis.
- B. 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.
- C. 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 herein.
- D. 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 <https://www.mass.gov/massdot-contract-price-adjustments> the Wednesday immediately following the publishing of the monthly price in ENR, which is normally the first week of the month.

- E. 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.
- F. The price adjustment applies only to the actual Portland cement content in the mix placed on the job in accordance with the Contract Plans and Specifications. No adjustments will be made for any cement replacement materials such as fly ash or ground granulated blast furnace slag.
- G. The Price Adjustment will be a separate pay 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.
- H. 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.
- I. No Price Adjustment will be allowed beyond the Completion Date of this Contract, unless there is an approved extension of time.

#### 1.07 STRUCTURAL AND REINFORCING STEEL PRICE ADJUSTMENT

- A. 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.
- B. Price adjustments will be variances between Base Prices and Period Prices. Base Prices and Period Prices are defined below.
- C. 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.
- D. 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.
- E. 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.
- F. The weight of steel subject to a price adjustment shall not exceed the final shipping weight of the fabricated part by more than 10%.
- G. Base Prices and Period Prices are defined as follows:

1. Base Prices of unfabricated structural steel and unfabricated reinforcing steel on a project are fixed prices determined by the MassDOT and found in the table below. While it is the intention 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 Engineers attention so that a contract alteration may be processed that adds the missing steel to the table and its price adjustments to the Contract.
2. The Base Price Date is the month and year in which the Owner opened bids for the project. This date is used to select the Base Price Index.
3. 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.
4. 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 Owner 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.
5. The index used for the calculation of Period Prices is the U.S. Bureau of Labor Statistics (BLS) 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)".

H. Period Prices are determined as follows:

1. Period Price = Base Price X Index Factor
2. Index Factor = Period Price Index / Base Price Index

I. Example of a Period Price Calculation:

1. 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.
2. The Period Price Date is December 2009. From the PPI website\*, the Period Price Index = 218.0.
3. The Base Price Date is March 2009. From the PPI website\*, the Base Price Index = 229.4.
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
5. Since \$0.82 - \$0.78 = \$0.04 is less than 5% of \$0.82, no price adjustment is required.
6. 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 the Owner. When the Period Price is higher than the Base Price, the price adjustment is owed to the Contractor.
7. \* 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>

- J. The Contractor will be paid for unfabricated structural steel and unfabricated reinforcing steel under the respective contract pay items or for all components constructed of either structural steel or reinforced Portland cement concrete under their respective Contract Pay Items.
- K. Price adjustments, as herein provided for, will be paid separately under Pay Item 999.2.
- L. No price adjustment will be made for price changes after the Contract Completion Date, unless the Owner has approved an extension of Contract Time for the Contract.
- M. Steel base prices shall be as per the table below.

	Steel Type	Price per Pound
1	ASTM A615/A615M Grade 60 (AASHTO M31 Grade 60 or 420) Reinforcing Steel	\$0.63
2	ASTM A27 (AASHTO M103) Steel Castings, H-Pile Points & Pipe Pile Shoes (See Note (8) below.)	\$0.87
3	ASTM A668 / A668M (AASHTO M102) Steel Forgings	\$0.87
4	ASTM A108 (AASHTO M169) Steel Forgings for Shear Studs	\$0.90
5	ASTM A709/A709M Grade 36 / AASHTO M270M/M270 Grade 36 or 250 Structural Steel Plate	\$0.96
6	ASTM A709/A709M Grade 36 / AASHTO M270M/M270 Grade 36 or 250 Structural Steel Shapes	\$0.89
7	ASTM A709/A709M Grade 50 / AASHTO M270M/M270 Grade 50 or 345 Structural Steel Plate	\$0.96
8	ASTM A709/A709M Grade 50 / AASHTO M270M/M270 Grade 50 or 345 Structural Steel Shapes	\$0.89
9	ASTM A709/A709M Grade 50WT / AASHTO M270M/M270 Grade 50WT or 345WT Structural Steel Plate	\$1.00
10	ASTM A709/A709M Grade 50WT / AASHTO M270M/M270 Grade 50WT or 345WT Structural Steel Shapes	\$0.90
11	ASTM A709/A709M Grade 50W / AASHTO M270M/M270 Grade 50W 345W Structural Steel Plate	\$1.00
12	ASTM A709/A709M Grade 50W / AASHTO M270M/M270 Grade 50W or 345W Structural Steel Shapes	\$0.90
13	ASTM A709/A709M Grade HPS 50W / AASHTO M270M/M270 Grade HPS 50W or 345W Structural Steel Plate	\$1.04
14	ASTM A709/A709M Grade HPS 70W / AASHTO M270M/M270 Grade HPS 70W or 485W Structural Steel Plate	\$1.11
15	ASTM A514/A514M-05 Grade HPS 100W / AASHTO M270M/M270 Grade HPS 100W or 690W Structural Steel Plate	\$1.71
16	ASTM A992/A992M Grade 50S / AASHTO M270M/M270 Grade 50S or 345S Structural Steel Plate	\$1.00
17	ASTM A992/A992M Grade 50S / AASHTO M270M/M270 Grade 50S or 345S Structural Steel Shapes	\$0.90
18	ASTM A276 Type 316 Stainless Steel	\$5.10
19	ASTM A240 Type 316 Stainless Steel	\$5.10
20	ASTM A148 Grade 80/50 Steel Castings (See Note (8) below.)	\$1.76
21	ASTM A53 Grade B Structural Steel Pipe	\$1.11

22	ASTM A500 Grades A, B, 36 & 50 Structural Steel Pipe	\$1.11
23	ASTM A252, Grades 240 (36 KSI) & 414 (60 KSI) Pipe Pile	\$0.88
24	ASTM 252, Grade 2 Permanent Steel Casing	\$0.88
25	ASTM A36 (AASHTO M183) for H-piles, steel supports and sign supports	\$0.94
26	ASTM A328 / A328M, Grade 50 (AASHTO M202) Steel Sheetpiling	\$1.68
27	ASTM A572 / A572M, Grade 50 Sheetpiling	\$1.68
28	ASTM A36/36M, Grade 50	\$0.96
29	ASTM A570, Grade 50	\$0.94
30	ASTM A572 (AASHTO M223), Grade 50 H-Piles	\$0.96
31	ASTM A1085 Grade A (50 KSI) Steel Hollow Structural Sections (HSS), heat-treated per ASTM A1085 Supplement S1	\$1.11
32	AREA 140 LB Rail and Track Accessories	\$0.58

**END OF SECTION**

## SECTION 01067

### STATE OF MASSACHUSETTS AND LOCAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. EXCERPTS FROM MASSACHUSETTS STATUTES
- B. MINIMUM WAGE RATES
- C. SAFETY AND HEALTH

##### 1.02 EXCERPTS FROM MASSACHUSETTS STATUTES

- A. In addition to the requirements as set forth under "Compliance with Laws" in the AGREEMENT, particular attention is directed to certain stipulations of Chapter 149 of the General Laws of Massachusetts, as amended to date as follows:

Section 25. "Every employee in public work shall lodge, board, and trade where and with whom he elects; and no person or his agents or employees under contract with the commonwealth, a county, city or town, or with a department, board, commission or officer acting therefore, for the doing of public work shall directly or indirectly require, as a condition of employment therein, that the employee shall lodge, board or trade at a particular place or with a particular person. This section shall be made a part of the contract for such employment."

Section 26. "In the employment of mechanics and apprentices, teamsters, chauffeurs and laborers in the construction of public works by the commonwealth, or by a county, town or district, or by persons given to citizens of the commonwealth who have been residents of the commonwealth for at least six months at the commencement of their employment who are male veterans as defined in clause forty-three of section seven of chapter four and who are qualified to perform the work to which the employment relates;

and secondly, to citizens of the commonwealth generally who have been residents of the commonwealth for at least six months at the commencement of their employment, and if they cannot be obtained in sufficient numbers then to citizens of the United States, and every contract for such work shall contain a provision to this effect."

Section 34. "Every contract, except for the purchase of, material or supplies, involving the employment of laborers, workmen, mechanics, foremen, or inspectors, to which the commonwealth or any county or any town, subject to section thirty, is a party, shall contain a stipulation that no laborer, workman, mechanic, foreman or inspector working within the commonwealth, in the employ of the contractor, subcontractor or other person doing or contracting to do the whole or a part of the work contemplated by the contract, shall be required or permitted to work more than eight hours in any one day or more than 48 hours in any one week, or more than six days in any one week, except in cases of emergency, or in case any town subject to section thirty-one is a party to such a contract, more than eight hours in any one day, except as aforesaid..."

Section 34A. "Every contract for the construction, alteration, maintenance, repair or demolition of or addition to, any public building or other public works for the commonwealth or any political subdivision thereof shall contain stipulations requiring that the contractor shall, before commencing performance of such contract, provide by insurance for the payment of compensation and the furnishing of other benefits under chapter one hundred and fifty-two to all persons to be employed under the contract, and that the contractor shall continue such insurance in full force and effect during the term of the contract. No officer or agent contracting in behalf of the commonwealth or any political subdivision thereof shall award such a contract until he has been furnished with sufficient proof of compliance with the aforesaid stipulations. Failure to provide and continue in force such insurance as aforesaid shall be deemed a material breach of contract and shall operate as an immediate termination thereof. No cancellation of such insurance, whether by the insurer or by the insured, shall be valid unless written notice thereof is given by the party proposing cancellation to the other party and to the officer or agent who awarded the contract at least fifteen days prior to the intended effective date thereof, which date shall be expressed in said notice. Notice of cancellation sent by the party proposing receipt of the addressee requested, shall be a sufficient notice..."

Section 34B. "Every contract for the construction, alteration, maintenance, repair or demolition of, or addition to, any public works for the commonwealth or any political subdivision thereof shall contain stipulations requiring that the contractor shall pay to any reserve police officer employed by him in any city or town the prevailing rate of wage paid to regular police officers employed by him in such city or town."

Attention is directed to Chapter 774 of the Acts of 1972 amending Section 39F of Chapter 30 to read as follows:

Section 39F. "(1) Every contract awarded shall contain the following subparagraphs and in each case those subparagraphs shall be binding between the general contractor and each subcontractor.

"(a) Forthwith after the general contractor receives payment on account of a periodic estimate, the general contractor shall pay to each subcontractor the amount paid for the labor performed and the materials furnished by that subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(b) Not later than the sixty-fifth day after each subcontractor substantially completes his work in accordance with the plans and specifications, the entire balance due under the subcontract less amounts retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, shall be due the subcontractor; and the awarding authority shall pay that amount to the general contractor. The general contractor shall forthwith pay to the subcontractor the full amount received from the awarding authority less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(c) Each payment made by the awarding authority to the general contractor pursuant to subparagraphs (a) and (b) of this paragraph for the labor performed and the materials furnished by a subcontractor shall be made to the general contractor for the account of that subcontractor; and the awarding authority shall take reasonable steps to compel the general contractor to make each such payment to each such subcontractor. If the awarding authority has received a demand for direct payment from a subcontractor for any amount which has already been included in a payment to the general contractor for payment to the subcontractor as provided in

subparagraphs (a) and (b), the awarding authority shall act upon the demand as provided in this section.

(d) If, within seventy days after the subcontractor has substantially completed the subcontractor work, the subcontractor has not received from the general contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, the subcontractor may demand direct payment of that balance from the awarding authority. The demand shall be by a sworn statement delivered to or sent by certified mail to the awarding authority, and a copy shall be delivered to or sent by certified mail to the general contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the seventieth day after the subcontract work. Within ten days after the subcontractor has delivered or so mailed the demand to the awarding authority and delivered or so mailed a copy to the general contractor, the general contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the awarding authority and a copy shall be delivered to or sent by certified mail to the subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor and of the amount due for each claim made by the general contractor against the subcontractor.

(e) Within fifteen days after receipt of the demand by the awarding authority, but in no event prior to the seventieth day after substantial completion of the subcontract work, the awarding authority shall make direct payment to the subcontractor of the balance due under the subcontract including any amount due for extra and materials furnished to the general contractor, less any amount (i) retained by the awarding authority as the estimated cost of completing the incomplete or unsatisfactory items of work, (ii) specified in any court proceedings barring such payment, or (iii) disputed by the general contractor in the sworn reply; provided, that the awarding authority shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (d). The awarding authority shall make further direct payments to the Subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

(f) The awarding authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (e) in an interest-bearing joint account in the names of the general contractor and the subcontractor in a bank in Massachusetts selected by the awarding authority or agreed upon by the general contractor and the subcontractor and shall notify the general contractor and the subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the general contractor and the subcontractor or as determined by decree of a court of competent jurisdiction.

(g) All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to subparagraph (f) shall be made out of amounts payable to the general contractor at the time of receipt of a demand for direct payment for a subcontractor and out of amounts which later become payable to the general contractor and in the order of receipt of such demands from subcontractors. All direct payments

shall discharge the obligation of the awarding authority to the general contractor to the extent of such payment.

(h) The awarding authority shall deduct from payments to a general contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (f), are sufficient to satisfy all unpaid balances of demands for direct payment received from subcontractors. All such amounts shall be earmarked for such direct payments, and the subcontractors shall have a right in such deductions prior to any claims against such amounts by creditors of the general contractor."

Section 39L. The commonwealth and every county, city, town, district, board, commission or other public body which, as the awarding authority, requests proposals, bids or sub-bids for any work in the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or other public works (1) shall not enter into a contract for the work with, and shall not approve as a subcontractor furnishing labor and materials for a part of the work, a foreign corporation which has not filed with the awarding authority a certificate of the state secretary stating that the corporation has complied with requirements of section 15.03 of subdivision A of Part 15 of chapter 156D and the date of compliance, and further has filed all annual reports required by section 16.22 of subdivision B of Part 16 of said chapter 156D, and (2) shall report to the state secretary and to the department of corporations and taxation any foreign corporation performing work under such contract or subcontract, and any person, other than a corporation, performing work under such contract or subcontract, and residing or having a principal place of business outside the commonwealth.

Attention is also directed to Chapter 774 of the Acts of 1972 further amending Chapter 30 by adding after Section 39M the following section:

Section 39M. (b) Specifications for such contracts, and specification for contracts awarded pursuant to the provisions of said sections forty-four A to forty-four L of said chapter one hundred and forty-nine, shall be written to provide for full competition for each item of material to be furnished under the contract; except, however, that said specifications may be otherwise written for sound reasons in the public interest stated in writing in the public records of the awarding authority or promptly given in writing by the awarding authority to anyone making a written request therefore, in either instance such writing to be prepared after reasonable investigation. Every such contract shall provide that an item equal to that named or described in the said specifications may be furnished; and an item shall be considered equal to the item so named or described if (1) it is at least equal in quality, durability, appearance, strength and design, (2) it will perform at least equally the function imposed by the general design for the public work being contracted for or the material being purchased, and (3) it conforms substantially, even with deviations, to the detailed requirements for the item in the said specifications. For each item of material the specifications shall provide for either a minimum of three named brands of material or a description of material which can be met by a minimum of three manufacturers or producers, and for the equal of any one of said named or described materials.

Section 39N. "Every contract subject to section forty-four A of chapter one hundred forty-nine or subject to section thirty-nine M of chapter thirty shall contain the following paragraph in its entirety and an awarding authority may adopt reasonable rules or regulations in conformity with that paragraph concerning the filing, investigation and settlement of such claims:

If, during the progress of the work, the contractor or the awarding authority discovers that the actual subsurface or latent physical conditions encountered at the site differ substantially or materially from those shown on the plans or indicated in the contract documents either the contractor or the contracting authority may request an equitable adjustment in the contract price of the contract applying to work affected by the differing site conditions. A request for such an adjustment shall be in writing and shall be delivered by the party making such claim to the other party as soon as possible after such conditions are discovered. Upon receipt of such a claim from a contractor, or upon its own initiative, the contracting authority shall make an investigation of such physical conditions, and, if they differ substantially or materially from those shown on the plans or indicated in the contract documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the plans and contract documents are of such a nature as to cause an increase or decrease in the cost of performance of the work or a change in the construction methods required for the performance of the work which results in an increase or decrease in the cost of the work, the contracting authority shall make an equitable adjustment in the contract price and the contract shall be modified in writing accordingly."

Attention is also directed to Chapter 1164 of the Acts of 1973 further amending Chapter 30 by adding after Section 39N the following two sections:

Section 39O. "Every contract subject to the provisions of section thirty-nine M of this chapter or subject to section forty-four A of chapter one hundred forty-nine shall contain the following provisions (a) and (b) in their entirety...

"(a) The awarding authority may order the general contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as it may determine to be appropriate for the convenience of the awarding authority; provided however, that if there is a suspension, delay or interruption for fifteen days or more due to a failure of the awarding authority shall make an adjustment in the contract but shall not include any profit to the general contractor on such increase; and provide further, that the awarding authority shall not make any adjustment in the contract price under this provision for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this contract provides for an equitable adjustment of the contract price under any other contract provisions.

(b) The general contractor must submit the amount of a claim under provision (a) to the awarding authority in writing as soon as practicable after the end of the suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under this contract and, except for costs due to a suspension order, the awarding authority shall not approve any costs in the claim incurred more than 20 days before the general contractor notified the awarding authority of the act or failure to act involved in the claim."

Section 39P. "Every contract subject to section thirty-nine M of this chapter or section forty-four A of chapter one hundred forty-nine which requires the awarding authority, any official, its architect or engineer to make a decision on interpretation of the specifications, approval of equipment, material or any other approval, or progress of the work, shall require that the decision be made promptly and, in any event no later than thirty days after the written submission for decision; but if such decision required extended investigation and study, the awarding authority, the official, architect or engineer shall, within thirty days after the receipt of the submission, give the party making the submission written notice of the reasons why the decision cannot be made within the thirty day period and the date by which the decision will be made."

Attention is also directed to Chapter 30, Section 39R of the General Laws of Massachusetts as amended to date as follows:

Section 39R. (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 section thirty-nine M of chapter thirty, sections forty-four A through forty-four H, inclusive, of chapter one hundred forty-nine and sections thirty B through thirty P, inclusive, of chapter seven.

(2) "Contract" means any contract awarded or executed pursuant to sections thirty B through thirty P, inclusive, of chapter seven and any contract awarded or executed pursuant to section thirty-nine M of chapter thirty, or sections forty-four A through forty-four H, inclusive, of chapter one hundred forty-nine, which is for an 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, memorandum invoices, computer printouts, tapes, discs, papers and other documents 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/her 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 delineation 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 she/he has made and sets forth his/her 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 a 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 30B through 30P, inclusive, of chapter seven, and pursuant to section 39M of chapter 30 or to section 44A through 44H, inclusive, of chapter 149, 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 awarding authority, office of inspector general, and the deputy commissioner of capital planning and operations shall have the right to examine any books, documents, papers or records of the contractor or of his/her subcontractors that directly pertain to, and involve transactions relating to, the contractor or his/her 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/her description the date of the change and reasons therefore, 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 she/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.

(d) Every contractor awarded a contract by the commonwealth or by any political subdivision thereof shall annually file with the awarding authority during the term of the contract a financial statement prepared by an independent certified public accountant on the basis of an audit by sub accountant. The final statement filed shall include the date of final payment. All statements shall be accompanied by an accountant's report. Such statements shall be made available to the awarding authority upon request.

(e) The office of inspector general, the deputy commissioner for capital planning and operations and any other awarding authority shall enforce the provisions of this section. The deputy commissioner of capital planning and operations may after providing an opportunity for the inspector general and other interested parties to comment, promulgate pursuant to the provisions of chapter thirty A such rules, regulations and guidelines as are necessary to effectuate the purposes of this section. Such rules, regulations and guidelines may be applicable to all awarding authorities. A contractor's failure to satisfy any of the requirements of this section may be grounds for debarment pursuant to section forty-four C of Chapter one hundred forty-nine.

(f) Records and statements required to be made, kept or filed under the provisions of this section shall not be public records as defined in section seven of chapter four and shall not be open to public inspection; provided, however, that such records and statements shall be made available pursuant to the provisions of clause (2) of paragraph (b).

### 1.03 MINIMUM WAGE RATES

A. Minimum Wage Rates as determined by the Commissioner of Department of Labor and Industries under the provision of the Massachusetts General Laws, Chapter 149, Sections 26 to 27D, as amended, apply to this project. It is the responsibility of the contractor, before bid opening, to request if necessary, any additional information of Minimum Wage Rates for those trades-people who may be employed for the proposed work under this contract. Minimum wage rates are included in the attachment to Section 00650.

### 1.04 SAFETY AND HEALTH

A. This project is subject to the Safety and Health regulation of the U.S. Department of Labor set forth in 29 CFR Part 1926, Commonwealth of Massachusetts Regulations CMR 454, and to the Massachusetts (Department of Labor and Industries,) Division of (Industrial) Occupational Safety "Construction Industry Rules and Regulations for the Prevention of Accidents in

Construction operations (Chapter 454 CMR 10.00 et. seq.)". Contractors shall be familiar with the requirements of these regulations.

**END OF SECTION**

## SECTION 01069

### HEALTH & SAFETY REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Requirements for providing a Health and Safety Plan (HASP) and maintenance of health and safety, while performing the Work.

##### 1.02 REQUIREMENTS

- A. Monitor working conditions at all times during construction and provide appropriate protective clothing, equipment and facilities for personnel, and establish workplace procedures to ensure personnel safety.
- B. If required, implement Health and Safety protection program. The procedures for such implementation shall be submitted to the Engineer and Owner for approval. The procedures shall include provisions for stations allowing workers to wash and to put on and remove protective clothing, and stations for vehicles to be cleaned, if necessary, before leaving the site, air monitoring, and evaluation of areas where unsafe levels of gas has accumulated.
- C. Comply with all Federal, State, and local safety requirements related to the hazards anticipated to be encountered during the course of this project.
- D. In addition to the above requirements, comply with the following:
  - 1. All construction equipment on the site shall be equipped with vertical exhaust pipes or a spark proof exhaust.
  - 2. Smoking shall not be permitted in any area where gases can accumulate, or in areas where contaminated soil is present.
  - 3. Welding or open flames shall not be permitted in enclosed areas.
  - 4. Toxic gas indicators, an organic vapor analyzer, a combustible gas indicator, an oxygen indicator, and fire extinguishers shall be available at all times during operations. Periodic monitoring with portable monitoring devices shall be employed as dictated by the Health and Safety Plan.
  - 5. During operations, whenever unsafe levels of toxic gases are detected, all work will cease in that area until acceptable levels are reached.

##### 1.03 SHOP DRAWINGS

- A. Submit site specific Health and Safety Plan (HASP) that complies with all applicable OSHA requirements to the Engineer for review and acceptance within fifteen (15) working days of the Contractor's Notice to Proceed. Certified Industrial Hygienist must certify the Contractor's plan prior to submittal to and review by the Engineer. The Contractor is not to proceed with any subsurface or site work without review and acceptance of the submitted Health and Safety Plan by the Engineer.

##### 1.04 QUALITY ASSURANCE

- A. Engage an independent, qualified Health and Safety expert having experience in similar construction conditions, to monitor site conditions and recommend all necessary Health and Safety protection. This person shall be a Certified Industrial Hygienist (CIH). The Contractor

shall follow such recommendations and shall provide such protection to his personnel, and personnel of the Owner and Engineer, as may be affected.

#### 1.05 REGULATORY REQUIREMENTS

- A. Establish work place procedures, enforce the use of these procedures, and the associated equipment and facilities in accordance with the following guidelines:
  - 1. Safety and Health Regulations Promulgated by the U.S. Department of Labor OSHA, 29 CFR 1910 - Occupational Safety and Health Standards, and 29 CFR 1920 - Safety and Health Regulations for Construction.
  - 2. Occupational Safety and Health Standards, 29 CFR 1926 - Safety and Health Regulations for Construction.
  - 3. U.S. Environmental Protection Agency Medical Monitoring Program Guidelines.

#### 1.06 SITE CONDITIONS

- A. Contractor is also responsible for reviewing site specific investigation reports included in the various Appendices of the Contract Documents.

### PART 2 PRODUCTS

NOT USED

### PART 3 EXECUTION

#### 3.01 PROTECTION

- A. If, at any time, the Owner or the Engineer is apprised of a safety hazard which demands immediate attention because of its high potential for harm to the public travel, persons on or about the Work, or public or private property, the Owner or the Engineer shall have the right to order such safeguards to be erected and such precautions to be taken as necessary and the Contractor shall comply with such orders. If, under such circumstances, the Contractor does not or cannot immediately put the Work into proper and approved condition, or if the Contractor or his representative is not upon the site so that he can be notified immediately of the insufficiency of safety precautions, then the Owner may put the Work into such a condition that is, in his opinion, in all respects safe, and the Contractor shall pay all expenses of such labor and materials as may have been used for this purpose by him or by the Owner. The fact that the Owner or the Engineer does not observe a safety hazard or does not order the Contractor to take remedial measures shall in no way relieve the Contractor of the entire responsibility for any costs, loss or damage by any party sustained on account of the insufficiency of the safety precautions taken by him or by the Owner acting under authority of this Section.
- B. If the Contractor is alerted to the fact that conditions of high hazard are present or can be present at the site during the performance of the Work, it is the responsibility of the Contractor to take appropriate safety precautions to meet whatever conditions of hazard may be present during the performance of the Work, whether reasonably foreseeable or not. The safety conditions enumerated in the Specifications are the minimum permissible and neither the Owner nor the Engineer makes any representation that the safety standards provided herein will be adequate to meet all eventualities. The Contractor is therefore alerted to the fact that it shall be his responsibility to anticipate and provide such additional safety precautions, facilities, personnel

and equipment as shall be necessary to protect life and property from whatsoever conditions of hazard are present or may be present.

- C. Contractor shall supply and erect highly visible safety fencing a minimum of three feet in height around all construction areas that pose a threat to safety and post proper signage as required by Local, State and Federal requirements. The Contractor shall erect safety fencing as documented in the Contact Drawings or as directed by the Engineer and shall maintain such fencing and signage until such a time that the potential safety hazard has been rectified. Upon final completion of construction all safety fencing shall be removed off-site by the Contractor. Safety fencing requirements of OSHA shall be enforced by the Contractor.

**END OF SECTION**

## SECTION 01170

### ENVIRONMENTAL PROTECTION

#### PART 1 GENERAL

##### 1.01 SUMMARY

###### A. Section Includes

1. Requirements for environmental protection during and as the result of construction operations under this Contract except for those measures set forth in other provisions of these Specifications.

##### 1.02 QUALITY ASSURANCE

###### A. Requirements of regulatory agencies:

1. In order to prevent environmental pollution and to provide for environmental protection arising from construction activities related to the performance of this Contract, the Contractor shall comply with all applicable Federal, State, and local laws and regulations concerning environmental protection, as well as the specific requirements stated in the Section and elsewhere in the Specifications.

#### PART 3 EXECUTION

##### 3.01 PROTECTION OF LAND RESOURCES

- A. It is intended that the land resources within the project boundaries and outside the limits of permanent work performed under this Contract be preserved in their present condition, or be restored to a condition after completion of construction, that will appear to be natural and not detract from the appearance of the project. The Contractor shall confine his construction activities to areas defined on the Drawings or in the Specifications except with written approval of the property owners and the Engineer.
- B. Limits of working areas include areas for storage of construction material, and shall be cleared in a manner which will enable satisfactory restoration and which will not affect the environment during or after the construction period. The Contractor shall not enter beyond the working limits of the working area except with written approval of the Engineer and Owner.
- C. Location of areas for storage of the Contractor's materials required temporarily in the performance of the work, shall be within the limits of the working area and shall require written approval of the Engineer prior to use. The preservation of the landscape shall be an imperative consideration.

##### 3.02 PROTECTION OF WATER RESOURCES

- A. Contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumen's, calcium chloride, acids or harmful materials. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State, County, and Municipal laws concerning pollution of rivers, streams and impounded water. All work under this Contract shall be performed in such

a manner that objectionable conditions will not be created in streams through, or bodies of water adjacent to, the project area.

- B. Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall, if turbidity producing materials are present, be held in suitable sedimentation basins or shall be graded to control erosion within acceptable limits. Temporary erosion and sediment control measures such as berms, dikes, drains, or sedimentation basins, if required to meet the above standards, shall be provided and maintained until permanent drainage and erosion control facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum.
- C. Apply temporary mulch on denuded ground immediately after rough grading is completed. This shall apply to all areas not subject to appreciable traffic during construction, even those that are to receive some form of construction later if ground is to be exposed 30 days or more.
- D. Stream and drainage ditch crossings by fording with equipment shall be limited to control turbidity, and in areas of frequent crossings, temporary culverts or bridge structures shall be installed. Any temporary culverts or bridge structures shall be removed upon completion of the project. Fills and waste areas shall be constructed by selective placement to eliminate silts or clays on the surface that will erode and contaminate adjacent streams.
- E. Special measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, waste washings, herbicides and insecticides, and cement and surface drainage from entering public waters.
- F. Disposal of any materials, wastes, effluents, trash, garbage, oil, grease, chemicals, etc., in areas adjacent to streams or other waterways shall be disposed of by the Contractor in accordance with the applicable governing regulations. If any waste material is dumped in unauthorized area, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed area. If necessary, contaminated ground shall be excavated, disposed of as specified hereinbefore, and replaced with suitable fill material, compacted and finished with topsoil, all at the expense of the Contractor.

### 3.03 MAINTENANCE

- A. The Contractor shall dispose of all discarded debris and aggregate samples in a manner approved by the Engineer. Toilet facilities shall be kept clean and sanitary at all times. Services

shall be performed at such a time and in such a manner to least interfere with the operations. Services shall be accomplished to the satisfaction of the Engineer.

- B. The Contractor shall frequently remove materials no longer required on the site so that, at all times, the site, access routes to the site and any other areas disturbed by his operations shall present a neat, orderly, workmanlike appearance.

#### 3.04 DUST CONTROL

- A. Contractor shall maintain all excavations, embankments, stockpiles, and all other work areas within or without the project boundaries free from dust which would cause a hazard or nuisance to others or contaminate surface water.

#### 3.05 NOISE CONTROL

- A. Contractor shall use every effort and means possible to minimize or eliminate noise caused by his operation which the Engineer may consider objectionable.

#### 3.06 LITTER CONTROL

- A. Any litter generated by the Contractor's operation, whether from disturbance of existing buried solid waste or generated in the course of performing the work under Contract, shall be collected and properly disposed of on a daily basis.

#### 3.07 PROHIBITED CONSTRUCTION PROCEDURES

- A. Contractor is advised that the disposal of excess excavated material in wetlands, stream corridors, and floodplains is strictly prohibited. Any violation of this restriction by the Contractor or any person employed by him, will be brought to the immediate attention of the responsible regulatory agencies.
- B. Contractor shall comply with the following requirements regarding prohibited construction procedures as follows:
  1. Dumping of spoil material into any stream corridor, any wetland, any surface waters, or at unspecified locations.
  2. Indiscriminate, arbitrary or capricious operation of equipment in any stream corridors, any wetlands or surface waters.
  3. Pumping of silt-laden water from trenches or other excavations into any surface waters, any stream corridors or any wetlands.
  4. Damaging vegetation adjacent to, or outside of, the area of the work.
  5. Disposal of trees, brush and other debris in any stream corridors, any wetlands, any surface waters, or at unspecified locations.
  6. Permanent or unspecified alteration of the flow line of any stream.
  7. Open burning of project debris.
  8. Location of storage stockpile areas in environmentally sensitive areas.
  9. Disposal of excess or unsuitable excavation material in wetlands or floodplains, even with permission of the property owner.

**END OF SECTION**

**SECTION 01200**

**PROJECT MEETINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Administrative and procedural requirements for project meetings.

**1.02 PRECONSTRUCTION CONFERENCE**

- A. Engineer will schedule and administer a pre-construction conference.
- B. Pre-construction conference will be scheduled and administered within fourteen (14) calendar days after the dated "Notice to Proceed". The Contractor shall be prepared to address such topics as projected construction schedules, major personnel, critical work areas, construction facilities and shop drawing submittals.

**1.03 Progress meetings**

- A. Engineer will schedule and administer progress meetings and specially called meetings throughout the duration of the Work at minimum monthly intervals.
- B. Time and location of such meetings shall be designated by the Engineer and shall be convenient for all parties involved.
- C. Engineer will, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies to participants.

**PART 2 PRODUCTS**

NOT USED

**PART 3 EXECUTION**

NOT USED

**END OF SECTION**

## SECTION 01300

### SUBMITTALS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Requirements for submission of schedules and shop drawings.

##### 1.02 PROGRESS SCHEDULE

- A. Within fourteen (14) calendar days after execution of the Contract Documents, the Contractor shall submit to the Engineer for review a construction progress schedule conforming to requirements specified. This schedule should show the proposed dates of commencement and completion of each of the various subdivisions of work required under this Contract and the anticipated monthly percentage of completion based on the total contract price. The Contractor shall be responsible for updating and/or revising this schedule whenever directed by the Engineer throughout the duration of the Contract.
- B. Special attention is directed to the requirement that the Contractor shall start the Work, as specified under this Contract, no later than thirty (30) calendar days after the execution of the Contract Documents, unless otherwise directed by the Owner. The Contractor shall comply with all pre-construction requirements as specified. The Owner reserves the right to delay the commencement of the Work or any part thereof if the specified requirements as determined by the Engineer have not been satisfied. The Owner further reserves the right to limit or, delay construction, or certain activities thereof, in certain areas of the Contract should the Owner deem it to be in the public's best interest and/or safety to do so.
- C. Contractor shall contact the appropriate town or city authorities concerning any public or semi-public events that may occur during the construction period that may affect construction. The Contractor alone shall be responsible for arranging his construction sequence to conform to any restrictions these events may impose. No claims for extras will be allowed because of any delay, extra materials handling, extra excavation, etc. caused by the imposed restrictions. However, additional time may be granted for completion of the work to compensate for delays caused by said restrictions.

##### 1.03 SHOP DRAWINGS

- A. Once approved through the Electronic Submittal Procedure, Contractor to submit one (1) full-sized copy of all approved shop and working drawings of concrete reinforcement, structural details, piping layout, wiring, materials fabricated especially for the Contract, and materials and equipment for which such drawings are specifically requested.
- B. A maximum of two (2) submittals of each shop drawing will be reviewed by the Engineer. If more submittals are required due to the Contractor's neglect or failure to fulfill the requirements of the Contract plans and specifications, or to make corrections or modifications required by the Engineer in the review of the first two submittals, the Engineer will review the submittal and the Contractor will be responsible for the cost of the review, as determined by the Owner based on the Engineer's documentation of time and rates for additional services established in the Engineering Agreement between the Owner and the Engineer.

- C. Such drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When the dimensions are of particular importance, or when specified, the drawings shall be certified by the manufacturer or fabricator as correct for the Contract.
- D. When so specified or if considered by the Engineer to be acceptable, manufacturer's specifications, catalog data, descriptive matter, illustrations, etc., may be submitted in place of shop and working drawings.
- E. Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings to eliminate delay to the Work due to the absence of such drawings. All shop and working drawings must be submitted to the Engineer within thirty (30) calendar days prior to incorporation into the Work, unless otherwise permitted by the Engineer. **Prior to the submittal of any shop drawings, the Contractor shall submit a schedule of proposed shop drawing transmittals.** The schedule shall identify the subject matter of each transmittal, the corresponding specification section number and the proposed date of submission. Prior to and during the progress of the Work the schedule shall be revised and resubmitted as requested by the Engineer.
- F. No material or equipment shall be purchased or fabricated for the Contract until the required shop and working drawings have been submitted as hereinabove provided and reviewed for conformance to the Contract requirements. All such materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by said drawings.
- G. Until the necessary review has been made, the Contractor shall not proceed with any portion of the Work (such as the construction of foundations) for which review is required.
- H. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. All shop and working drawings shall be prepared on standard size, 24 inch by 36 inch sheets, except those which are made by changing existing standard shop and working drawings. All drawings shall be clearly marked with the names of the Owner, Contractor, and building, equipment, or structure to which the drawing applies, and shall be suitable numbered. Submitted shop drawings shall be accompanied by a letter of transmittal, completed by the Contractor provided by the Engineer.
- I. Only drawings which have been checked and corrected by the fabricator should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings which are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer; other drawings shall be returned for correction.
- J. If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in his letter of transmittal.
- K. The review of shop and working drawings by the Engineer will be general only, and nothing contained in this Section shall relieve, diminish or alter in any respect the responsibilities of

the Contractor under the Contract Documents and in particular, the specific responsibility of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance as specified. The Contractor shall be responsible for errors and omissions in shop drawings.

- L. Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires, appurtenances, or layouts etc., either existing or as detailed on the Drawings, he shall also submit details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do the work necessary to make such modifications.
- M. The Contractor shall furnish additional copies of shop drawings or catalog cuts when so requested.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

**END OF SECTION**

**SECTION 01400**  
**QUALITY CONTROL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements for Contractor's quality control of products, suppliers, manufacturers, services, site conditions, and workmanship, to produce Work of specified quality.

**1.02 QUALITY ASSURANCE/CONTROL OF INSTALLATION**

- A. Comply fully with manufacturers' instructions, including each step in sequence.
- B. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- D. Perform work by persons qualified to produce workmanship of specified quality.
- E. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

**1.03 FIELD SAMPLES**

- A. Install field samples at the site as required by individual specifications sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Where field sample is specified to be removed, clear area only after field sample has been accepted by the Engineer.

**1.04 CERTIFIED WELDERS**

- A. Structural welds shall be made only by operators who have been qualified by tests, as prescribed in the "Standard Qualification Procedure" of the American Welders Society, to perform the type of work required.
- B. Pipe welds shall be made only by operators who have been qualified by the National Certified Pipe Welding Bureau and each operator's qualification record shall be submitted to the Engineer before any work is performed.
- C. Shop welding shall be in accordance with the "Code for Welding in Building Construction".

**PART 2 PRODUCTS**

NOT USED

**PART 3 EXECUTION**

NOT USED

**END OF SECTION**

## SECTION 01410

### LABORATORY TESTING

#### PART 1 GENERAL

##### 1.01 SUMMARY

###### A. Section Includes

1. Qualification, duties and responsibilities of testing laboratories.
2. Coordination and scheduling responsibilities of the Contractor.

###### B. Related Sections

1. Section 01600 - Materials and Equipment

##### 1.02 PAYMENT PROCEDURES

###### A. Initial Testing

1. Unless otherwise specified herein, the Contractor will pay for initial testing services required by the Engineer.

###### B. Retesting

1. When initial tests indicate noncompliance with the Contract Documents, subsequent retesting occasioned by the noncompliance shall be performed by the same testing agency, at no additional cost.

###### C. Contractors Convenience Testing

1. Inspecting and testing performed exclusively for the Contractor's convenience or a required by him by the technical specifications shall be the sole responsibility of the Contractor.

##### 1.03 REFERENCES

###### A. American Society for Testing and Materials (ASTM)

1. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

##### 1.04 REQUIREMENTS

###### A. Work included:

1. Cooperate with the selected testing agency and all others responsible for testing and inspecting the Work.
2. Provide other testing and inspecting as specified to be furnished by the Contractor in this Section and/or elsewhere in the Contract Documents.
3. Where no testing requirements are described, but the Owner directs testing, the Contractor shall provide testing under the requirements of this Specification.

###### B. Work not included:

1. Selection of testing laboratory: The Contractor will select a qualified independent testing laboratory, subject to approval by the Owner..

## 1.05 QUALITY ASSURANCE

### A. Qualifications

1. The testing laboratory will be qualified to the Owner's approval in accordance with ASTM E329.

### B. Regulatory requirements

1. Testing, when required, will be in accordance with all pertinent codes and regulations and with selected standards of the American Society for Testing and Materials.
2. Regulatory Requirements Inspections and tests required by codes or ordinances, or by a plan approved authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

## 1.06 DELIVERY, STORAGE, AND HANDLING

### A. Comply with pertinent provisions of Section 01600 - Materials and Equipment.

### B. Promptly process and distribute, to the Engineer, required copies of test reports and instructions to assure necessary retesting and replacement of materials with the least possible delay in progress of the Work.

## 1.07 SCHEDULING

### A. Establishing schedule

1. By advance discussion with the testing laboratory, determine the time required for the laboratory to perform its tests and to issue each of its findings.
2. Provide all required time within the construction schedule.
3. Coordinate testing activity with the appropriate testing laboratory.

### B. Revising schedule

1. When changes of construction schedule are necessary during construction, coordinate all such changes with the testing laboratory as required.

### C. Adherence to schedule

1. When the testing laboratory is ready to test according to the established schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra charges for testing attributable to the delay may be back-charged to the Contractor and shall not be borne by the Owner.

## PART 2 PRODUCTS

NOT USED

## PART 3 EXECUTION

### 3.01 FIELD QUALITY CONTROL

#### A. Site Tests

1. Representatives of the testing laboratory shall have access to the Work at all times and at all locations where the Work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.

2. All specimens and samples for testing, unless otherwise provided in the Contract Documents, shall be taken by the testing personnel. All sampling equipment and personnel will be provided by the testing laboratory. All deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

**END OF SECTION**

**SECTION 01510**

**TEMPORARY UTILITIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements for temporary utilities required during construction.

**1.02 GENERAL REQUIREMENTS**

- A. Contractor is responsible for payment of all costs associated with the installation and operation of all temporary utilities necessary for the completion of the work.

**1.03 TEMPORARY WATER**

- A. If needed, temporary pipe lines and connections from the permanent service lines, necessary for the use of the Contractor and his Subcontractors shall be installed, protected, and maintained at the expense of the Contractor.
- B. Contractor shall provide adequate supply of drinking water from an approved source of acceptable quality, satisfactorily cooled, for his employees and those of his Subcontractors.

**1.04 TEMPORARY ELECTRICITY**

- A. If needed, provide electrical energy required for temporary lighting and power.
- B. Contractor shall bare all costs necessary to provide a temporary, separately metered electric service for construction. Electrical work to be done in accordance with applicable codes.

**1.05 TEMPORARY SANITARY FACILITIES**

- A. Provide adequate sanitary facilities for the use of those employed on the Work. Sanitary facilities shall be made available when the first employees arrive on the site of the Work, be properly secluded from public observation, and be maintained during the progress of the Work in suitable numbers.
- B. Maintain sanitary facilities in an orderly and sanitary condition at all times and enforce their use. Rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the Owner, or any adjacent property.

**PART 2 PRODUCTS**

NOT USED

**PART 3 EXECUTION**

NOT USED

**END OF SECTION**

## SECTION 01560

### TEMPORARY CONTROLS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Requirements for cleaning, maintenance of the site, barriers and fences required during construction.

##### 1.02 CLEANING DURING CONSTRUCTION

- A. Contractor shall perform clean-up operations during construction as herein specified.
  - 1. Control accumulation of waste materials and rubbish; periodically dispose of off-site. Bear all costs, including fees resulting from disposal.
  - 2. Maintain project in accordance with all local, State and Federal Regulatory Requirements.
  - 3. Store volatile wastes in covered metal containers, and remove from premises.
  - 4. Prevent accumulation of wastes that create hazardous conditions.
- B. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
  - 1. Do not burn or bury rubbish and waste materials on site.
  - 2. Do not dispose or volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
  - 3. Do not dispose of wastes into streams or waterways.
  - 4. Use only those materials which will not create hazards to health or property and which will not damage surfaces.
  - 5. Use only those cleaning materials and methods recommended by manufacturer of surface material to be cleaned.
  - 6. Execute cleaning to ensure that the buildings, the sites, and adjacent properties are maintained free from accumulations of waste materials and rubbish and windblown debris, resulting from construction operations.
  - 7. Provide on-site containers for collection of waste materials, debris, and rubbish.
  - 8. Remove waste materials, debris, and rubbish from the site periodically and dispose of at legal disposal areas off the construction site.
  - 9. Handle material in a controlled manner with as little handling as possible. Do not drop or throw materials from heights.
  - 10. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not damage surrounding surfaces.
  - 11. During its progress, the work and the adjacent areas affected thereby shall be kept cleaned up and all rubbish, surplus materials, and unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.
  - 12. Where material or debris has washed or flowed into or been placed in existing watercourses, ditches, gutters, drains, pipes, structures, work done under this contract, or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the work, and the ditches, channels, drains, pipes, structures, and work, etc. shall, upon completion of the work, be left in a clean and neat condition.

### 1.03 DUST CONTROL

- A. Provide adequate means for the purpose of preventing dust caused by construction operations throughout the period of the construction contract.
- B. This provision does not supersede any specific requirements for methods of construction or applicable general conditions or performance obligations of the Contractor.

### 1.04 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize amount of bare soil exposed at one time.
- C. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts for clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Construct sediment control devices for discharge from dewatering trenches.
- G. Construct all sedimentation control devices shown on the plans.

### 1.05 NOISE CONTROL

- A. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum.
- B. Execute construction work by methods and by use of equipment which will reduce excess noise.
  - 1. Equip air compressors with Silencers, and power equipment with mufflers.
  - 2. Manage vehicular traffic and scheduling to reduce noise.

### 1.06 POLLUTION CONTROL

- A. Special care shall be taken to prevent contamination or muddying up or interfering in any way with the stream flows, if any along the line of work. No waste matter of any kind will be allowed to discharge into the stream flows or impounded water of any pools or other bodies of water.

### 1.07 SURFACE WATER CONTROL

- A. Take all precautions to prevent damage to the work or equipment by high waters or by storms. Engineer with the approval of the Owner may prohibit the carrying out of any work at any time when in his judgment, high water or storm conditions are unfavorable or not suitable, or at any time, regardless of the weather, when proper precautions are not being taken to safeguard previously constructed work or work in progress.
- B. In case of damage caused by the failure of the Contractor to take adequate precautions, the Contractor shall repair or replace equipment damaged and shall make such repairs or rebuild such parts of the damaged work, as the Engineer may require, at no additional expense to the Owner.

### 1.08 BARRIERS AND ENCLOSURES

- A. Fences and Barricades

1. Provide and maintain temporary fences, barriers, lights, guardrails, and barricades as indicated in the Contract Documents, or as necessary to secure the Work and adjacent property, and protect persons and property.

B. Protection of Trees

1. The Contractor shall take care not to harm trees along the sides of roads or within the existing facility in which the construction work is to be done or trees on adjacent lands except as indicated on the drawings or with the written permission of the Owner and any other owner of the trees involved. Care shall be taken not to cut tree roots so as to harm the growth of trees to remain.
2. If, in the opinion of the Engineer, any trees damaged during construction can be repaired, the Contractor shall satisfactorily repair same at no further cost to the Owner.
3. If, in the opinion of the Engineer, any tree damaged during construction cannot be repaired and should be removed, the Contractor shall satisfactorily remove and replace, in kind, same at no further cost to the Owner.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

**END OF SECTION**

## SECTION 01570

### TRAFFIC REGULATIONS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Requirements for traffic control for the duration of the Contract.

##### 1.02 REFERENCES

- A. Manual of Uniform Traffic Control Devices (MUTCD) Latest Edition, including all latest revisions.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Contractor shall have the sole responsibility for the maintenance and protection of traffic.
- B. An authorized representative of the Contractor shall be available on a 24-hour basis for the duration of the Contract for the purpose of correcting construction related impediments or hazards.

##### 1.04 SHOP DRAWINGS

- A. In accordance with SECTION 01300 – SUBMITTALS, submit a traffic plan delineating requirements of this section, the Contract Drawings. Traffic control plans shall detail all typical work zones and detours.

##### 1.05 SITE CONDITIONS

- A. Replace, at no cost to the Owner, pavement markings, legends and lane arrows removed or damaged by the construction operation.
- B. Restore temporary detours to original condition.
- C. Replace traffic signal loops damaged during construction within 72 hours.

#### PART 2 PRODUCTS

##### 2.01 TRAFFIC CONTROL DEVICES

- A. In accordance with the MUTCD.

#### PART 3 EXECUTION

##### 3.01 INSTALLATION OF TRAFFIC CONTROL DEVICES

- A. In accordance with the MUTCD.

##### 3.02 PROTECTION OF TRAFFIC

- A. Barricade trenches and roadway excavations at the end of each work period with temporary precast concrete barriers, properly lighted and marked to guide traffic to designated travel lane, or other means acceptable to the Engineer and approved on the Traffic Plan.

- B. Maintain and protect traffic movements for the entire length of the project.
- C. Keep one lane of traffic open at all times except for brief stoppages dictated by the construction operation involving safety of vehicles in the travel lanes.
- D. Maintain access to business and private ways during construction operations.
- E. Furnish sufficient number of signs, temporary precast concrete barriers, warning lights, drums and traffic cones to warn traffic of construction and guide traffic through the construction area in accordance with the MUTCD.

**END OF SECTION**

**SECTION 01590**

**FIELD OFFICES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

A. Requirements for Contractor's and Engineer's field offices.

**1.02 CONTRACTOR'S FIELD OFFICE**

A. Maintain temporary field office near the work for his own use during the period of construction at which readily accessible copies of all contract documents shall be kept. Locate field office where it will not interfere with the progress of the Work. In charge of this office there shall be a responsible contractor superintendent.

**1.03 REMOVAL OF OFFICES**

A. Remove the Engineer's field office and all other temporary facilities from the site, after the date of completion of the Work as stated in the final estimate, unless otherwise directed by the Engineer. The field office and temporary facilities shall become the Contractor's property and the premises shall be left in a condition acceptable to the Engineer.

**PART 2 PRODUCTS**

NOT USED

**PART 3 EXECUTION**

NOT USED

**END OF SECTION**

## SECTION 01600

### MATERIALS AND EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SUMMARY

###### A. Section Includes

1. Requirements for delivery, storage, handling and installation of systems, materials, manufactured units, equipment, components, and accessories used in the work.

###### B. Related Sections

1. Section 01300 - Submittals

##### 1.02 DELIVERY

A. Refer to Specifications' Sections for requirements pertaining to delivery and handling of materials and equipment.

B. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturers' unopened containers or packaging, dry.

C. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

D. Promptly inspect shipments to assure that products comply with requirements, that quantities are correct, and products are undamaged.

##### 1.03 STORAGE AND PROTECTION

A. Refer to Specifications' Sections for requirements pertaining to storage and protection of materials and equipment.

B. Store products in accordance with manufacturers' instruction, with seals and labels intact and legible. Store sensitive products in weather tight enclosures; maintain within temperature and humidity ranges required by manufacturers' instructions.

C. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

D. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

E. Arrange storage to provide access for inspection. Periodically inspect to assure that products are undamaged, and are maintained under required conditions.

1.04 INSTALLATION STANDARDS

- A. Comply with Specifications and referenced standards as minimum requirements.
- B. Components required to be supplied in quantity within a Specification Section shall be the same, and shall be interchangeable.
- C. Do not use materials and equipment removed from existing structures, except as specifically required, or allowed, by the Contract Documents.
- D. Perform work by persons qualified to produce workmanship of specified quality.
- E. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.
- F. When work is specified to comply with manufacturers' instructions, submit copies as specified in Section 01300 - Submittals, distribute copies to persons involved, and maintain one set in field office.
- G. Perform work in accordance with details of instructions and specified requirements.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

**END OF SECTION**

## SECTION 01800

### MAINTENANCE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Procedures for maintaining work completed under this Contract.

##### 1.02 MAINTENANCE PERIOD

- A. The general maintenance period for all construction or materials under this Contract shall be one (1) year subsequent to the date of the acceptance of the work by the Owner, or as provided by other sections of this Specification.
- B. If the Owner puts any structure or equipment to use prior to acceptance of all work under the Contract, the maintenance period for such structures or equipment shall be calculated from the time use begins.
- C. Contractor agrees to replace the material which does not conform to the Contract requirements, and to repair any damage of material or work without cost to the Owner, to satisfaction of Engineer, in conformance with Contract Documents provided orders for replacement and/or repairs are received in writing by the Contractor within the one year period.
- D. This Section shall in no way limit the duration of the Contractor's responsibility for the correction of any defect due to workmanship or materials provided by the Contractor which are not in compliance with the Contract Documents.

##### 1.03 ABUSE OF WORK

- A. Contractor is not obligated to perform work of replacement or repair that he may prove is required because of abuse by parties other than the Contractor, after the date the Owner puts to continuous use the work requiring replacements or repair, or after date the Owner has approved the Certificate of Completion.

##### 1.04 EMERGENCY REPAIRS

- A. If the Owner deems necessary, the Owner shall order replacement or repairs be undertaken within 24 hours.
- B. If the Contractor delays or fails to make the ordered replacement or repairs within the time specified, the Owner shall have the right to make such replacements or repairs and the expense shall be deducted from moneys due the Contractor, or moneys of the Contractor retained by the Owner.

#### PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

**END OF SECTION**

# DIVISION 2

## SECTION 02500

### SPECIAL PROVISIONS SUMMARY OF WORK AND SPECIFIC REQUIREMENTS

#### SCOPE OF WORK

The work to be done under this contract consists of furnishing all necessary labor, materials and equipment required for the replacement of the Rosemont Street Bridge over Little River, and the reconstruction of the roadway. The project will include other improvements in accordance with the plans and these Special Provisions.

The work includes replacing the existing bridge and performing approach roadway reconstruction. The work includes replacing the existing bridge with a new single span bridge constructed of prestressed concrete NEXT F beams; installation of drilled concrete filled micropiles; cast-in-place concrete pile cap; concrete abutments and wingwalls; temporary cofferdams; rock excavation; reinforced concrete deck slab; reinforced concrete bridge railings; reinforced concrete approach slab; installation of a temporary utility bridge; sewer and gas main relocation; temporary relocation of overhead utilities; excavation; temporary water controls; installation of riprap and simulated streambed material; milling and resurfacing; installation of signing and pavement markings; the provision of safety controls and signing for construction operations, restoration of wetlands; and other incidental items included in the contract documents necessary to complete the Project.

The roadway will be closed to vehicular traffic for the duration of the construction project. A detour route will be assigned.

The Contractor shall coordinate his work with all utility owners and the City of Haverhill before and during the work.

“Engineer” or “Director” shall mean the Town Engineer/City Engineer or his appointed agent(s).

“Town/City” or “Department” shall mean the City of Haverhill.

The locations, general characteristics, and principal details are shown on the plans entitled: City of Haverhill, Massachusetts; Highway Department; Rosemont Street Bridge Replacement, Contract No. IFB006.25.

All work under this contract shall be done in conformance with the Massachusetts Department of Transportation *Standard Specifications for Highways and Bridges* dated 2024; the *Supplemental Specifications* dated June 30, 2024; the *2017 Construction Standard Details*, 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 Massachusetts Amendments* and the *Standard Municipal Traffic Code*; the *1968 Standard Drawings for Traffic Signals and Highway Lighting*; the latest edition of *American Standard for Nursery Stock*; the Plans and these Special Provisions.

References within the Standard Specifications to the Massachusetts Department of Transportation or the Engineer shall for the purposes of this Contract be construed to mean the City of Haverhill or its representative.

EXISTING UTILITIES OR CONNECTIONS: The location of existing underground pipes, cables, conduits and structures as shown has been collected from the best available sources and the City of Haverhill together with its agents does not imply or guarantee the data and information in connection with underground pipes, cables, conduits, structures and such other parts as to their completeness not their locations as indicated. The Contractor shall contact utility owners and request marking locations of all their lines in the work areas. Any expense and/or delay occasioned by these utilities and structures or damage thereto, including those not shown, shall be the responsibility of the Contractor at no additional expense to the City of Haverhill.

### RESTRICTIONS

The bridge will be closed for a significant portion of construction operations, and all traffic detoured. Access to adjacent driveways shall be provided at all times.

The Contractor shall provide necessary access for fire apparatus and other emergency vehicles through the work zones to abutting properties at all times.

The bridge shall not be closed to traffic until the Contractor has received approvals for all materials and procedures required for construction activities scheduled to occur during the bridge closure period. Additionally, the bridge shall not be closed to traffic until all such materials are either on site, or the Contractor can provide a delivery schedule from his suppliers showing scheduled delivery dates that would be in agreement with the Contractor's schedule to enable uninterrupted construction during the bridge closure period.

The Contractor shall notify the Engineer and the City of Haverhill Engineering Department 14 days before the bridge closure.

In general, work on this project is restricted to a normal eight-hour day, five-day week, with the Contractor and all Subcontractors working on the same shift. When extended work hours are required for certain activities, the Contractor shall provide the Engineer with at least 72 hours' advance notice.

If night work is requested by the Contractor, then no additional payment will be made for additional traffic management required and shall be included in the cost of the appropriate contract item(s). Also, night work cannot occur unless approved by the Engineer.

### NOTICE TO OWNERS OF UTILITIES

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 his

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.

The following are the names and addresses of some of the agencies which may be affected, and must be notified. Completeness of this list is not guaranteed. The Contractor shall assure that all affected agencies are notified. It will be the Contractor's responsibility to verify this contact information and to notify the City of changes to this list.

Haverhill Engineering Department 4 Summer Street Haverhill , MA 01830	John H. Pettis III, P.E., City Engineer (978) 374-2335
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Haverhill Highway Department 500 Primrose Street Haverhill , MA 01830	Michael Arpino, Superintendent (978) 374-2360
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Haverhill Water/Wastewater Department 4 Summer Street Haverhill , MA 01830	Robert E. Ward, Director (978) 374-2370
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Haverhill Fire Department 4 Summer Street Haverhill , MA 01830	Chief Robert O'Brien (978) 373-8460
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Haverhill Police Department 40 Bailey Boulevard Haverhill , MA 01830	Chief Robert Pistone (978) 373-1212
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National Grid Electric Engineer	Veasna Eang (978) 955-4819
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National Grid Gas PW Lead Engineer	Melanie Tribble (781) 254-7065
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Comcast	Bill Bowlan (617) 279-6391
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Verizon Sr. Engineer Specialist	Paul Diamantopoulos (508) 245-5522
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Full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved in protecting or repairing property as specified in this section shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefore.

The Contractor shall coordinate his/her work with the work required to be performed by any private utility owner for this project. No additional compensation or time extensions shall be allowed for delays as a result of work required to be performed by a private utility owner.

The Contractor shall be required to furnish all labor, materials, and equipment necessary to protect underground structures and electrical vaults within the project site from construction debris and water penetration. When underground structures or electrical vault roofs are excavated, the Contractor shall be responsible for maintaining security of these structures or electrical vaults against unauthorized access. The Contractor shall be responsible for leaving the structures and vaults in a state of water tightness equal to that existing at the commencement of the contract.

### **NATIONAL GRID EMERGENCY TELEPHONE NUMBERS**

#### **ELECTRIC:**

Outage/ Emergency: 1-800-465-1212

New Service: 1-800-375-4730

Customer Support: 1-800-322-3223

#### **GAS:**

Outage: 1-800-465-1212

Emergency: 1-800-233-5325 or 911

New Service: 1-877-696-4743

Customer Support: 1-800-233-5325

### **TEMPORARY ACCESS TO AREA ABUTTERS**

The Contractor shall provide safe and ready means of ingress and egress to all abutting properties in the project area, both day and night, for the duration of the project.

### **NEW INTRODUCTIONS OF INVASIVE PLANTS INTO OR AROUND THE SITE**

(Supplementing Subsections 7.01(D) Plant Pest Control and 7.13 Protection and Restoration of Property)

The Contractor shall ensure that no invasive plant species, as defined and listed as Invasive, Likely Invasive, or Potentially Invasive, by the Massachusetts Invasive Plant Advisory Group <http://www.massnrc.org/MIPAG>, are introduced or spread around the site by construction activities including but not limited to improperly cleaned construction equipment and importation of infected materials such as borrow, compost, nursery stock, seed, or hay bales. Corrective measures, if necessary, shall be made by the Contractor as directed by the Engineer.

The Contractor shall be solely responsible for all costs associated with ensuring that invasive species are not introduced or spread around the site by construction activities and for all corrective measures required for as long as necessary to eliminate the introduced invasive plant species and prevent re-establishment of same.

## ENVIRONMENTAL CONTROLS

All construction equipment shall be fitted with suitable muffling devices so that the noise from construction operation shall be properly controlled.

The Contractor shall control all dirt, dust erosion and other related construction emissions from the project to the satisfaction of the Engineer.

The Orders of Conditions issued by City of Haverhill Conservation Commissions has been included in Appendix B of these Special Provisions and made part of these Special Provisions.

Payment for work required by the Order of Conditions, unless otherwise provided for, shall be considered incidental to other items, and no additional payment shall be made for this work.

## CONCRETE WASHOUT STATIONS

Concrete washout stations shall be a pre-engineered system. Design, details, and proposed locations of concrete washout stations shall be submitted to the Engineer and the Haverhill Conservation Commission for approval prior to construction. No separate payment will be made for concrete washout stations.

## MATERIAL STOCKPILES

Material stockpiles shall be enclosed with erosion control barriers. Proposed locations for material stockpiles shall be submitted to the Engineer and the Haverhill Conservation Commissions for approval prior to construction. No separate payment will be made for erosion control barriers for material stockpiles.

## SAWCUTTING

Sawcuts shall be made in the existing pavement at areas of new or reset curb, limits of full depth pavement construction, limits of box widening, cement concrete pavement, sidewalk construction, limits of work, and as directed by the Engineer. Payment for this work shall be included in the unit price under the applicable items without additional compensation.

The work under sawcuts shall conform to the relevant provision of Section 480 of the Standard Specifications and the following:

Sawcutting equipment shall be approved by the Engineer prior to commencing work.

All edges of excavations made in existing pavements, driveways, and sidewalks which will not be overlaid and which will be visible shall be squared by sawcutting with power-driven tools to provide a neat, clean edge for joining new pavement and sidewalks as shown on the Plans.

Ragged, uneven edges shall not be accepted. Areas which have been broken or undetermined shall be edged neatly with a minimum disturbance to remaining pavement or sidewalks.

Sawcut surfaces shall be sprayed or painted with a uniform thin coat of RS-1 asphalt emulsion immediately before placement of bituminous concrete material against the surface.

No separate payment will be made for sawcutting required for installation of drainage, and water pipe trenches, structures, conduit trench, and permanent utility trenches, but all costs in connection therewith shall be included in the unit price bid for applicable items.

### SAFETY CONTROLS FOR CONSTRUCTION OPERATIONS

(Supplementing Subsection 850.21 and 850.61)

Safety controls for construction operations shall be done in accordance with the relevant provisions of Section 850 of the Standard Specifications, the Manual on Uniform Traffic Control Devices (MUTCD), the Traffic Management Plan, and the following:

The providing of safety controls for construction operations for all locations shall be considered incidental to this contract with the cost for safety controls considered to be included in the unit bid price for those contract items requiring such controls.

Installation, positioning, adjusting, and re-positioning of all devices such as traffic cones, reflectorized drums, high level warning devices, impact attenuators, etc., not otherwise classified and paid for under other items in this contract, is considered incidental and no separate payment will be made.

All safety signing, temporary pavement markings, reflectorized and lighted drums, and all other safety controls used for construction operations shall conform to the NCHRP 350 and the MUTCD, Current Edition, for Street and Highways including all amendments.

### 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 **033-1565**.

### ENVIRONMENTAL PERMITTING

If Contractor 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 Engineer in writing at least 60 days prior to commencement of the proposed activity. All environmental submittals, including any contact with Local, State, or Federal environmental agencies, must be coordinated through the Engineer. The Contractor is expected to fully cooperate with requests for information and provide same in a timely manner. The Contractor is further advised that the Engineer will not entertain a delay claim due to the time required to modify or obtain the environmental permits.

## ORDERS OF CONDITIONS

The project is subject to Massachusetts General Laws Chapter 131, section 40, the Massachusetts Wetlands Protection Act (WPA). This project is also subject to Section 401 of the federal Clean Water Act, 33 USC 1341, and Massachusetts Clean Water Act, M.G.L. c 21, § 26-53.

An Order of Conditions under the WPA has been issued for the project by the Haverhill Conservation Commission. The Order of Conditions is considered to be part of this contract and a copy of the Order of Conditions and all plans/attachments shall be on-site while activities regulated by the Order of Conditions are being performed.

The Contractor's attention is directed to the fact that special conditions and other requirements are associated with the Order of Conditions. It is the Contractor's responsibility to be aware of and comply with these conditions and requirements and plan his/her work and schedule accordingly. **The Contractor is hereby notified that he/she will be responsible and held accountable for performing any/all work necessary to satisfy and comply with the entire Order of Conditions.**

The Order of Conditions is contained in Appendix A. The Contractor is advised that no additional compensation will be allowed for work required to establish, achieve, and maintain compliance with the Order of Conditions, as payment for the work shall be included in the various bid items.

The Order of Conditions also serves as the Section 401 Water Quality Certification under section 401 of the Federal Clean Water Act.

## ARMY CORPS OF ENGINEERS PERMIT

Work under this project is subject to Section 404 of the Federal Clean Water Act, 33 U.S.C. 1251 et seq and is authorized under the Department of the Army General Permits for Massachusetts (GPs), dated June 2, 2023, which are issued by the New England District of the U.S. Army Corps of Engineers (Corps). is submitted to the Corps. Activities subject to the GPs qualify for preconstruction notification provided that 1) the activity meets the terms and conditions of applicable GPs and General Conditions (GCs), and 2) a Pre-Construction Notification (PCN) is submitted to the Corps. A PCN listing the applicable GPs (GP-23) for the work under this project was submitted to the Corps. The GPs are to be considered part of this contract and a copy of the entire GPs document, PCN authorization and all associated plans/attachments shall be on-site while activities regulated by the GPs are being performed.

The Army Corps of Engineers DRAFT Authorization and the General Permits are contained herein as Appendix B. Note that the Army Corps of Engineers DRAFT Authorization contains special conditions, including Time of Year Restrictions.

**The Contractor is hereby notified that he/she will be responsible and held accountable for performing any/all work necessary to satisfy and comply with the entire GPs document and the Special Conditions.** The Contractor is advised that no additional compensation will be allowed for work required to establish, achieve, and maintain compliance with the GPs and special conditions, as payment for the work shall be included in the various bid items, unless specified elsewhere. This work may include, but is not limited to, the following: the hiring and paying for the services of a Professional Biologist, Botanist, Wetland Scientist, Engineer, Landscape Architect, etc.; preparation and submission of as-built plans; wetland flagging; wetland replication monitoring reports, etc.

### **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.

The project is eligible for a May Affect, Not Likely to Adversely Affect (NLAA) determination, with 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 the US Army Corps of Engineers, the lead federal agency for Section 7 consultation, BETA 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 USFWS NLAA**). Therefore, the project has completed Section 7 consultation through the Endangered Species Act, and the AMMs listed below.

#### **General AMM**

- 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.

#### **Tree Removal AMMs**

- Modify all phases/aspects of the project (e.g., temporary work areas, alignments) to the extent practicable to avoid tree removal in excess of what is required to implement the project safely.
- Apply time of year (TOY) restrictions for tree removal when bats are not likely to be present. TOY restrictions for tree removal on this project are June 1st and July 31st of any year (ie. No removal should occur between June 1<sup>st</sup> and July 31<sup>st</sup> of any year).

- Ensure tree removal is limited to that specified in project plans and ensure that contractors understand clearing limits and how they are marked in the field (e.g., install bright colored flagging/fencing prior to any tree clearing to ensure contractors stay within clearing limits).
- If additional cutting is proposed by the Contractor that is outside the scope of this contract, additional review is required by the Engineer, and additional review and restrictions may be required by the USFWS.

## **GENERAL REQUIREMENTS FOR DEMOLITION AND WORK INVOLVING PAINTED STEEL**

Demolition and work involving painted steel shall conform to the requirements of Section 961 of the Standard Specifications.

### **Work Involving Painted Steel.**

Hazardous materials shall be removed in the immediate area of any intended welding, heating, saw cutting or burning of steel. Hazardous material removal is required to allow the demolition of structural steel, railings, drainage systems, utility supports, steel lamp posts, etc.

The contractor shall assume that the coatings on the steel contain lead (Pb), unless otherwise determined by testing. The contractor shall certify in writing to the Engineer the results of all testing and shall also certify that any lead (Pb) coated steel removed from the project was not reused or buried, but was sent to a scrap metal recycling facility.

Implement and maintain programs and procedures, which comply with the requirements of this specification and all applicable standards and regulations. Comply with all applicable regulations even if the regulation is not specifically referenced herein. If a state or local regulation is more restrictive than the regulation of this specification, follow the more restrictive requirements.

This requirement is intended only for the demolition and preparation prior to repair and does not include provisions for recoating of steel.

### **Environmental**

All applicable portions of Sections 961.65 “Worker Protection” and 961.66 “Environmental Protection and Monitoring” shall be followed when performing this work.

During chemical stripping a hand washing facility may be used in lieu of a decontamination/changing facility.

Hazardous material shall be collected during the disassembly and disposed of as outlined in Section 961.68 “Handling of Hazardous Waste and Reporting Release Programs”.

The applicable submittals shall be according to Section 961.69 “Submittals”.

## **Cleaning/Removal**

### **Cutting Or Burning Of Steel**

All surfaces to be welded, heated, saw cut or burned shall be cleaned so as to remove all contaminants and/or hazardous materials, which could be discharged to the environment as a function of the subsequent operations.

Lead paint shall be removed in its entirety in an area prescribed by a 6 inch (15 cm) minimum offset from the required work. The paint removal operation may be dry abrasive blasting, wet abrasive blasting or chemical stripping.

Proper level of containment shall be used when performing this work in accordance with Section 961.67 "Containment". Full containment is not required during chemical stripping operation however; the Contractor shall install proper shielding and/or tarpaulins under the chemical stripping operations in order to catch all debris generated during this procedure. A cleaned area must be inspected and approved before the demolition operations are started.

During cleaning operations the Contractor shall be required to furnish and erect temporary floodlights illuminating the steel surface at a minimum of 30-foot candles. This lighting shall be used in areas where there is insufficient lighting for proper cleaning operations and inspection. The Contractor shall supply electrical power.

The Contractor shall provide support for interim and final inspection of the bridge during cleaning operations. This support shall include the necessary traffic controls and safe access to the work.

### **Mechanical Disassembly Of Steel**

All surfaces to be mechanically disassembled by shear cutting or removing bolts or rivets shall not require deleading. When shear cutting or removing bolts or rivets, the Contractor shall not use any method that will cause dust and/or particles to be emitted and/or dispersed into the environment to an extent that would expose the workers above the Action Levels of 30 $\mu$ g/m<sup>3</sup>.

For purposes of limiting the lead (Pb) dust, the Contractor will be required to dampen the lead paint work areas.

The contractor shall install a proper shielding and/or tarpaulins under all lead-paint-coated surfaces to be shear cut or bolts or rivets ordered removed in order to catch any loose lead paint chips, dust or particles.

## **PIGEON WASTE**

The Contractor shall remove and disposal of the pigeon waste and any other debris accumulated on the steel members and bridge seats in areas where work is being performed. Pigeon waste and debris material contaminates will require special handling and disposal in accordance with all

Federal, state, and local requirements. No separate payment shall be made for removal, special handling and proper disposal of pigeon waste and other debris found on Bridge components.

**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, for approval by Engineer, proposed location for disposal. Disposal shall be in city or town of project, or at minimum, within county, of construction operations.

**END OF SECTION**

## SECTION 02550

### SPECIAL PROVISIONS CONSTRUCTION SPECIFICATIONS

#### ITEMS

All Items of work in this Contract shall be governed by the Commonwealth of Massachusetts Department of Transportation *Standard Specifications for Highways and Bridges* dated 2024, and the *Supplemental Specifications* dated June 30, 2024.

The following items reflect special conditions particular to this Project. As such, they amend and/or supplement the provisions governing the Item, as described in the Standard Specifications.

#### **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 IMPS. Work shall be done during the growing season from May – October unless otherwise specified in the IPMS.

Areas identified for vegetation control measures shall be as shown on the plans and as determined in the field by the Engineer.

## 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.

## 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. 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 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.

### 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.

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.

**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.

**QUALIFICATIONS**

Individual shall be from the same company as that providing services for Item 102.3 Herbicide Treatment of Invasive Plants and shall submit the following, if not submitted under Item 102.3:

- 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.

**SUBMITTALS****Task Summary & Reports**

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 Engineer. The Engineer must be notified to attend the final walk through when a Final Report has been 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. All chemicals and methods proposed shall be consistent with applicable Massachusetts Wetlands Protection Act Order of Conditions.

The IPMS shall be completed in coordination with the 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 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** the success of the ISCP should be reported in the weekly, seasonal, and final EM reports as required by the project permits.

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.

## Photo Documentation

Digital photos with date and time verification shall be provided with the IPMS and with any follow-up monitoring or reporting.

## METHODS

### Initial Site Walk

Prior to any construction activities and soil disturbance, the Contractor shall walk the site with the Engineer 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.

### IPMS Follow-up Amendment

The IPMS may be amended to address additional concerns or adjust to conditions if required by the Engineer. The amended IPMS shall be submitted to the Engineer for approval at least fourteen (14) days prior to any proposed treatment.

### Interim Site Monitoring Inspection Reports

If required by the Engineer, Interim Site Monitoring and an accompanying report shall be conducted.

### Final Inspection

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.

## METHOD OF MEASUREMENT

Item 102.33 will be measured for payment by the Hour. The basis for measurement shall be per the completion of tasks as approved under the Task Summary submittal.

## 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.

Payment shall not include travel time to and from the Contractor's place of business.

General

This section outlines the requirements of the Natural Heritage and Endangered Species Program (NHESP) of the Division of Fisheries and Wildlife (DFW) for projects that occur within Wood Turtle Habitat. The requirements consist of monitoring and protecting turtles during the replacement of the Rosemont Street bridge over Little River in the City of Haverhill, Massachusetts.

Turtle Protection Plan

Prior to the start of work including vegetation clearing and soil disturbance, a Wood Turtle Protection Plan (the Plan) shall be developed and submitted to the Engineer for submission to the MA DFW (the Division) for review and written approval. Said Plan shall be consistent with the specifications provided herein and detail procedures for protecting state-listed turtles during construction, and be prepared and implemented by a qualified, Division-approved wildlife biologist in possession of a valid Scientific Collection Permit issued by the Division.

Following approval of the Plan by the Division, the Plan shall be filed with the Haverhill Conservation Commission as a discussion item request for a scheduled meeting. A representative shall attend that meeting to detail the Plan to the Commissioners and to Address any questions or comments.

One Time Sweeps – Prior to Vegetation Clearing and In-water Cofferdam Installation

The Turtle Monitor (the Monitor) shall be a wildlife biologist approved by the Division. The Monitor shall have a scientific collecting permit from the NHESP to handle wood turtles. The Monitor shall visit the site prior to the start of work, and the Contractor shall coordinate this site visit with the Monitor at least 30 days prior to construction commencement. The Monitor shall sweep the site prior to any site clearing, grubbing, earth disturbance, or site preparations. The Monitor shall inspect vegetation within 200' of the stream, prior to the establishment of the limit of work line and Turtle Exclusion Fence Barrier.

In addition, the Monitor shall provide a sweep of the site prior to any work in water. The Monitor shall inspect all areas of land under water where cofferdams are to be installed, paying close attention to overhanging banks and in water coarse woody debris. The Monitor shall visually sweep the described areas immediately before machines enter the area and relocate any turtles to suitable habitat immediately beyond the construction site. The Monitor shall provide contact information to the project supervisor in the event a wood turtle is discovered on-site. The Monitor may visit the site on only one day if the vegetation clearing and in-water work are initiated on the same day.

By December 31<sup>st</sup> of any year in which work occurs, the Monitor shall submit a summary report to the Division detailing project status and compliance with the Plan and any observations of state-listed turtles. This report shall include the number and duration of visits and rare species observation forms for all state-listed species encountered. In the event of finding an injured turtle, the turtle shall be transported to a suitable veterinarian. In the event of finding a turtle with a radio transmitter, the NHESP and the contact on the transmitter shall be alerted immediately.

All state-listed species encountered in or near the project shall be reported to the NHESP through a Rare Animal/Plant Observation Report with the required supporting materials within 10 days of the observation. No state-listed species may be removed from the project site unless under the direct supervision of the Monitor or the NHESP.

#### Establishment of a Limit of Work Barrier

Following the sweep of the work site, a limit of work barrier shall be installed. This line shall consist of staked compost filter tubes and Turtle Exclusion Fence Barrier (silt fence as the outer boundary) and shall contain signage clearly identifying it as the limits of work in all four quadrants. Refer to the attached sketch for the approximate location of the Turtle Exclusion Fence Barrier.



*Example limit of work sign.*

Installation of the barrier must be conducted using methods that result in a minimum of disturbance (i.e., hand-dug, “2-man” trencher or auger). It is not appropriate to clear large access paths prior to sweeps for turtle. No clearing may occur outside the limit of work approved by the NHESP without additional review and approval by the NHESP.

1. The barrier must be composed of at least 2 1/2 feet of vertical barrier above ground and an additional 4-6 inches buried below ground.
2. The face of the material must be relatively smooth. Materials commonly used are staked at 6 - 10 foot intervals and include tightly woven geotextile, aluminum flashing, or other such materials stapled or tacked to stakes. Loosely woven geotextile fabrics, hay/straw bales, wattles or tubular materials are not generally sufficient.
3. The bottom of the silt fencing must be carefully buried in a 4-6 inch deep trench. The trench must be backfilled and compacted. If it is not possible to dig a trench, then the bottom of the barrier must be affixed to the surface.
4. If project phasing and the traffic management plan allow, the barrier shall only include a single gap at each limit of the project large enough for vehicle passage to access the construction area. These gaps must be closed each night during the turtle active season (March 15 – October 31) with a gate and/or silt fence barrier, and the bottom of the silt barrier weighted down with a solid wood post or sand bags. A solid wooden, plastic or metal turtle barrier gate may be furnished by the contractor in order to close the gap locations. The turtle barrier gate must be keyed into the barrier so that turtles cannot enter the construction area.
5. If hay or straw bales are to be used with silt fencing, they shall be installed on the work-side of the silt fence to avoid turtles using these to breach the barrier.

6. Once installed, the barrier shall be taut between the stakes. Slumps or loose materials will undermine the effectiveness of the barrier. In some circumstances, geotextile fabrics may need to be reinforced with backer material to ensure integrity. Backer material is typically similar to hardware cloth.

Once per week, a person familiar with silt barrier maintenance and installation shall inspect the barrier and facilitate any repairs or alterations. The limit of work barrier should remain taut between stakes and any holes along the bottom repaired. The Contractor shall provide the NHESP with the name and contact information of the person responsible for coordinating necessary sweeps and maintaining appropriate barriers.

Construction Worker Training:

The Monitor shall provide to the construction foreperson wood turtle identification and handling pamphlets. All construction, landscaping, and other sub-contractors associated with the Project shall be informed in writing of the likely presence of State-listed Species on the Property and what measures (observation and injury protection) should be implemented to minimize direct harm to State-listed Species.

Further, no wildlife shall be removed from the Property without approval of a qualified wildlife biologist or the Division except as necessary to receive veterinary treatment in the case of harm during construction.

Method of Measurement and Basis of Payment:

There will be no measurement for Item 102.53. Installation of a limit of work barrier and signage shall be paid at the lump sum bid price and shall be compensation for all labor, equipment and materials necessary for the successful installation, maintenance and removal of the work barrier and signage and the maintenance and removal of the system.

40% of the lump sum bid price shall be made following the installation of the barrier and signage. The remaining 60% shall be paid in 10% increments throughout the remaining period of the contract.

Item 102.531 will be measured for payment by the number of hours of actual Turtle Monitor services rendered and approved by the Engineer.

Payment for this work will be at the contract price for actual number of hours for Turtle Monitor and shall include services for construction, educational, and training meetings; on Site inspections and sweeps; preparation and submittal of all the Turtle Protection Plan, reports, correspondences, and incidental work.

**ITEM 115.1****DEMOLITION OF BRIDGE**  
**BRIDGE NO. H-12-024****LUMP SUM**

Work under this Item shall conform to the relevant provisions of Section 112 of the Standard Specifications for Highways and Bridges and the following:

The work includes furnishing all labor, materials, and equipment necessary to perform demolition of the existing bridge as shown on the Plans or as directed by the Engineer. Except as specified, all material and debris shall become the property of the Contractor, and shall be recycled, reused, or disposed of in accordance with all applicable local, state and federal requirements. There are no known construction plans of the existing bridge.

The Contractor shall demolish, remove, and dispose of the existing bridge and adjacent retaining walls including but not limited to the following major items: reinforced concrete slab; embedded steel beams/rails; wearing surface; bridge railings; curbing; reinforced concrete approach slabs; reinforced concrete abutments and footings; stone masonry retaining walls; reinforced concrete retaining walls; and other miscellaneous items.

Demolition of the existing bridge and retaining wall structures shall be done in the dry. Demolition of these structures shall not commence until all the required environmental measures are in place and approved by the Engineer, including siltation fence, compost filter tubes, cofferdam, and control of water devices.

The Contractor shall be responsible for protecting from damage any utilities within the limits of the work area, as well as protection of the riverbed.

The Owner makes no assurances regarding the presented conditions, dimensions, and materials of the existing structures as shown on the Plans. The Contractor shall verify all existing conditions and construction features of the structure to be demolished, as necessary, for the proper planning and completion of the work. The Contractor shall base its bid on his/her own findings. No increase will be made to the bid prices due to the nature of the materials involved in the demolition. All costs for permits, dump fees, taxes, etcetera, shall be included in the bid price of the demolition items.

The Contractor shall be solely responsible for maintaining the stability of the existing structure at all times during the demolition and construction operations. The Contractor shall prepare and submit a plan indicating the proposed demolition procedures and methods to be used including equipment, tools, devices, bracing, excavator capacity and location, schedule of operations, methods of utility protection, traffic management procedures, etc., to the Engineer for approval. The requirements for equipment and all procedures utilized shall be in conformance with the intent of Subsection 960.61, Steel Erection of the Standard Specifications. The submittal shall include drawings and calculations of all loads and selection of lifting devices.

The demolition procedures and method, calculations and drawings shall be stamped by a Professional Structural Engineer registered in Massachusetts and shall certify that all existing members and elements are suitably braced and supported throughout the demolition process. The Contractor's demolition method shall take into consideration any utilities on or near the bridge. Work under this item may not commence until the Engineer has given written approval.

The Contractor's demolition operations shall not damage any components of the structure to be temporarily, or permanently, retained. Any damage to these components, as a result, of Contractor's operations shall be repaired, or replaced in-kind, as directed by the Engineer and no additional compensation shall be made.

No debris, tools or incidental equipment of any kind shall be permitted to fall into the water below. The Contractor shall provide any necessary shielding or other means to prevent debris from falling into the water below as specified under Item 994.01. Any material that accidentally falls into the water shall be removed immediately. All debris shall be promptly removed and satisfactorily disposed of by the Contractor at his/her own expense.

At least 30 days prior to the start of demolition work, notify the Engineer and each Utility having services connection to, or immediately adjacent to, or overhead of, the structure to be demolished. The Contractor shall exercise caution in the areas of any existing utilities to avoid damage to such.

### Payment

The contractor will make his own investigation of the structure to be demolished including the materials that are part of, or may be stored in the structure. No increase will be made to the bid price due to the nature of the materials involved in the demolition. All costs for permits, dump fees, etcetera, shall be included in the bid price of the demolition item.

The work under these Items shall be paid for at the Contract Lump Sum bid price for Item 115.1, which price constitutes full payment for all labor, transportation, equipment, tools, disposal fees, and any other incidental items to complete the work as specified above, as shown on the Contract Plans and/or as directed by the Engineer. Miscellaneous removals and disposals that are not specifically listed for payment under another item shall be deemed included under this Item.

**ITEM 120.1****UNCLASSIFIED EXCAVATION****CUBIC YARD**

The work to be done under this Item shall consist of removing and disposing in accordance with the relevant provisions of Section 120, all the materials obstructing the execution of required work, as shown on the plans and as directed, except for those materials for which payment is made inclusive with work specified to be performed under other items of this Contract.

The work under this Item shall include all excavation, not otherwise included for payment under other items of this contract, including, but is not limited to, the removal and disposal, if necessary, of the following: buried foundations, all trees & shrub removal, tree stumps and roots, stones, ledge, rip rap, curbing, concrete slabs, reinforced concrete, rock, pipe, granite, cobblestones, muck, fencing and posts, not otherwise paid for under other Items of this contract. The removal of sand barrel shall be paid under this item. Coordination shall be made with the Town if the Town would like to keep the sand barrels. If the Town does not want to keep the sand barrels, then they shall become the property of the Contractor or disposed at no additional cost. Excavation required for hot mix asphalt waterway shall also be included in this item.

The excavating and stacking of excess topsoil/spoils to be reused and spread is included under this item.

Work under this Item shall also include excavation of bituminous concrete pavement at limits of resurfacing and reconstruction; box widening, and at curb lines in areas of resurfacing. Edges of excavation made in existing pavements shall be squared by saw cutting with power driven tools to provide a neat, clean edge for joining new pavement as shown on the Plans. Ragged, uneven edges shall not be accepted. Pavement areas that have been broken or undermined shall be edged neatly with a minimum disturbance to remaining pavement. Payment for this saw-cutting work shall be paid for under the paving items.

Before starting any excavation, the Contractor shall become familiar with the area and verify all utilities and other sub-surface features in the project area to make sure that the excavation will not unnecessarily disturb or damage such features. They will coordinate their construction activities with the owners of such features and obtain approval or permits, if necessary, prior to starting the excavation. Any damage done to sub-surface features during the construction process will be the responsibility of the Contractor and will be repaired by the Contractor at his own expense. If the owner so wishes, they will repair the damage themselves and bill the Contractor for his expenses.

When working next to existing retaining walls or structure, the Contractor shall exercise extreme caution not to disturb existing walls or structure. If existing walls or structure are disturbed, they shall be reconstructed at the Contractor's expense to thoroughly match the existing in color, texture, material and workmanship.

Payment under this Item shall be at the Contract Unit Price bid per Cubic Yard, which price shall include all labor, materials, tools, saw-cutting, and equipment necessary to complete the excavation and disposal of unwanted or surplus material, not cover by other items of this contract.

**ITEM 151.9**

**STREAMBED RESTORATION**

**LUMP SUM**

**DESCRIPTION**

This work shall consist of removing, stockpiling, and replacing river bed material within the streambed limits and within the bridge cofferdam. The streambed restoration shall replicate the existing natural channel bed outside the work area in terms of material, roughness, shape, profile, and appearance. The ultimate product will, to the extent possible, replicate the function and appearance of the natural stream channel.

The Contractor shall coordinate with his/her sub-contractors to ensure all required equipment is available on-site to complete the work in this manner. The streambed restoration is required to comply with environmental permits issued for the project.

At least 30 days prior to the commencement of construction, the Contractor shall coordinate with the Engineer. At this meeting, the Engineer will provide an overview of the restoration work. The Contractor should be prepared to discuss the anticipated means, methods, and schedule.

Process Approval:

In lieu of a mockup, the Contractor shall schedule an onsite meeting to discuss the streambed restoration with the Engineer. The Contractor shall provide the Engineer adequate access to observe, direct, and inspect the channel restoration work throughout the duration of the removal, stockpile, and reinstallation of the existing streambed material. If material is being brought to the site for streambed restoration, the Contractor shall provide the Engineer with photographs to see the material.

**MATERIAL**

The top 2 feet of streambed material excavated from the existing streambed shall be removed and stockpiled to facilitate reinstallation and replication of the natural streambed. The excavated streambed material below the top 2 feet shall be stockpiled and reused to fill the voids in the proposed riprap placed below the top streambed restoration layer.

In the event that the excavated material is not suitable or there is not enough available suitable material, additional streambed restoration material shall be locally sourced that matches the composition of the existing native river bed. The following gradation shall be used as a guide. The median grain size (D50) is approximately 7 mm (fine gravel).

Stream Bed Material Gradation

<b>Particle</b>	<b>Percent (%) Composition</b>
Gravel	65
Sand	35

The streambed material shall be approved by the Engineer prior to use.

**CONSTRUCTION**

## Channel

The streambed material shall be reinstalled over dumped riprap, as depicted on the plans, to an average thickness of 2.0 feet, with variations in thickness as necessary to replicate existing channel conditions. The initial placement of streambed material shall fill / choke the voids in the underlying riprap. Fill voids by shaking stone with the teeth of an excavator bucket, hand tamping with metal tamping rods, and by spraying water to settle fines between large stones. Plate compactors shall not be used. The purpose of filling the voids is to prevent subsurface flow where surface water disappears into large voids between the stone fill below the channel bed surface during low flow conditions. The final streambed shape and appearance shall be finalized in the field as directed by the Engineer.

Reinstallation of the stockpiled streambed material shall be placed on top of the riprap to restore streambed habitat and fish passage. The streambed materials shall be installed during normal low water conditions behind cofferdams in accordance with the environmental permits.

## Completion

Once all material has been placed in the stream channel and approved by the Engineer, the Contractor shall remove the cofferdams in such a way as to slowly wet the stream to minimize the initial sediment pulse. Every attempt shall be made to minimize the downstream movement of sediment.

The final streambed shall maintain the general configuration of the existing streambed bedform and there shall be minimal subsurface flow upon final inspection by the Engineer. The project must be passable by fish and other aquatic organisms following construction.

The streambed restoration to be measured for payment will be the complete and accepted work for restoration of the streambed within the limits shown on the Plans as approved by the Engineer.

## BASIS OF PAYMENT

The accepted streambed restoration will be paid for on a lump sum basis. Payment will be full compensation for excavating, stockpiling, transporting, and placing the material specified and for furnishing all labor, tools, equipment, testing, and incidentals necessary to complete the work.

**ITEM 160.7****PERMANENT BENCHMARK****EACH**

The work under this Item shall consist of furnishing and installing a permanent survey benchmark on the Rosemont Street Bridge and providing the City with its elevation.

The survey marker shall be bronze. The marker shall have a circular head with a minimum diameter of 2.5 inches, and a minimum stem length of 2 inches. The head shall be stamped with the words "CITY OF HAVERHILL" AND "BENCHMARK" just inside the perimeter of the head.

The survey marker shall be installed at the location indicated on the Construction Plans. The survey marker shall be cast into the concrete.

The Contractor shall determine the elevation of the survey marker in relation to the North American Vertical Datum of 1988 (NAVD 88). The determination shall be made by a Professional Land Surveyor licensed in Massachusetts. To allow for initial settlement of the bridge abutment to take place, the determination of the survey marker elevation shall not be undertaken until a minimum of six months after completion of the bridge construction, including installation of final paving. The elevation of the survey marker shall be reported to the Engineer and the City. Reporting of the benchmark shall be made in writing on the surveyor's letterhead and signed by the Professional Land Surveyor.

**Measurement and Payment**

This Item shall be measured per each survey marker installed, complete in place.

Payment for this Item shall be made at the contract unit price per survey marker installed, which price shall include all labor, materials, and equipment necessary to complete the work.

**ITEM 163.1****DEFORMATION AND VIBRATION MONITORING****LUMP SUM**

The work under this Item shall include monitoring of potential movements and vibrations in existing structures during performance of the work. Monitoring shall include procurement and installation of instruments and collection and reporting of data as specified herein.

The work shall include monitoring of deformations and vibrations during demolition, installation of cofferdams, installation of drilled micropiles, rock excavation, and bridge excavation.

Deformation monitoring shall be performed using survey methods at up to nine (9) locations as described in this Special Provision and/or as determined in the field by the Engineer. Deformation monitoring points shall be installed and baseline measurements performed and submitted prior to demolition, excavation, installation of cofferdams, installation of drilled micropiles, or rock excavation. Monitoring shall be performed on a daily basis during the aforementioned construction activities, and on a weekly basis at all other times, for the duration of the Contract.

The Contractor shall perform vibration monitoring using a minimum of two (2) seismographs at the two closest structures to the vibration-inducing construction operations, or as directed by the Engineer. The locations of the seismographs may change during the work based on conditions and work sequence. Vibration monitoring shall be performed during demolition, excavation, installation of cofferdams, installation of drilled micropiles, or rock excavation. Initial vibration monitoring data shall be collected and compared to Response Values on an hourly basis during the first 4-hours of usage of any new piece of vibration producing equipment and on an hourly basis during the first four hours of demolition activity activities. After performing the initial evaluation described above, vibration monitoring shall continue in continuous peak particle velocity recording mode with the peak values reported daily for the during of the vibration producing activity.

Crack deformation monitoring shall be performed at up to six (6) locations as directed by the Engineer.

Data from the deformation and vibration monitoring will be compared to the Response Values indicated below. Should the data exceed the Response Values, the Contractor shall implement modifications to construction procedures to mitigate potential damage to the affected structures. The Contractor shall also be responsible for the repair, at no additional cost to the Department, of any damage to existing structures caused by the Contractor's actions.

Instruments that become damaged, destroyed, inoperable, or out of calibration during the Work shall be repaired or replaced at no additional cost to the Department. The Contractor shall be responsible for the protection of all instrumentation during the course of the Work.

Remove instruments at the end of the construction and restore the site of instrumentation locations unless otherwise directed by the Engineer.

## QUALIFICATIONS

The Chief Surveyor shall be a Registered Land Surveyor in the Commonwealth of Massachusetts with a minimum of three (3) years of experience in displacement measurements of types and accuracies specified in accordance with this Section.

The Field Survey Party Chief Shall have a minimum of one (1) year of experience in displacement survey measurement of the types and accuracies specified herein in accordance with this Section.

The vibration monitoring shall be performed by a technician familiar with the installation and operation of seismographs under the direction of a Professional Engineer registered in the Commonwealth of Massachusetts. The technician and Engineer shall each have a minimum of one (1) year of experience in vibration monitoring.

## SUBMITTALS

At least thirty (30) days prior to start of the Work, submit for review and approval the following information:

- 1) Locations of proposed deformation monitoring points on a scaled sketch supplemented with at least one (1) photograph of each proposed location for review prior to installation of monitoring points.
- 2) Proposed means and methods for monitoring horizontal and vertical displacements of deformation monitoring points.
- 3) Resumes for the Chief Surveyor, Field Survey Party Chief, Field Technician and Registered Professional Engineer.
- 4) Proposed initial locations of seismograph instruments.
- 5) Manufacturer's information on proposed seismograph instruments.
- 6) Proposed daily and weekly data submittal formats with example data.

At least fourteen (14) days prior to the start of the work submit Formal Initial Readings for each deformation monitoring survey point.

During demolition, excavation, installation of cofferdams, installation of drilled micropiles, or rock excavation submit daily monitoring data from crack gages and deformation monitoring points, along with continuous vibration monitoring data. Data collected each day shall be submitted by 4 PM on the following day.

During all other work activities, submit weekly monitoring data from crack gages and deformation monitoring points. Weekly data shall be submitted by 4 PM the following Monday (Tuesday for holiday weekends).

Submitted deformation monitoring data shall include the following at a minimum:

1. A summary sheet showing the cumulative vertical movement, horizontal movement or crack elongation of each instrument from its Formal Initial Reading.

2. A statement to indicate whether any Response Value has been reached.
3. A summary of construction activities and weather conditions for the day of readings, along with a scaled sketch showing locations of construction activities in relation to monitoring points.
4. Names of individuals making measurements.
5. Accuracy of readings.
6. Horizontal and vertical locations of deformation monitoring points.
7. Changes from previous measurements and readings of all monitoring points and crack gages.
8. Cumulative movements and readings over time since the initial readings of the instrumentation.
9. Comparison of current instrument readings to previous readings.

Daily vibration data should be submitted in conjunction with and on the same schedule as daily deformation monitoring data. Submitted vibration monitoring data shall include at a minimum: 1) raw data and dated plotted on a graph of peak particle velocity versus frequency, 2) a scaled sketch showing the locations monitored, 3) name of person making measurements, and 4) a statement to indicate whether any Response Value has been reached. The sketch shall include locations of vibration producing construction activities. The submitted data shall be correlated to the scaled sketch to allow evaluation of vibration data collected from multiple locations during the day.

Within one week of installation of each deformation monitoring point and crack gage, submit the as-installed location on a scaled sketch showing the installed location supplemented with at least one (1) photograph of each installed instrument.

## MATERIALS

Provide two (2) portable seismographs for monitoring the velocities of ground vibrations resulting from construction activities. Acceptable seismographs include Micromate by Instantel; MiniSupergraph II by Nomis Seismographs; 3000 LCP by Geosonics/Vibra-Tech; or approved equal. Factory calibration shall have been performed by the manufacturer within the past year using a shake table and a reference sensor traceable to the National Institute of Standards and Technology.

Each deformation monitoring point shall consist of a center-punched  $\frac{3}{8}$ -inch (0.375") diameter by minimum two-inch (2") long, stainless steel, socket head cap screw ASTM A307-UNC with stainless steel washer, screwed into  $\frac{3}{8}$ -inch (0.375") machine screw anchor; a 2-inch long "PK" masonry nail; or a clearly marked existing feature on the surface to be monitored that allows reproducible survey of horizontal and vertical movement.

Provide calibrated direct read building crack gages consisting of overlapping glass or acrylic plates. The crack gages shall be waterproof and weather resistant and shall be capable of being read to a resolution of 0.02 inch with a maximum horizontal range of at least 0.75 inch and a

vertical range of at least 0.375 inch such as crack gages manufactured by Durham Geo Slope Indicator, Slone Mountain, GA, or an approved equivalent.

## METHOD OF CONSTRUCTION

The Contractor shall provide the Engineer with safe access at all times for reading instrumentation.

Formal Initial Readings and Accuracy:

- 1) Obtain Formal Initial Readings (FIRs) on all deformation monitoring points and crack gages for use as the baseline reference for the instrument. Before establishing the FIR for each instrument, a minimum of three readings shall be performed that demonstrate that changes resulting from the installation process have ceased. The three readings demonstrating that the installation has stabilized shall be performed on different days and may be used to establish the FIR.
- 2) The FIR for a deformation monitoring point shall consist of the average of at least two survey measurements of elevation and horizontal location obtained with independent survey set-ups. Where applicable, the initial readings will be taken after allowing sufficient time for the grout or epoxy to set. Each reading other than the FIR will consist of a single set of survey measurements. Reading accuracy shall be  $\pm 0.01$  foot.
- 3) The FIR for a crack gage will be the reading of the cross hairs on the crack gage when the tape connecting the two plates is cut after the gage has been installed and/or the epoxy has set. Reading accuracy shall be  $\pm 0.5$  millimeters.
- 4) Formal Initial Readings are not required for vibration monitoring. Vibration Monitoring accuracy shall be  $\pm 0.02$  inches per second. The Contractor may, at his or her option, make baseline surveys of vibrations resulting from normal traffic on the bridge for comparison purposes only.

All survey data shall be collected and reported using project datums.

Measurements shall be made in a reproducible manner. For example, deformation monitoring point bolts shall be firmly seated before reading; crack gage measurements shall be made at approximately same time of day to reduce impacts of temperature expansion/contraction upon readings, and survey shall be made at reproducible locations (e.g. punchmark in bolt or nail).

Response Values and Interpretation of Data

- 1) Response values are relative to Formal Initial Readings and are subject to adjustment by the Engineer as indicated by prevailing conditions or circumstances.
- 2) The Engineer will retain prime responsibility for interpretation of data. In the event a Response Value is reached or exceeded or undesirable impacts to the monitored structure are otherwise indicated, the Engineer will inform the Contractor who shall take action as outlined in this Subsection. The Contractor may make their own interpretation of the data.
- 3) If the Contractor's collected data indicates that a Response Value has been reached or exceeded, the Contractor shall immediately inform the Engineer.

- 4) The maximum allowable peak particle velocity (PPV) measured by the seismographs shall not exceed a threshold defined by linear interpolation between the following points on a plot of vibration frequency versus peak particle velocity:

Frequency (Hz)	PPV (in/sec)
1	0.19
4	0.75
15	0.75
40	2.0
100	2.0

- 5) The Response Values for surveyed vertical deformation movements are as follows: Threshold Value of 0.25 inches (1/4") and Limiting Value of 0.5 inches (1/2").
- 6) The Response Values for surveyed horizontal deformation movements are as follows: Threshold Value of 0.5 (1/2") and Limiting Value of 0.75 inches (3/4").
- 7) The Response Values for crack elongation are as follows: Threshold Value of 0.05 inches and Limiting Value of 0.1 inches
- 8) If a Threshold Value is reached, the Contractor shall:
- Promptly inform the Engineer.
  - Meet with the Engineer to discuss response action(s) within 24 hours.
  - Provide a daily report to the Engineer until all instrument readings fall below the specified Threshold Values, or unless otherwise directed.
- 9) The Engineer may require the contractor to initiate one or more of the following response actions if the Threshold Value is reached:
- Increase instrument monitoring frequencies.
  - Install and monitor additional instruments.
  - Modify construction procedures.
- 10) If the Limiting Value is reached, the Contractor shall:
- Suspend activities in the affected area with the exception of those actions necessary to avoid further exceeding the Limiting Value. Work shall only resume at the sole discretion of the Engineer.
  - Immediately commence monitoring deformation instruments at an increased frequency as directed by the Engineer.
  - The Contractor shall meet with the Engineer to discuss additional response action(s) and prepare a mitigation plan within 24 hours.

### BASIS OF PAYMENT

Deformation and Vibration Monitoring will be paid for at the Contract LUMP SUM bid price, which price shall include installation of instruments and collection and reporting of data as specified herein.

**ITEM 164.**

**PRE- AND POST-CONSTRUCTION  
CONDITION SURVEYS**

**EACH**

The work under this Item shall include performance of a pre-construction and a post-construction condition survey of the following properties: #128, #129, #133, #135, and #154 Rosemont Street; and the sewage pumping station adjacent to the northwest corner of the bridge.

The intent of the pre- and post-construction condition surveys is to document conditions at these properties prior to and after construction. The pre-construction survey will form a baseline for later comparison to the post-construction survey to evaluate impacts (if any) from construction activities. The two surveys could also be useful to evaluate construction-related damage claims that could later arise from the property owners.

**QUALIFICATIONS**

The pre- and post-construction condition surveys shall be performed by a Professional Engineer registered in the Commonwealth of Massachusetts. The Contractor's Professional Engineer shall have been in business for at least five consecutive years and shall have completed in the past five years at least 5 building condition surveys similar to those specified herein.

**SUBMITTALS**

At least 30 days prior to the start of the Work, the Contractor shall submit the resume of the Registered Professional Engineer who will be performing the surveys.

At least 30 days prior to the start of the Work, the Contractor shall submit the methods to be used for building surveys, including contingencies for a) interior access to structures; b) exterior access to structures from the building property; and c) no access to property (survey from public property). The submittal shall include proposed agreement forms between the Contractor and building owners allowing access for surveys.

At least 14 days prior to the start of the Work, the Contractor shall submit a pre-construction condition survey conforming to the requirements specified herein.

No more than 30 days after substantial completion, the Contractor shall submit a post-construction condition survey conforming to the requirements specified herein.

**METHOD OF CONSTRUCTION**

The Contractor shall coordinate the pre- and post-construction survey schedule with the Engineer. The Contractor shall arrange for access to the buildings for surveys. Building access agreement forms shall be sent to Owner's via Certified Mail.

The Contractor's Professional Engineer and the Engineer must be present during each survey.

The pre- and post-construction condition surveys shall include the main buildings and dwellings; accessory buildings; hardscape elements; and all trees, shrubs, and landscaping elements within 100 feet of the limits of construction.

Surveys shall be performed in accordance with the Contractor's reviewed and approved submittal. Written property owner access agreement forms must be obtained by the Contractor prior to entering each property.

The Contractor's Professional Engineer shall submit results of the survey in a report format, including checklists, sketches and photographs.

#### METHOD OF MEASUREMENT

Pre- and post-construction condition surveys will be measured for payment by the Each surveys performed.

#### BASIS OF PAYMENT

Pre- and post-construction condition surveys will be paid for at the Contract unit price per EACH, which price shall include all labor, materials, equipment, and incidental costs required for performance of surveys and submission of reports as specified herein.

**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 City, 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.

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 the City 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 the Engineer 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 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 the Engineer 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.

**ITEMS 181.11 through 181.14** (continued)

**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. The City 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.

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 the City. Whenever there is a conflict or overlap within the regulations, the most stringent provisions shall apply. The Contractor shall reimburse the City 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 the Engineer.

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.

**ITEMS 181.11 through 181.14** (continued)

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 the Engineer.

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.

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. The City 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 the Engineer.

**ITEMS 181.11 through 181.14** (continued)

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.

**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.

**BASIS OF PAYMENT AND METHOD OF MEASUREMENT**

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.

**ITEMS 181.11 through 181.14** (continued)

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.

**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

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

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 MATERIAL**

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

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 PERMIT

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.

#### 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 through 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.
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 license 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 184.1****DISPOSAL OF TREATED WOOD PRODUCTS****TON**

Work under this item shall include the transportation and disposal of all treated existing wood product as directed by the Engineer.

The timber components of the existing structure are suspected to be treated with creosote, pentachlorophenol and/or CCA. This item shall include all costs for sampling, laboratory testing, loading, transportation and disposal of the treated wood. The Contractor is required to submit disposal manifests to the Engineer prior to the completion of the project. All aspects of this Item are to be completed in accordance with state and federal regulations.

**COMPENSATION**

Measurement and payment will be by the weight, in tons, of treated timber transported and accepted at a licensed facility. The work shall be considered full compensation for all labor, tools, equipment, materials, testing, loading, transportation, approvals, and permits necessary for the completion of the work.

**ITEM 201.****CATCH BASIN****EA**

Work under this item shall conform to the relevant provisions of Subsections 201, 220, and 227 of the Standard Specifications and the following:

The work under this item includes the furnishing and installation of catch basin with 4' deep sump and non-metallic hoods to be installed in catch basins to prevent oil and floating debris from being discharged from the stormwater management system. Hoods shall be either Town Standard, The Eliminator (Ground Water Resource (617)-773-1128); Snout (BMP Inc. (800)-504-8008); SKUNK (Upstream Technologies (651)-237-5123); or approved equal. The specified size of the hood is based on the outlet pipe size.

**CONSTRUCTION**

Catch Basins shall be installed per MassDOT Standard Specifications. Hoods shall be installed in proposed catch basins within the project limits and as directed by the Engineer. Hoods shall be securely attached to the outlet pipe or structure wall to form a watertight seal and shall be installed in full accordance with the recommendations of the manufacturer.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Items 201. will be measured and paid at the Contract unit price per each, complete in place including hood, which price shall include all labor, materials, equipment and incidental costs required to complete the work.

**ITEM 210.****SANITARY SEWER MANHOLE****EACH**

The work of this Item shall conform to the relevant provisions of Section 301 of the Standard Specifications, the details shown on the plans and the following:

**MATERIALS**

All materials used in the construction of sewer manholes will conform to the following:

**American Society for Testing and Materials (ASTM)**

- A48, Standard Specification for Gray Iron Castings.
- A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- C32, Standard Specification of Sewer and Manhole Brick (Made from Clay or Shale), AASHTO Designation M91-42, Red Sewer Brick Only Grade SS.
- C144, Standard Specification for Aggregate for Masonry Mortar.
- C150, Standard Specification for Portland Cement.
- C207, Standard Specification for Hydrated Lime for Masonry Purposes.
- C443, Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.
- C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
- C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
- C1244, Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure.
- D4101, Standard Specification for Propylene Plastic Injection and Extrusion Materials.

**DESIGN REQUIREMENTS**

Manholes shall conform in shape, size, dimensions, materials, and other respects to the details indicated in the Contract drawings. All manholes shall have concrete bases. Invert channels may be formed in the concrete of the base or brickwork upon the base. Manhole walls (barrels and cones) shall be precast concrete sections. The top of the cone (not to be more than 12-in.) shall be built of brickwork to permit adjustment of the frame to meet the finished surface. The inverts shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerlines of adjoining pipelines.

**PRECAST CONCRETE SECTIONS**

Conform to the ASTM C478 with the following exceptions and additional requirements:

All cast in place concrete shall be Class A and shall conform to the requirements specified under SECTION 03300. Wall sections to be 5-inch thick minimum. Type II cement in accordance with ASTM C150.

4.0 feet and 5.0 feet diameter manholes minimum of 4,000 psi - 28 days compressive strength. 6.0 foot diameter manhole minimum of 5,000 psi. - 28 days compressive strength. Except as otherwise permitted.

Sections shall be cured by subjecting them to thoroughly saturated steam at a temperature between 100 and 130 degrees F. for a period of not less than 12 hours or, when necessary for such additional item as may be needed to enable the sections to meet the strength requirements. No more than two lift holes may be cast or drilled in each section. The date of manufacture and the name of trademark of the manufacturer shall be clearly marked on the inside of the barrel. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.

#### Flat Slab Tops

Thickness and reinforcement as indicated on the drawings and in accordance with ASTM C-478.

#### Cones

Cones shall be precast sections of construction similar to above.

#### Bases

The tops of the bases shall be suitably shaped by means of accurate bell-ring forms to receive the barrel sections. All holes for pipes shall be cast in the base sections so that there is a clear distance of four inches minimum between the inside bottom of the base section and the pipe invert. Base pad shall be pre-cast with extended base as indicated on drawings and herein specified. Openings for pipe and materials to be embedded in the wall of the base for these joints shall be cast in the base at the required locations during the manufacture of the base.

### **Components**

#### Pipe Seals

Premolded elastomeric-sealed joints fitted or cast integrally into the pipe opening of the manhole base and/or wall section. Provide a watertight joint. Maximum 10-degree omni-directional deflection.

Conform to ASTM C-923.

#### Seals to be:

Lock Joint Flexible Manhole Sleeve made by Interpace Corp., Parsippany, NJ; Kor-N-Seal made by National Pollution Control Systems, Inc., Nashua, NH; A-LOK manhole pipe seal made by A-LOK Corp., Trenton, NJ; or an acceptable equivalent product. All materials, accessories and construction methods used in making the joints shall be supplied or approved by the manufacturer of the premolded elastomeric-sealed joint. Furnish manufacturer's written instructions to the Engineer.

#### Aluminum Manhole Steps

Cast into walls of the precast sections to form a continuous ladder with a distance of twelve inches (12) between steps. Aluminum drop-front type. Stock No. 12653B made by Aluminum Company of America, Pittsburgh, PA. Stock No. F-14-2-B made by New Jersey Aluminum Co., New Brunswick, N.J., or an acceptable equivalent product. Before the steps are built into the masonry and after thorough cleaning, those parts of aluminum steps which will be embedded shall be given a protective coating of an acceptable, heavy-bodied, bituminous material. The cleaning shall be done by suitable means and with suitable cleaning agents to ensure that the surfaces to be coated

are free from all foreign matter such as dirt, oil, and grease. The steps shall be thoroughly rinsed and dried before the coating is applied and the coating shall have become thoroughly dry before the steps are built into the masonry.

#### Plastic Manhole Steps

Install in walls of the precast sections to form a continuous ladder with a distance of twelve inches (12) between steps. Copolymer Polypropylene plastic manhole step Model PS2-PFSL as manufactured by M. A. Industries, Inc., Peachtree City, Georgia. Plastic steps to be in conformance with ASTM D-4101 for type II propylene copolymers. Plastic to encase 1/2-inch grade 60 steel reinforcing rod conforming to ASTM A-615.

#### Exterior Coating

The material shall be:

Minwax Fibrous Brush Coat made by the Minwax Co., New York, N.Y. or Tremco 121

Foundation Coating made by the Tremco Inc., Cleveland, OH; or Acceptable equivalent product.

#### Rubber Gaskets (between manhole sections)

In accordance with ASTM C443. Gasket configuration per manufacturers recommendation.

#### Butyl Resin Gaskets (between manhole sections)

In accordance with ASTM C990. Gasket configuration per manufacturers recommendation.

### **Accessories**

#### Manhole Frames and Covers

Furnish all cast-iron manhole frames and covers conforming to the details shown on the drawings, or as hereinbefore specified. Castings shall be of good quality, strong, tough, even-grained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers. Casting shall be thoroughly cleaned and subject to a careful hammer inspection.

Castings shall be at least Class 25 conforming to the ASTM A48. Standard sewer manhole frames and covers to have 30 inch opening, and be E.L. LeBaron Foundry Co., Model LC326, or approved equal. Pattern of cover and lettering shall comply with the Owner's standards. Watertight sewer manhole frames to have 32 inch diameter covers with 4 bolts, and gasket, and be E.L. LeBaron Foundry Co., Model LCB326, or approved equal. Pattern of cover and lettering shall comply with the Owner's standards.

#### Brick

Sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to the Engineer. In accordance with ASTM C32, Red Sewer Brick Only Grade SS.

In accordance with AASHTO M91-42, Red Sewer Brick Only Grade SS. Reject brick shall be immediately removed from the work.

#### Mortar for Brickwork

Composed of Portland cement, hydrated lime, and sand in which the volume of sand shall not exceed three times the sum of the volume of cement and lime. The proportions of cement and lime shall be 1:1/4.

Cement shall be Type II Portland cement in accordance with Specification SECTION 03300. Hydrated lime shall be Type S conforming to the ASTM C207. Hydrated lime shall be "Mortaseal" manufactured by U.S. Gypsum or "4X Hydrate" manufactured by the New England Lime Company or an acceptable equivalent product. The sand shall conform to ASTM C144.

#### Stubs in Manholes

The stubs shall be of PVC pipe and shall have PVC stoppers sealed with premolded gasket joints.. Lengths as indicated on the Drawings.

#### Drop Inlets

Construct with pipe precast concrete sections provided by the manhole manufacturer with all materials conforming to this Specification.

#### Measurement and Payment

Compensation for this work shall be at the contract unit price bid per manhole for this Item, and shall include all labor, tools, equipment, materials and necessary incidental work to complete the work.

**ITEM 210.02****SANITARY SEWER MANHOLE REMOVED****EACH**

The work of this Item shall conform to the relevant provisions of Section 301 of the Standard Specifications, the details shown on the plans and the following:

Removal of existing sewer manhole will include the removal and disposal of frame, cover, brick leveling course, and precast sections. Manholes and connecting pipes may have concrete fill if previously abandoned.

Compensation for this work shall be at the contract unit price bid per manhole removed for this Item, and shall include all labor, tools, equipment, materials and necessary incidental work to complete the work.

**ITEM 212.****TEMPORARY SEWER BYPASS****LUMP SUM**

Work shall include installation of temporary sewer line with primary and secondary bypass pumps and connection to existing sewer main.

All pumping units (primary and secondary) and appurtenances shall be sized properly to handle the flows encountered including increased flows due to wet weather. Pumps shall have a design point of 775 gpm at 100' TDH. All piping systems (primary and secondary) and appurtenance shall be sized properly to handle the flows encountered including increased flows due to wet weather. Primary pump to be electric and secondary pump to be electric with generator or diesel.

Include power-generating facilities capable of providing all power necessary to operate any primary and secondary pumping systems. Maintain facility to be ready for use if required. Operating onsite power generating facilities outside of normal working hours shall not be allowed unless authorized by the Owner and Engineer as an Emergency back-up in the event of a power failure to prevent shut down of the diversion system.

Noise prevention measures for all equipment shall be used to insure minimum noise impact or surrounding areas. Measures may include but shall not be limited to insulated enclosures, electric pumping units, and hospital grade silencers or mufflers, and special equipment as necessary. Noise shall be kept below 64 db at a distance of 23 feet. Should at any time prior to or during the performance of above mentioned work, the Engineer determines the noise prevention measures being used are not adequate, the Contractor shall at no additional cost to the Owner suspend all work until acceptable measures are incorporated.

Keep the Engineer advised at all times of any changes made to the overall operation(s) to accommodate field conditions. Flow diversions and/or bypass pumping shall be maintained at all times as long as it is necessary to maintain the flow through the limits of the project during construction. Maintain auxiliary and/or emergency equipment at the site to continue flow diversion and/or by-pass pumping operations in the event of a breakdown and/or loss of normal power.

No work shall begin until all provisions and requirements of this Section have been reviewed and approved by the Engineer.

The Engineer reserves the right to limit and/or otherwise restrict the Contractor's overall activities and/or operations at any time without claim should the Engineer deem it to be in the Owner's or public's best interest to do so.

Payment under this lump sum Item shall include all compensation for furnishing and installing temporary sewer pipe, temporary connections to existing sewer main and manholes, furnishing and maintaining sewer pumping and any other incidental items required to complete this work shall be included in the contract lump sum for this item.

<u>ITEM 250.06</u>	<u>6 INCH POLYVINYL CHLORIDE</u> <u>SANITARY SEWER PIPE</u>	<u>FEET</u>
<u>ITEM 250.12</u>	<u>12 INCH POLYVINYL CHLORIDE</u> <u>SANITARY SEWER PIPE</u>	<u>FEET</u>

The work of these items shall conform to the relevant provisions of Section 230 of the Standard Specifications and the following:

MATERIALS

All gravity sewer pipe shall be a minimum of 6 inches in diameter. Pipe 15 inches in diameter and smaller shall be PVC SDR 35, in conformance with ASTM D3034 unless otherwise directed. Pipe 18 inches in diameter and larger shall be PVC C905, DR 32.5, in conformance with ASTM F679 unless otherwise directed.

The length of straight pipe shall not be more than 13 feet. Lengths of Y-branches shall not be more than 3 feet unless otherwise permitted by the Engineer. Saddle Y-branches shall not be allowed. For Specials, conform to the specifications for straight pipe as applicable and to the details indicated on the drawings or bound into the back of the specifications.

Joints shall be push-on bell and spigot joints using elastomeric ring gaskets and conforming to ASTM D3212. Gaskets shall conform to ASTM F477. Gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The composition and texture of gaskets shall be resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, so that they will endure permanently under the conditions of the proposed use. All PVC installed in areas with suspected petroleum-derived contaminated soil or groundwater, as directed by the Engineer, shall have fluoroelastomer (FKM) gaskets.

Lubricant shall be in accordance with manufacturers requirements.

## ITEMS 250.06 and 250.12 (Continued)

### CONSTRUCTION METHODS

#### Inspection and Acceptance of Pipe

All pipes will be inspected before being installed. No single piece of pipe shall be laid unless it is generally straight and undamaged. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inches per foot of length. Sewer pipe that fails to meet any of the specifications listed herein or is found to be damaged as determined by the Engineer shall be rejected and removed from the site. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit. The Contractor shall provide all labor and equipment necessary to assist the Engineer in inspecting the pipe. Any pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed from the project site. Any pipe showing visible damage and for which it is believed there is no incipient fracture beyond the limits of the damaged section, may have the damaged section, as identified by the Engineer, cut off before the pipe is laid. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the damage. All pipe cuts shall be filed smooth and beveled to match the manufacturer's spigot end of the pipe. All cutting shall be done with blade-type cutters, abrasive discs or other equipment approved by the Engineer. Care shall be taken to avoid exposure to direct sunlight or prolonged high temperature for extended periods of time immediately preceding installation.

#### Installing PVC Pipe

The pipe shall be laid true to the lines and grades indicated on the contract plans. Should a utility conflict or other obstruction as determined by the Engineer, occur and a field change is necessary, the Engineer shall make the required decisions regarding final placement of the pipe. Each pipe unit shall be handled into its position in the trench, by such means as acceptable to the Engineer. Care shall be taken to avoid damaging the pipe and fittings. The pipe shall be set in a bedding of 3/4 inch crushed stone meeting MassDOT Highway Division Standard Specifications Section M2.01.4. No pipe or fitting shall be permanently supported on saddles, blocking, or stones. Provide suitable depressions in crushed stone to accept pipe bells, so that after placement, only the barrel of the pipe receives bearing pressure from the supporting material. The bedding shall be placed to a minimum depth of six (6) inches below the bottom of the pipe unless excavation is made in rock in which case twelve (12) inches of crushed stone shall be required; and shall extend around the pipe; and minimum of twelve (12) inches above the pipe. The pipe shall be laid accurately to the required lines and grades using a pipe-laying laser in accordance with the manufacturer's recommendations. Care shall be taken to maintain an accurate alignment and to give the pipe a firm bearing along its entire length. Walking or stepping directly on the pipes shall not be permitted after they have been laid. Adjustments to the line and grade in order to comply with the contract plans shall be made by re-grading the bedding material. Clear pipe and fittings of debris, dirt, etc., before being installed, keep clean until accepted in the completed work.

**ITEMS 250.06 and 250.12 (Continued)**

The bedding shall then continue over the pipe using gravel borrow, type c as specified in the appropriate sub-section of these specifications unless the existing spoil is determined to be suitable by the Engineer. Should the existing spoil be used, all stones greater than three (3) inches shall be removed prior to placement of the spoil. Bedding and backfilling from the bottom of the trench to one foot above the pipe shall be done by hand using a vibratory compactor in layers not to exceed 4 inches in thickness with thorough tamping between each layer. Any length of pipe which becomes damaged or misaligned shall be removed and replaced by a sound and satisfactory length to the correct alignment by the Contractor at his expense. The pipe shall be installed from the low end to the high end with the bell of the pipe at the high end. Each pipe unit shall be handled into its position in the trench by using equipment adapted for that purpose. The Contractor shall furnish approved devices to properly support the pipe when it is lifted. Excavations and backfill for the pipe shall be made in accordance with Sections 140 and 150, respectively.

Install pipe and fittings to the lines and grades indicated on the drawings or as required by the Engineer. Care shall be taken to ensure true alignments and gradients. Unless otherwise instructed, minimum acceptable pipe slope shall be as follows:

Pipe Size	Slope
8"	0.0040 ft/ft
10"	0.0028 ft/ft
12"	0.0022 ft/ft
15"	0.0017 ft/ft
18"	0.0012 ft/ft
24"	0.0008 ft/ft

**Pipe Jointing Requirements**

Pipe joints shall meet ASTM Specification D-3212 for pipes using flexible elastomeric seals and shall not allow infiltration to exceed 50 gallons/inch/diameter/mile/day. Each pipe unit shall be laid and connected so as to form a tight joint with the adjoining pipe and bring the inverts continuously to the required grade. The pipe shall not be driven down to the required grade by striking it with a shovel handle, timber or other unyielding object. Pipe ends shall be kept clean of all debris, dirt, grease or other material which may prevent a tight seal from forming. Care shall be taken to preserve the alignment of pipes already laid during the jointing process. After the pipe units are aligned in the trench and are ready to be joined, all Joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendations. Suitable devices shall be used to force the pipe units together so that they will fit with a minimum open recess inside and outside and have tightly sealed joints. Joints where the gasket is damaged or not properly positioned as determined by the Engineer shall be pulled apart and remade using a new gasket. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer. Where any two pipe units do not fit each other closely enough to enable them to be properly jointed, they shall be removed and replaced with suitable units. Gasket installation and joint assembly shall follow the directions of the manufacturers of the joint material and of the pipe, all subject to review by the Engineer. The resulting joints shall be watertight and flexible. Open ends of pipe and branches shall be closed with polyvinyl chloride stoppers secured in place in an acceptable manner.

## **ITEMS 250.08 and 250.12 (Continued)**

### Pipe Fittings

Couplings shall be non-shear elastomeric with a pipe stiffness factor two times greater than SDR-35 PVC pipe. Both pipe ends and the coupling shall be cleaned of all dust, dirt or debris prior to making the connection. Cut pipe ends shall be filed smooth using a hand file around the inside and outside diameter of the pipe prior to application of the coupling. Stainless steel clamps shall be used to secure the coupling to the pipe.

### Rejecting Pipe

Pipe of a particular manufacturer may be rejected if there are more than five unsatisfactory joint assembly operations or "bell breaks" in 100 consecutive joints, even though the pipe and joint conform to the appropriate ASTM Specifications as hereinbefore specified. If the pipe is unsatisfactory, as determined above, the Contractor shall, if required, remove all pipe of that manufacturer of the same shipment from the work and shall furnish pipe from another manufacturer which will conform to all of the requirements of these specifications.

### Bedding Pipe

After each pipe has been properly placed, enough gravel shall be placed between the pipe and the sides of the trench, and thoroughly compacted, to hold the pipe in correct alignment. Bell holes (depressions), provided for jointing, shall be filled with crushed stone and compacted, and then crushed stone shall be placed and compacted to complete the pipe bedding, as indicated on the drawings.

### Protecting Pipe

Take all necessary precautions to prevent flotation of the pipe in the trench. Close the open ends of the pipe with temporary watertight plugs, at all times pipe installation is not in progress. If water is in the trench when work is to be resumed, the plug shall not be removed until suitable provisions have been made to prevent water, earth, or other substances from entering the pipe. Pipelines shall not be used as conductors for trench drainage during construction.

### Saddles

Saddles shall be flexible elastomeric wye configuration. Saddle tees shall not be used unless specifically approved in writing by the Engineer. The saddle wye shall be set at the two o'clock or ten o'clock position on the pipe barrel and angled in the direction of flow. Saddle connections shall be at least 2 feet away from all existing sewer main pipe joints.

## **ITEMS 250.08 and 250.12 (Continued)**

Prior to the application of the saddle, the surface of the pipe shall be cleaned of all dust, dirt or debris. In the case of PVC pipe, the barrel shall be cored using a hole saw and the inside and outside edges filed smooth. Holes in clay pipe shall be accomplished by drilling several drill holes around the circumference of the connection and chiseling the remainder to produce as neat and uniform a hole as possible. Holes which introduce fractures into the pipe barrel or are non-uniform or jagged in appearance as determined by the Engineer shall result in replacement of the pipe section by the Contractor at his expense.

The saddle shall be secured to the barrel of the pipe with two stainless steel clamps.

Saddle connections to the sewer main shall be supported by a concrete cradle at least two (2) feet in length.

### **Wyes, Tees and Bends**

Wye, tee and bend fittings shall be SDR-35 PVC meeting ASTM specification D3034 and D3212. Fittings shall be as manufactured by Plastic Trends, Inc., Vassallo, CertainTeed Corp. or approved equal.

### **Temporary Caps and Plugs**

Temporary caps and plugs shall be SDR-35 PVC meeting ASTM specification D3034 and D3212. Caps and plugs shall be as manufactured by Plastic Trends, Inc., Vassallo, CertainTeed Corp. or approved equal.

### **Concrete Cradles and Envelopes**

The Contractor shall provide concrete cradles for saddle connections as specified above and/or concrete envelopes in accordance with these specifications and as indicated on the contract plans or as directed by the Engineer. Concrete shall be 3000 psi Type II Portland cement concrete with 3/4 inch aggregate and shall be placed to a minimum thickness of six (6) inches from the barrel of the pipe along its length. Concrete cradles shall be installed up to the spring line of the pipe (120 arc centered on the vertical axis of the pipe cross-section). Concrete envelopes shall completely surround the pipe. Concrete (including aggregates) shall conform to MHD Specification M4.02.00 et. seq. Precast concrete blocks shall be used to support the pipe at the correct line and grade while placing the concrete. No wood blocks are permitted.

### **Sewer Main Connections to Existing Structures**

Connections to existing sewer manholes shall be made by coring. Watertight expandable rubberized boots shall be used at each connection. The Contractor shall be responsible for insuring that the invert of the connecting pipe is built to the design invert elevation shown on the plans. The pipe shall extend into the structure sufficiently so that all portions of the end of the pipe match the inside wall of the structure. The cavity between the outside wall of the pipe and the cored surface shall be completely filled with quick drying non-shrink hydraulic cement. The cement surfaces shall be made smooth, neat and in a good workmanlike condition.

## **ITEMS 250.08 and 250.18 (Continued)**

The existing brick table shall be rebuilt to meet the new invert. The Contractor may elect to core a new channel-in the existing brick table if conditions permit. However, any failure or leakage that develops shall be repaired by the Contractor at his expense. It may also be necessary to bulkhead openings in an existing structure as a result of a change in invert elevation.

### **Service Connections to Sewer Main**

Sewer service laterals shall be connected to the sewer main at a wye or a saddle wye. When connecting to a proposed sewer main, a wye must be used. When connecting to an existing sewer main, a saddle wye must be used. The wye or saddle wye shall be located at either the two o'clock or ten o'clock positions and angled in the direction of the flow. A bend fitting shall be used to adjust the alignment and grade of the service lateral to meet design requirements. The service lateral shall be four (4) inch SDR 35 PVC or other diameters approved by the Engineer. Schedule 20 or Schedule 40 PVC is not permitted. Joints shall be "ring-tite" and shall meet the same requirements here-in specified. The lateral's pipe slope shall be at least two (2) percent and shall have no angles or changes in direction except at the sewer main connection. The service lateral shall be bedded in gravel borrow, type c, and compacted to the satisfaction of the Engineer. Partial sewer service laterals shall extend from the sewer main to the frontage of the property proposed to be served.

### **Leakage Testing**

All newly installed sewers and appurtenant structures shall be made as nearly watertight as possible. Sewer mains and partial sewer service laterals shall be tested for leakage by an independent testing company approved by the Engineer other than the Contractor who installed the sewer main. Leakage testing procedures and allowances shall conform to ASTM Specification C924. Sewer mains or portions thereof which exceed the maximum allowable leakage shall be repaired and retested at the Contractor's expense until they comply with the ASTM specification. Sewer manholes shall not show any evidence of leakage as determined by the Engineer. Manholes which are found to be leaking shall be repaired and retested at the Contractor's expense.

### **Video Tape**

The Contractor will be responsible for supplying the City with a video-audio DVD of all new sewer mains, which will become the property of the City of Haverhill Department of Public Works.

## **ITEMS 250.08 and 250.18 (Continued)**

### **As-Built Drawings**

The work under this item shall also include the development of As-Built plans in electronic format (AutoCAD 2004 or newer version of AutoCAD if compatible with City's software). The AutoCAD file shall conform to the current version of the MassGIS Standard for digital Plan Submission to Municipalities. The plan shall include a minimum of three (3) tie dimensions to all manholes as well as rims and inverts using a datum acceptable to the City of Haverhill. Plans shall be submitted in both hard copy and electronic format (AutoCAD 2004 and PDF) to the City of Haverhill Department of Public Works.

### **MEASUREMENT AND PAYMENT**

Measurement and payment for PVC sewer pipe shall be based on the unit bid price per foot. Payment shall include all materials, labor, tools and equipment to remove or sawcut the existing pavement (where necessary), excavate the trench including support of excavation, provide trench drainage (pumping), lay and joint the pipe, cut the pipe to meet required lengths, install pipe fittings including saddle wyes, wyes, tees, bends and plugs, safeguard and protect other utilities, core holes in existing sewer manholes to connect proposed sewer pipes, connect the sewer pipe to existing sewer manholes, apply hydraulic cement, backfill with gravel, grade, compact the trench, provide concrete cradles or envelopes, chimneys, dispose of surplus or unacceptable spoil, maintain the backfilled trench and provide as-built drawings in accordance with these specifications and as shown on the contract plans or as directed by the Engineer.

The crushed stone bedding shall be paid for under Item 156.

Any necessary bypass pumping will be included in the sewer pipe price.

Payment for sewer pipe items shall include all leakage testing required under the contract including all phases thereof and any retesting, which is required by the specifications.

The work of this Item shall conform to the relevant provisions of Section 301 of the Standard Specifications, the details shown on the plans and the following:

Insulation for the permanent 12" sewer main shall meet the following requirements:

All exposed pipe (i.e. bridge crossing) shall be insulated with factory installed insulation.

1. Insulation shall have the following properties and specifications:
  - a. Material: rigid polyurethane foam, factory applied.
  - b. Insulation thickness: 2 inch
  - c. Density: (ASTM D 1621) 2.0 to 3.0 lbs/ft<sup>3</sup>
  - d. Closed cell content: to ASTM D 2856, 90% minimum.
  - e. Water absorption: to ASTM C 272, 4.0 % by volume.
  - f. System compressive strength: modified ASTM D 1621 approximately 200 lbs/in<sup>2</sup>. (excluding field kits).
  - g. Thermal conductivity: to ASTM C 518, 0.14 to 0.17 Btu in/ft<sup>2</sup> Hr °F.
  - h. Service temperature range: from -49°F to 200°F
  - i. Locked seam galvanized steel O-Pipe jacket, 22 gage.
2. Insulated pipe joints shall be complete with the use of prefabricated urethane foam half shells, the joints shall be complete with the application of one of the following:
  - a. Cut and rolled galvanized metal, c/w stainless steel bands, and clips, 20 gage.
  - b. Slip-joints Application 0.125 inch – 0.250 inch wall split casing, c/w stainless steel bands and clips. The joint shall allow for expansion and contraction by having one end fixed while the other end is free to slide.
  - c. Heat shrink wrap

Welded stainless steel casing pipes shall be furnished and installed as indicated on the contract documents. Pipe shall be Schedule 20 and Grade 304L in conformance with ASTM A 312, ASTM A 358. Contractor to provide appropriate pipe spacers per manufacturer's recommendations.

#### Measurement and Payment

Compensation for this work shall be at the contract lump sum price bid for this Item, and shall include all labor, tools, equipment, materials and necessary incidental work to complete the work.

Payment for PVC pipe shall be made under Item 250.12.

<b><u>ITEM 450.23</u></b>	<b><u>SUPERPAVE SURFACE COURSE – 12.5 (SSC - 12.5)</u></b>	<b><u>TON</u></b>
<b><u>ITEM 450.31</u></b>	<b><u>SUPERPAVE INTERMEDIATE COURSE – 12.5 (SIC – 12.5)</u></b>	<b><u>TON</u></b>
<b><u>ITEM 450.41</u></b>	<b><u>SUPERPAVE BASE COURSE – 37.5 (SBC – 37.5)</u></b>	<b><u>TON</u></b>

Work under these items shall conform to the Standard Specifications Section 460, and the following:

Each course shall be constructed to the depth, typical section, or elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

The Contractor shall plan the paving operation to meet the proposed finish grades shown on the plans. He shall coordinate his depth of milling and overlay operations, such as to meet these finish grades.

Street sweeping shall be performed by a mechanical street sweeper vehicle to clear the paved surface of all debris, to the extent as determined by the Engineer. There shall be no separate payment for street sweeping. Payment for such work shall be included in the various contract items.

The timing of the street sweeping operation should be such that the road remains sufficiently clean between the completion of the sweeping and the start of any repaving. Should the Engineer decide that the road surface requires additional sweeping, no additional compensation shall be offered the Contractor to complete this process.

No additional compensation will be allowed when street sweeping operations are used as a means of clearing off and/or exposing areas of pavement covered with vegetation or debris.

All material collected from the street sweeping process shall be disposed of by the Contractor outside and away from the limits of the project with no additional measurement or payment to be made.

Tack coat and sand shall be applied to all joints composed of hot mix asphalt immediately after paving or as directed by the Engineer. Tack coat and sand, when applied to joints in accordance with subsection 460.62, shall be considered incidental to these items with no additional measurement or payment to be made.

All final exposed joints shall be entirely coated with hot poured rubberized asphalt sealer. The application will deliver sufficient sealant to effectively bond and seal transverse and longitudinal joints. Any areas on joints without sufficient hot rubber material will require either re-application or localized handwork as directed by the Engineer. Hot Poured Rubberized Asphalt Sealer shall be placed at paving joints and considered incidental to these items with no additional measurement or payment to be made.

It should be noted that roads could require several lifts of leveling material in order to eliminate water problems in low spots prior to placing the top course of hot mix asphalt.

Paper joints shall be used when the road is not completed in its entirety. The joint shall be underlain with tarpaper and hot mix asphalt shall be placed on top next to the existing pavement.

No joints shall be left at intersections of roadways. Special care should be taken to leave any joints no less than twenty feet away from all radius points at intersections or as directed by the Engineer. Side street aprons shall be paved in the same pass as the road itself.

Payment under these Items shall be at the Contract Unit Price bid per Ton and include all necessary work to prepare the pavement surface, including street sweeping, sawcutting, and all labor, materials, equipment and incidental costs required to complete the work. Tonnage shall be determined by weight slips submitted to the Engineer. Where weight slips are unavailable, the inch per square yard method shall determine tonnage (inches of specified thickness, multiplied by square yard unit measurement, multiplied by the volume to weight conversion factor of 0.056 tons/inch/square yard). This calculation method shall also be used to confirm tonnage used.

Temporary patch for utility trenches shall be paid under Item 472.

**ITEM 472****TEMPORARY ASPHALT PATCHING****TON**

Work under this Item shall conform to the relevant provisions of the Standard Specifications, the Material Specification for sub section 472 and the following:

Work will include temporary trench repair in areas to be milled and overlaid (where not otherwise included under other items), miscellaneous patching, utility trench patching and other uses as may be directed by the Engineer. Hot mix asphalt for miscellaneous work shall also be used to provide temporary access and egress to properties abutting the work area, as determined by the Engineer. The Contractor is advised that this is material which will be spread primarily by hand.

No additional compensation will be made for cutting existing pavement in order to provide a clean match line. No payment will be made for roadway patching done outside the excavation pay limits as detailed on the plans. The subsequent removal of this material, if directed by the Engineer, shall also be included in this Item.

Asphalt mixtures for temporary work shall be placed only upon the direction of the Engineer.

Tonnage shall be determined by weight slips submitted to the Engineer. Where weight slips are unavailable, the inch per square yard method shall determine tonnage (inches of approved thickness, multiplied by square yard unit measurement, multiplied by the volume to weight conversion factor of 0.056 tons/inch/square yard). This calculation method shall also be used to confirm tonnage used.

Compensation for this Item shall be at the Contract Unit Price per Ton, which price shall include all labor, materials, equipment for surface preparation, placement, maintenance and removal, and incidental costs necessary to complete the work to the satisfaction of the Engineer.

The Contractor shall be required to maintain areas of temporary pavement in reasonable repair, as determined by the Engineer, and not be compensated for additional materials, labor and incidentals required to do so.

**ITEM 580.2**

**TIMBER CURB REMOVED AND RESET**

**FEET**

Work under this Item shall conform to the relevant provisions and the following:

RR Ties at 133 Rosemont Street will need to be removed and reset for the sewer service installation. RR ties shall be carefully removed and stacked during the sewer service installation. After the sewer service has been installed the RR ties shall be reset in its original location.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Method of measurement and payment shall be by length feet of tie removed and reset. If RR ties are deemed non-salvageable then they shall be disposed of per Item 184.1 Disposal of Treated Wood Products.

**ITEM 628.241****MODIFIED TRANSITION TO BRIDGE RAIL****EACH**

Work under this Item shall conform to the relevant provisions of Section 601 and the following:

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

This item also includes Modified Transition to Bridge Rail, which is a shorter version of the Transition to Bridge Rail shown in standard drawing 400.3.6. The Modified Transition to Bridge Rail shall only include the Thrie Beam Terminal Connector, collapsible tube, and (2) 12'-6" Thrie-Beam Panel (Nested). The nested panel will then be connected to Guardrail – Curved, TL-3 (Single Faced) Thrie Beam. Payment for the Modified Transition to Bridge Rail will be by the unit price Each and paid under Item 628.241 Modified Transition to Bridge Rail. This Item shall include all material, equipment, and labor necessary to install the Modified Transition to Bridge Rail and Transition to Bridge Rail Item.

**ITEM 657.****TEMPORARY FENCE****FOOT**

The work under this Item shall conform to the relevant provisions of Section 644 of the Standard Specifications and supplemented by the following:

Work under this item shall include furnishing, installing, removing and resetting and, subsequently, removing a chain link fence located around the work area, river, staging area and/or field office as necessary for safety and security. The Contractor will be responsible for providing an acceptable method for the installation of the fence that will provide for the safety and security for which it is intended.

Fence gates for access/egress shall be furnished, installed and maintained by the Contractor, and shall be included in the unit cost. All posts including end, gate, corner and intermediate brace posts shall be included in the unit cost. The fencing height shall be 6 feet minimum from ground level. Material need not be new, but shall not be deteriorated, nor in any way jeopardize the security purposes intended. All fencing shall meet the approval of the Engineer.

The Contractor shall be responsible for maintenance of the temporary fence, and shall be responsible and cognizant that it remains secure, and that the area is sealed off at all times to the general public. It may be necessary to remove and reset sections of temporary fence at times to conform to current stage construction.

Fence fabric shall be placed on the face of the post away from the work area. A top tension wire, rather than a pipe top rail, shall be used. The top edge of the fabric shall be finished with a "Knuckled" selvage. The fence shall not be removed until the bridge work is complete and safe pedestrian passage is provided. No additional compensation will be paid for resetting and removing the temporary fence.

**MEASUREMENT AND PAYMENT**

Measurement and Payment for Item 657., Temporary Fence will be paid at the Contract unit per FOOT, which price shall include all equipment, material, labor and tools necessary for a complete installation including foundations, if required, removing and resetting for each construction stage, and final removal of fence, all components of fence and foundations as described above and/or as directed by the Engineer. No payment shall be made for the replacement and/or restoration of fence damaged due to construction accidents, vandalism and/or any other manner, but shall be provided by the Contractor without additional compensation.

**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 gutter inlets within the project limits and as directed by the 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 dispose of accumulated debris as required at no additional cost. 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 Contractor's expense.

All curb openings shall be blocked to prevent stormwater from bypassing the device.

All silt, sediment, and debris accumulated in silt sacks shall be handled and disposed of as specified in Section 227 of the Standard Specifications. Under no condition shall silt and sediment from the insert be deposited on site and used in construction.

**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.

**ITEM 698.1**  
**ITEM 698.4**

**GEOTEXTILE FABRIC FOR STABILIZATION**  
**GEOTEXTILE FABRIC**  
**FOR PERMANENT EROSION CONTROL**

**SQUARE YARD**  
**SQUARE YARD**

All work shall be done in conformance with the applicable sections of the Standard Specifications.

Geotextile Fabric shall conform to requirements of AASHTO M 288 and shall be listed on MassDOT's Qualified Construction Materials List. Geotextile for Permanent Erosion Control shall be used under modified rock fill at end of paved waterway, including two feet of overlapping width. Geotextile Fabric for Stabilization shall be used under the areas of crushed stone under riprap and crushed stone under modified rockfill at the northeast corner as shown on the Plans. If geotextile fabric requires anchor pins, they shall be included under this item.

**BASIS OF PAYMENT**

Compensation will be at the contract unit price bid per square yard and shall include the fabric, all labor, tools, materials, and any necessary incidental items to provide complete in place installation. No additional payment will be made for overlapping of fabric. Geotextile which become damaged during construction operations, shall be repaired or replaced immediately at no additional cost to the City.

**ITEM 751.****LOAM FOR ROADSIDES****CUBIC YARD**

The work under these Items shall conform to the relevant provisions of Section 751, 765, 767, 770 and as supplemented below. Work includes the placement of approved loam borrow, lime, and fertilizer to restore all disturbed areas as authorized by the Engineer.

Loam Borrow shall meet with Material Specifications M1.07.0. Loam Borrow shall pass a 3/8" screen and laid in a minimum depth of 4" after compacted and shall be free of grass and other unsuitable materials. The placement of new loam borrow shall be as follows.

In new areas or areas of significant disturbance, loam borrow shall be placed with a minimum depth of 6 inches after compaction. In existing grass areas to remain, or where there is minimal disturbance to the surface, depressions shall be filled and a top dressing of loam borrow shall be applied to a general depth of 1 inch after compaction. Prior to the application of the top dressing, the Contractor shall be required to mechanically aerate these areas by a means acceptable to the Engineer. Loam Borrow shall be used to fill depressions and shape the surface to provide for proper flow of drainage, as well as enhance the general appearance of these grassed areas. Areas adjacent to curbs and other such hard surfaces shall be pre-worked and tapered down 1 to 2 inches so as to allow the top dressing to end up flush with the hard surface.

Lime shall meet M6.01.0. Lime shall be applied at a rate of 75 to 100 lbs. per 1,000 square feet prior to seeding.

Fertilizer shall meet M6.02.0 and the applicable provisions of State and Federal laws and be furnished in containers plainly marked with the chemical analysis of the product. Fertilizer for general planting shall be slow release and shall be commercial grade 10-10-10, or sufficient to meet the recommendations for soil amendment. At least 40% of the nitrogen content shall be slow release, phosphorus shall be available phosphoric acid, and potassium shall be water-soluble potash.

Payment under Item 751 shall be the Contract Unit Price bid per Cubic Yard, based on a 4 inch depth, which price shall be full compensation for preparing surfaces; fine grading and compaction the sub base, furnishing, placing, raking, shaping and compacting new loam borrow; and furnishing and applying lime and fertilizer.

Unless otherwise approved by the Engineer, surfaces disturbed outside the Limits of Work line shown for the Contractor's convenience, shall be restored as specified herein, at the Contractor's own expense.

**DESCRIPTION**

The work under this item shall conform to the relevant provisions of Subsections 120, 751, 765, 767, and 771 of the Standard Specifications and the following:

Wetland Restoration shall refer to restoration of wetlands, bank and riverfront area as described herein and shown on the drawings.

Construction of the wetland restoration area shall be completed as shown on the drawings at the following location(s):

Area at Station: 13+50 LT                      Area = 281 s.f.

The work shall also include bank restoration as shown on the drawings at the following location(s):

Area at Station: 13+50 LT                      Length = 29 l.f.

The work shall also include riverfront area restoration as shown on the drawings at the following location(s):

Area = 5,147 s.f.

The work under this item shall include all labor and furnishing of materials to complete the work specified herein to protect and restore existing inland wetland areas that will be temporarily impacted as shown on the drawings and as required by the Engineer.

Restoration Area shall be constructed to meet the requirements of all associated permits and certifications, including relevant performance standards of the Massachusetts Wetlands Protection Act (MGL C. 131, s40), Section 401 Water Quality Certification, and Section 404, U.S. Army Corps of Engineers General Permit.

All work shall be in coordination with an approved Wetland Specialist. Wetland Specialist qualifications and requirements shall be per Item 755.75, Wetland Specialist.

**SUBMITTALS – DOCUMENTS**

Survey: To establish or confirm pre-construction baseline elevation of temporarily impacted area(s), a survey shall be submitted to the Engineer prior to any fill or other land disturbance.

Request for Conditional Acceptance: As specified below, a letter requesting Conditional Acceptance of the work and the site conditions shall be submitted to the Engineer.

Request for Final Acceptance: As specified below, a letter requesting Final Acceptance of the work and the site conditions shall be submitted to the Engineer.

Request for Certificate of Compliance (Partial or Full): If applicable, request for a Certificate of Compliance shall be submitted to the Engineer for distribution to appropriate regulatory agencies as specified below.

Monitoring Reports: Reports shall be submitted to the Engineer as specified below. Reports shall be compensated under Item 755.76 Wetland and Construction Monitoring Reports.

### ASSOCIATED ITEMS AND MATERIALS

**Geotextile Fabric for Temporary Soil Protection** shall be as specified under that item.

**Compost** shall be in accordance with Subsection 751 and M1.06.0 Organic Soil Additives of the Standard Specifications. Compost shall not contain seeds, roots, stems, or other viable parts of invasive plants or other noxious plants. Off-site sources shall be identified and available for inspection prior to transport of material to the site to verify that they are likely to be free of invasive plant species, including all viable plant parts.

### **Wetland Soil**

If during wetland restoration it is determined by the Wetland Specialist that manufactured wetland soil is necessary to restore impacted wetlands, it shall consist of off-site borrow thoroughly mixed with compost to achieve a target organic content of 10-12% by weight. Where empirical data are lacking, compost to soil ratio shall be 1:1 by volume.

No soil or soil amendment shall be brought on-site without approval of the material source by the Wetland Specialist and the Engineer. Soils used in the wetland restoration area shall be free of rocks greater than 4 inches in diameter.

Wetland soils for restoration area shall be stockpiled outside of the resource area and stored at least 100 feet from the edge of the wetland. Precautions shall be taken as necessary to prevent erosion of the stockpiled material. In the event there is excess borrow, it shall be disposed of without additional compensation.

### **Seed Mix**

Required submittals include:

- Certificate of Materials from the supplier shall be submitted and approved 30 days prior to ordering seed. Seed species listed on the certificate shall include ecotype region (i.e., *Asclepias incarnata*, PA Ecotype).
- Seed tag from the bag of seed used shall be submitted to the Engineer at the time of seeding. Seed tag shall include ecotype region and species, guaranteed percentages of purity, weed content and germination of the seed, and the net weight. Seed tag shall match the Certificate of Materials, include the name of the supplier, and date material was sent.

- Bill of lading or a notarized Certificate of Compliance from the Supplier serving as proof of purchase shall be submitted if requested by the Engineer. Document shall include date of sale, quantity, lot number, and address of Supplier. This shall match the seed tag. Notary shall not work for either the contractor or seed supplier.

Seeding shall conform to the Standard Specifications Subsection M6, ROADSIDE DEVELOPMENT MATERIALS.

Wetland restoration area seeding – Item 765.552 Wetland Obligate Mix

	<u>Botanical Name</u>	<u>Common Name</u>	<u>% PLS</u> <u>By</u> <u>Weight</u>
Grass	Carex vulpinoidea	Fox Sedge	26.50%
	Carex lurida	Shallow Sedge	15.00%
	Sparganium eurycarpum	Giant Bur Reed Eco PA	10.00%
	Carex lupulina	Hop Sedge	7.00%
	Carex crinita	Fringed Sedge	6.00%
	Scirpus cyperinus	Woolgrass	4.00%
	Juncus effusus	Soft Rush	3.00%
	Carex comosa	Bearded Sedge	3.00%
	Scirpus atrovirens	Green Bulrush	3.00%
	Sparganium americanum	Burrweed	2.50%
	Scirpus validus	Bulrush, soft-stem	2.00%
	Carex stricta	Tussock Sedge	1.00%
	Glyceria canadensis	Manna Grass	1.00%
			<hr/> 84.00%
Herb/Forb	Verbena hastata	Blue Vervain	4.00%
	Aster puniceus	Aster - Swamp	2.00%
	Eupatorium maculatum	Joe-pye Weed	1.50%
	Eupatorium perfoliatum	Boneset	2.00%
	Iris versicolor	Blue Flag Iris	2.00%
	Alisma subcordatum	Mud Plaintain	1.00%
	Vernonia noveboracensis	New York Ironweed	1.00%
	Bidens cernua	Nodding Burr Marigold	1.00%
	Solidago patula	Roughleaf goldenrod	0.50%
	Mimulus ringens	Monkey Flower	0.50%
	Chelone glabra	White Turtlehead	0.50%
			<hr/> 16.00%
			100.00%

Seeding Rate:

Species ecotype shall be as native to New England region as possible. Apply this mix at 20 lbs PLS/acre.

**Fertilizers** shall not be used.

**Straw mulch or hydromulch** shall be per Section M6 of the Standard Specifications.

Riverfront restoration area seeding – Item 765.442 Roadside Riverbank Mix

<u>Botanical Name</u>	<u>Common Name</u>	<u>% PLS</u> <u>By</u> <u>Weight</u>
Grass		
Elymus virginicus	Virginia Wild Rye	27.00%
Schizachyrium scoparium 'Albany Pine'	Little Bluestem 'Albany Pine'	20.00%
Andropogon gerardii NY Eco	Big Bluestem NY Eco	14.00%
Elymus riparius	Riverbank Wild Rye	14.00%
Panicum virgatum	Switch Grass	5.00%
Dichanthelium clandestinum 'Tioga'	Deertongue grass 'Tioga'	5.00%
Carex vulpinoidea	Fox Sedge	2.00%
Agrostis perennans	Upland Bentgrass	1.50%
Carex vulpinoidea	Fox Sedge	0.50%
Poa palustris	Fowl Bluegrass	0.30%
Juncus tenuis	Path Rush	0.10%
Juncus effusus	Soft Rush	0.10%
		<hr/>
		92.00%
Herb/Forb		
Chamaecrista fasciculata	Partridge Pea	3.00%
Penstemon digitalis	Beard-tongue	1.00%
Vernonia noveboracensis	New York Ironweed	0.60%
Helenium autumnale	Common Sneezeweed	0.50%
Verbena hastata	Blue Vervain	0.40%
Aster puniceus	Aster - Swamp	0.40%
Aster cordifolius	Blue Wood Aster	0.30%
Asclepias incarnata	Swamp Milkweed	0.30%
Monarda fistulosa	Wild Bergamot	0.20%
Aster novae-angliae	New England Aster	0.20%

Solidago rigida	Rigid Goldenrod	0.20%
Desmodium canadense	Showy Tick Trefoil	0.20%
Eupatorium perfoliatum	Boneset	0.20%
Eupatorium maculatum	Joe-pye Weed	0.20%
Solidago juncea	Early Goldenrod	0.10%
Euthamia graminifolia	Grass-leaved Goldenrod	0.10%
Lobelia siphilitica	Great blue lobelia	0.10%
		<u>8.00%</u>
		100.00%

**Seeding Rate:**

Species ecotype shall be as native to New England region as possible. Apply this mix at 15 lbs PLS/acre.

**Fertilizers** shall not be used.

**Straw mulch or hydromulch** shall be per Section M6 of the Standard Specifications.

**Plants**

Plant material shall conform to the applicable requirements of Subsection 771, PLANTING TREES, SHRUBS AND GROUND COVER, of the Standard Specifications and as amended below.

Plant Certifications shall be submitted at the time of delivery and shall conform to the Standard Specifications. Plants shall be native species, not cultivars. To the extent possible, plants shall originate from the applicable EPA Level III Ecoregion. The nursery source shall certify the provenance or origin of all plants.

Plant species and sizes to be included in the riverfront area restoration shall be as specified on the plans and identified below. Location of the plants is to be selected in the field by the Wetland Specialist.

QUANT.	BOTANICAL NAME	COMMON NAME	SIZE
2	Cornus amomum	Silky dogwood	2-3' #3 gallon
2	Acer rubrum	Red maple	1.5-2" caliper
2	Quercus rubra	Red Oak	1.5-2" caliper

Requests for substitutions shall be submitted in writing to the Engineer for review, and, if required, the relevant regulatory agency at least thirty (30) days prior to planting. All proposed substitutes shall be in conformance with the requirements herein and suitable for the site conditions.

Transplanting and plant material collected from the wild is prohibited unless approved in writing by the Engineer. Plants shall be selected from certified nurseries.

Dead and failing plants shall be replaced per the requirements of Subsection 771 of the Standard Specifications.

## **Water**

The Contractor shall provide water and all equipment required at no extra cost. Water shall be suitable for irrigation and free from ingredients harmful to plants and wildlife. Water from the adjacent water bodies or waterways shall not be utilized. It is the Contractor's responsibility to correct injury or damage due to the lack of water, too much water, or use of contaminated water.

## **CONSTRUCTION METHODS & SEQUENCE**

### **Site Protection Prior to Impacts**

Prior to any land work, as part of the initial site-walk, the Wetland Specialist shall photo-document the site and provide a summary report of existing conditions as outlined under Item 755.75 Wetland Specialist.

Where and as required vegetation shall be cut flush and area surveyed to establish pre-construction elevations.

Following the cutting and surveying, separation fabric or timber matting shall be placed as required to protect soil and vegetation from compaction, contamination, and/or other damages. Fabric and timber mats shall be placed as specified under the respective items and the Engineer shall approval placement.

### **Restoration Upon Completion of Roadway Construction Work**

#### **Sediment Barriers**

If required for sediment control during Restoration work (i.e, tilling is required to restore soil), sediment barriers shall be installed along the downslope perimeter of the Restoration Area beginning and ending in the surrounding upland so that no disturbed soil can enter adjacent wetlands or waters. Sediment barriers shall be in place and approved by the Engineer prior to any soil disturbance. No work shall take place outside the barriers.

#### **Removal of Fill and Grading**

Fill and fabric or mats shall be removed and disposed of as specified under the respective items.

If required, grades shall be restored to pre-construction elevations as shown in the baseline survey or as required by the Engineer and Wetland Specialist to restore hydrologic functions. Final elevations shall be approved by the Engineer prior to soil preparation and seeding. Grading shall be incidental to this item.

Following approval of grading to elevations required, soil shall be prepared and seeded as follows.

### Soil Scarification

Compacted soil shall be scarified with equipment approved by the Engineer. Upon approval of soil scarification, the area shall be seeded with mulch as specified below. Seeding shall immediately follow soil preparation.

### Seeding with Mulch

Upon approval of prepared soil, area shall be seeded. Seeding may be hand broadcast with straw mulch applied or hydroseeded per the Standard Specifications and per the manufacturer's directions. Hydromulch shall be straw or wood fiber only and shall be per the manufacturer's recommendations.

Seed tags shall be submitted at time of seeding.

### Planting

Planting shall conform to SECTION 771 PLANTING TREES, SHRUBS AND GROUNDCOVER of the Division I Standard Specifications and as amended below.

Planting Season is May 15-June 15 and September 1-November 1 unless otherwise specified in applicable permit conditions.

Restoration Area shall be planted in the dry. Plants shall be placed according to the planting details and within the range of target elevations and at the spacing shown on the Plans or, if spacing is not indicated on the Plans, at the direction of the Wetland Specialist or the Engineer. Unless otherwise noted on the Plans, final plant locations shall be determined on site and located with regard to expected hydrology, plant growth characteristics, habitat desired, and water protection.

Plant material shall be installed as soon as possible after delivery. Plants stored on-site prior to installation shall be stored in the shade and watered twice daily up until time of installation. Plants showing signs of stress or compromised health may be rejected by the Engineer and shall be replaced at the Contractor's expense.

Plants shall be watered as necessary to maintain healthy establishment. Plants that fail by September 1 after spring planting or by June 1 after fall planting shall be replaced at the Contractor's expense.

Plant material shall be furnished and installed as indicated including all labor, materials, plants, equipment, incidentals, re-setting of plants (frost heaves, etc), irrigation, re-planting and clean up.

If previously approved species are not available at the time of planting, the Engineer will propose substitutions relative to species, size, and quantities. Substitutions shall then be approved by the regulating authority if necessary. Provisions shall be made for a growth warranty as described below or as required by permits.

## PLANT AND SEED ESTABLISHMENT

*Plants* shall be watered as necessary to maintain healthy establishment. Plants that fail by September 1 after spring planting or by May 15 after fall planting shall be replaced within the immediate or next planting period and at the Contractor's expense.

*Seeding* that fails to establish according to the conditions of acceptance below shall be over-seeded as required by the Engineer. Washouts and channels shall be repaired and stabilized prior to overseeding. Excessive weed growth shall be pulled out by the roots or, with approval from the Engineer, cut prior to over-seeding. Soil repair and weed control are incidental to this item.

## CONDITIONAL ACCEPTANCE OF WORK

Conditional Acceptance shall indicate approval of the wetland restoration work and agreement that work has been done according to plan or modified as approved.

Upon completion of construction, the Contractor shall submit a Request for Conditional Acceptance that includes a brief narrative from the Wetland Specialist (if applicable to project) demonstrating that the wetland restoration work was done according to plans (or how modified) and meets required permit conditions (if applicable). The narrative shall include, photo-documentation of pre-construction conditions as well as soil work, planting, and seeding. Seed tags shall be submitted as part of the Request for Conditional Acceptance.

Upon receipt of a Request for Conditional Acceptance, the Engineer, the Wetland Specialist, and regulatory representative (if required) shall assess the Restoration Area and the surrounding areas. At a minimum, the following conditions shall be included in the narrative and reviewed as part of the on-site assessment of whether:

- The target elevations have been restored per the survey or adjusted per the Engineer. Areas that are too high or too low should be identified along with suggested corrective measures.
- Soil compaction has been mitigated.
- Soils are stabilized and there is no sediment in the wetland and no channeling of slopes.
- Hydrology meets performance standards and has been adequately restored.
- Specified seed mix has been seeded and seeded species in the wetland and adjacent upland show signs of good germination and healthy growth.
- Planted woody and herbaceous species (if included) meet specifications and are establishing well.
- There are no invasive plants visible in the restored wetland area.
- Silt fence and non-biodegradable sediment barrier materials have been removed.

Upon approval that the work meets the above conditions, the Engineer will issue a letter of Conditional Acceptance. If the Wetland Restoration work is not approved, the Engineer will issue a rejection letter requiring corrective actions. Work not approved shall be addressed by the Contractor at no extra cost.

Erosion of adjacent slopes or the flow of sediments into the wetland between Conditional and Final Acceptance shall be immediately addressed by the Contractor.

#### FINAL ACCEPTANCE OF WORK

Following one full growing season, the Contractor shall submit a Request for Final Acceptance. Submittal shall include a brief narrative of conditions. Upon receiving the Request, the Engineer, Wetland Specialist and regulatory representative (if required) shall assess the Restoration Area. Final Acceptance will initiate the start of the Monitoring Period (if required).

The following conditions shall be inspected and approved for acceptance and payment:

- Hydrology is functioning as intended.
- The desired seeded species are establishing well and cover 100 percent of the restoration area, excluding areas of open water, large boulders or planned bare soil.
- No sediments have entered the wetland.
- Adjacent slopes are stabilized with desirable vegetation.
- Planted woody and herbaceous species (if included) meet specifications and are establishing well.
- There are no visible invasive plants.

If the restoration work is not approved, the Engineer will issue a rejection letter requiring corrective action. All costs associated with corrective measures and plant replacement shall be incidental to this item with no additional compensation. Work not approved shall be addressed by the Contractor at no extra cost.

#### MONITORING REPORTS FOR REGULATORY COMPLIANCE

Post wetland construction Monitoring Reports shall be completed and submitted by the Wetland Specialist as specified and compensated under Item 755.76 Wetland and Construction Monitoring Reports.

Generally, the following conditions shall be met upon each inspection:

- Hydrology is functioning as intended, relative to the preexisting condition of the restored wetland.
- Seeded species are establishing well and cover 100 percent of the area, excluding areas of open water areas or planned bare soil.
- No sediments have entered into wetland.
- Adjacent slopes are stabilized with desirable vegetation.
- All planted species (if included) are living and establishing well.

- There are no visible invasive plants.

If, at the end of the required monitoring period (3 years), the requirements have not been met and success of the wetland restoration area has not been achieved as determined by the Monitoring Reports, the Contractor shall provide corrective measures. All costs associated with corrective measures and plant replacement shall be incidental to this item with no additional compensation.

#### METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 755.45 will be paid for at the Contract unit price per Square Yard, which price shall include all labor, materials, compost and amendments, seed, plants, mulch, equipment, submittals, maintenance, grading, and incidental costs necessary to complete the work as required.

Payment shall be as follows:

- 50% upon completion of soil preparation and seeding
- 25% upon Conditional Acceptance
- 25% upon Final Acceptance or approval of the Engineer

Excavation of temporary fill will be paid under Item 120.1

Sediment Control Barrier will be paid under Item 767.121

Wetland Specialist will be paid under Item 755.75.

Wetland and Construction Monitoring Reports for follow-up monitoring will be paid under Item 755.76

Plants will be paid under the respective items.

**ITEM 755.74****PPESC Monitor****HOUR**

Work under this item shall be for services of a Pollution Prevention and Erosion and Sedimentation Control (PPESC) Monitor in accordance with Special Condition 32 of the Order of Conditions. Construction Period Pollution Prevention and Erosion and Sedimentation Control measures will be implemented from the commencement of work until the site is fully and permanently stabilized and the temporary erosion and sedimentation controls are removed, upon Haverhill Conservation Commission approval.

**QUALIFICATIONS AND SCOPE OF WORK**

This Monitor shall be a professional with experience in PPESC practices and shall inspect PPESC devices daily for proper function and maintenance, including the proper disposal of waste products, in accordance with Special Condition 41 of the Order of Conditions. This Monitor shall arrange for the maintenance, replacement, augmentation, emergency placement, and any other corrective action of PPESC devices on site. Areas of construction shall remain in a stable condition at the end of each day. The PPESC Monitor shall be responsible for the following:

- Participate in necessary meetings, including the pre-construction meeting, as required by permits and when requested by the Engineer.
- Inspect PPESC devices daily to ensure compliance with applicable Special Conditions of the Order of Conditions.
- Notify the Contractor and Engineer of any Site conditions requiring notification to the Haverhill Conservation Commission in compliance with applicable Special Conditions of the Order of Conditions.
- Provide any reviews and approvals of applicable Site conditions or construction activities in compliance with applicable Special Conditions of the Order of Conditions.

**BASIS OF PAYMENT**

Item 755.74 PPESC Monitor shall be paid at the Contractor bid price for each hour, or fraction thereof, spent on-site to perform the work as described above. Reports and photo documentation are required for payment.

No payment shall be made for additional site inspections required due to non-compliance with the Order of Conditions but shall be provided by the Contractor without additional compensation.

**ITEM 755.75**

**WETLAND SPECIALIST**

**HOOR**

Work under this Item shall be for services of a Wetland Scientist, Wetland Ecologist, Restoration Ecologist, or other professional with similar qualifications hereafter referred to as the “Wetland Specialist.”

“Wetland Mitigation” shall be used herein for applicable wetland and riverfront restoration work. For this project, applicable wetland work is for: Item 755.45 Wetland Restoration (restoration after temporary impacts).

The Wetland Specialist shall demonstrate knowledge and expertise to coordinate and oversee all work associated with the Wetland Mitigation as defined herein, as shown on the Plans, as required by permits, and as specified under the relevant Wetland Mitigation items. The Wetland Specialist shall also serve as the Environmental Monitor, in accordance with Special Condition 29 of the Order of Conditions.

Regulatory monitoring reports following Final Acceptance of the Wetland Mitigation shall be per Item 755.76, Wetland and Construction Monitoring Reports.

For all onsite work, the Wetland Specialist shall sign in and sign out with the Engineer.

The Wetland Specialist shall not be from the same company as the company responsible for planting, seeding, and/or maintaining the wetland.

**QUALIFICATIONS**

The Wetland Specialist shall have a minimum of five (5) years of experience with construction and monitoring of wetland mitigation areas similar in size, type, and complexity to the Contract mitigation. The Wetland Specialist shall be thoroughly versed in the Commonwealth of Massachusetts Wetlands Protection Act (MGL C.131, s.40), U.S. Army Corps of Engineers New England District Compensatory Mitigation Guidance, and all other relevant regulations of the Massachusetts Department of Environmental Protection and the U.S. Army Corps of Engineers New England District.

**SUBMITTALS - QUALIFICATIONS**

Within sixty (60) days following the Notice to Proceed, the Contractor shall provide proof of qualifications for the Wetland Specialist to the Engineer for approval. Submittals shall include, but not be limited to, the following:

- Resume of the individual on-site implementing the Wetland Specialist work. If the Wetland Specialist changes over the course of the project, the new individual shall submit resume and qualifications for approval 30 days prior to doing any work on-site.
- Resume of any personnel working on-site in place of the Wetland Specialist. Individual shall be approved prior to work on-site.
- Narrative describing the company, its expertise, technical qualifications and experience with wetland construction.

- A summary of two reference projects including nature of the work, project size, dates, and period of construction and monitoring, methodologies used, and summary of success (or not) in terms of meeting performance objectives.

#### SUBMITTALS – DOCUMENTATION AND REPORTS

##### Wetland and Riverfront Area Restoration Oversight

Wetland Specialist shall provide documentation of pre-existing conditions and wetland and riverfront area restoration as specified below and as part of fulfilling the Scope of Work described below. Documentation shall include photos that are clear and legible. Photos are incidental to this item.

- ***Site Walk Prior to Disturbance of Wetlands and Riverfront Area:*** Provide brief assessment with photos, including documentation of the existing wetlands to be impacted (temporary), proposed wetland and riverfront restoration areas, and reference/model wetland areas (typically an adjacent undisturbed wetland or the existing wetland to be impacted). Photos of existing wetlands that will be temporarily impacted shall include a view from at least 3 angles.
- ***Excavation and Grading:*** Documentation shall include minimum of two photos of the areas excavated adjacent to the wetland and two photos after final grading prior to planting and seeding. For restoration areas, photos shall show soil preparation (i.e, tilling and grading).
- ***Approval of Grading:*** The Wetland Specialist shall inspect the final grade of the wetland restoration area to ensure that proper hydrology is likely to be established and shall provide the Engineer with written confirmation and photographs upon completion of subgrade excavation work. Written confirmation shall include recommended field adjustments, based on field observations, to achieve the desired hydrology and designed wetland system.
- ***Planting and Seeding:*** Provide assessment and photos of vegetation upon completion of planting and seeding work.

Wetland and riverfront area restoration documentation and reports shall be submitted with Request for Conditional Acceptance and for the Order of Conditions and other regulatory permits as required.

##### Requests for Acceptance of Work & Regulatory Compliance

The Wetland Specialist shall submit the following documents if and as specified herein and under Item the relevant Wetland Mitigation items:

- Request for Conditional Acceptance.
- Request for Final Acceptance.

##### SCOPE OF WORK

In the event of discrepancies with the applicable permits, the Wetland Specialist shall submit a Request for Information (RFI) to the Engineer.

##### General

The Wetland Specialist shall be responsible for the following:

- Review and have a comprehensive knowledge of the environmental permits relevant to the specific mitigation work being done so as to ensure compliance throughout the duration of the contract.
- Identify and inform the Contractor and Engineer of unique site conditions which may require adjustments to the schedule, design, or construction methods. For example, wildlife nesting, illegal dumping, or rare species.
- Identify and inform the Contractor and Engineer of any sediment or erosion control problems observed within mitigation areas.
- Advise so as to avoid impacts to adjacent areas and regulated wetland resources.
- Monitor compliance with the Order of Conditions while on-site during other required inspections, and ensure proper implementation of the conditions of this OOC, including inspections and reporting requirements, and the work outlined in the referenced plans and documents.
- Monitor the presence of Invasive Species as detailed in Special Condition 34 of the Order of Conditions.
- All inspections and reporting as outlined in the Order of Conditions.
- Participate in necessary meetings, including the pre-construction meeting and post-restoration site walk, as required by permits and when requested by the Engineer.

#### Inspections & Construction Oversight

The Wetland Specialist shall be responsible for, but not limited to, the following:

- Pre-Construction Site Walk
  - Following surveying, flagging, and staking of all relevant boundaries and elevations by the Contractor, the Wetland Specialist shall walk the site with the Engineer and the Contractor to review existing and proposed conditions, recommend changes if necessary, and approve the following: location and boundaries of the Mitigation Area, target elevations and grades, location of tree protection associated with the Mitigation Area, and final layout and limits of clearing for access route.
  - Select and mark snags, logs, and woody material to be retained for incorporation into the Wetland Mitigation, as appropriate.
  - Note invasive plants in and adjacent to Wetland Mitigation.
  - Provide summary report if and as specified under Wetland Mitigation items.
- Pre-Construction Meeting
  - Attend a pre-construction meeting with the Engineer, Contractor, PPESC Monitor, and Haverhill Conservation Commission. If applicable, the pre-construction meeting and the pre-construction site walk could occur during the same day.
- Grading for Restoration Areas
  - Approve grading for appropriate wetland hydrology, subsoil preparation, and finished grade of placed wetland soil, as needed.
  - Adjust grades as required and approve microtopography. If grades need to be adjusted, submit an RFI to the Engineer.
- Soil Protection and Restoration Measures for Restoration Areas
  - Review and approve methods of soil protection and restoration if required.

- Confirm decompaction will adequately restore appropriate wetland hydrology. If decompaction measures need to be adjusted, submit an RFI to the Engineer.
- Re-vegetation of Mitigation Area
  - Locate woody material to be re-used.
  - Verify seed used complies with specifications and site conditions, determine limits for wetland seeding based on elevations, approve seeding and mulching methods, and collect seed tags to submit with Request for Conditional Acceptance.
  - Review planting methods (if applicable) prior to installation and oversee layout of wetland plants.
- Attendance at a Post-Restoration Site Walk in accordance with Special Condition 68 of the Order of Conditions.
- On the Monday of every week throughout the life of this project, provide the Haverhill Conservation Commission with a status report of the project, including representative photographs of deviations, needed repairs, and on-going work under Special Condition 29.a. of the Order of Conditions. Completion of this report will require coordination with the PPESC Monitor, including but not limited to the PPESC Monitor providing photos representative of PPESC devices and ongoing work. The frequency of this reporting may be altered as site conditions warrant, upon concurrence between the Haverhill Conservation Commission and the Wetland Specialist. This report shall indicate
  - Functions of the PPESC devices and any need for maintenance, replacement, augmentation, emergency placement, and any other corrective action of PPESC devices.
  - Activities completed the previous week; and the activities planned for the current week.
  - Deviations from the previous week's report and any environmental mitigation measures that have been undertaken.
  - The success of the Invasive Species Control Plan, if applicable.

### Conditional Acceptance

Upon completion of restoration of the wetland and riverfront area, as part of the Request for Conditional Acceptance, the Wetland Specialist shall provide a brief narrative demonstrating that the wetland construction work was done according to plans (or how modified) and meets the conditions required for acceptance as specified under the Wetland Mitigation items. Submittal shall include a report and photo documentation of pre-construction conditions, construction work, seeding, planting, and other work as specified under the Wetland Mitigation items. Photos of completed Wetland Restoration areas shall include the same views as the pre-construction reference photos.

Upon receipt of a Request for Conditional Acceptance, the Engineer, the Wetland Specialist and regulatory representative (if required) shall assess the Wetland Mitigation and surrounding area to ensure that it meets the conditions specified under the Wetland Mitigation items.

Upon approval, Engineer will issue a letter of Conditional Acceptance. If the Wetland Mitigation work is not approved, the Town or Engineer will issue a rejection letter requiring corrective action. The Wetland Specialist shall recommend corrective actions.

### Request for Final Acceptance

Following one full growing season, the Wetland Specialist shall provide a brief narrative of the status of the Wetland Mitigation to be submitted with the Request for Final Acceptance.

Upon receipt of the Request, the Engineer, the Wetland Specialist and regulatory representative (if required) shall assess the Wetland Mitigation and surrounding area to ensure that it meets the conditions specified under the relevant Wetland Mitigation items.

If the Wetland Mitigation is not approved, the Town or Engineer will issue a rejection letter requiring corrective action. The Wetland Specialist shall recommend corrective actions.

### METHOD OF MEASUREMENT

Item 755.75 Wetland Specialist shall be measured per hour for on-site service provided by the Wetland Specialist.

Work shall include all inspections, photos, submittals, and associated tasks for construction and restoration oversight, narratives for Conditional and Final Acceptance, Request for Certificate of Compliance (Partial or Full) if required, documentation required for permits, and all other work specified above. Payment shall not include travel time or time spent off-site on reports. Decimal Pay Limits will be 0.25 hours.

### BASIS OF PAYMENT

Item 755.75 Wetland Specialist shall be paid at the Contractor bid price for each hour, or fraction thereof, spent on-site to perform the work as described above. Reports and photo documentation are required for payment.

Construction monitoring reports and post wetland and riverfront area restoration reports shall be per Item 755.76, Wetland and Construction Monitoring Reports. No payment shall be made for additional site inspections required due to non-compliance with the Order of Conditions but shall be provided by the Contractor without additional compensation.

**WETLAND AND**

**ITEM 755.76**                      **CONSTRUCTION MONITORING REPORTS**                      **LUMP SUM**

Work under this item shall be for the submittal of Wetland and Construction Monitoring Reports during work within and following the completion of wetland and riverfront restoration and shall include all inspections, photos, and other work required to complete those reports as specified herein.

“Wetland Mitigation” shall be used herein for applicable wetland restoration work and riverfront restoration work.

The Contractor shall retain the services of a Wetland Scientist, Wetland Ecologist, Restoration Ecologist, or other professional with similar qualifications, hereafter referred to as the “Wetland Specialist,” to complete the Wetland and Construction Monitoring reports. Wetland Specialist shall meet requirements specified under Item 755.75 Wetland Specialist.

All on-site Wetland Specialist services required to complete construction monitoring within Wetland Mitigation areas, including preparation and submission of monitoring reports during construction, shall be per Item 755.75 Wetland Specialist.

**SCOPE OF WORK**

**Construction Monitoring Reports**

Inspections and reports shall be performed to ensure compliance with the Order of Conditions and to keep the Haverhill Conservation Commission apprised of the current status of construction as detailed in Special Condition 29 of the Order of Conditions.

**Photographic Log**

The Wetland Specialist shall keep a color photographic log of the Site with associated text descriptions as detailed in Special Condition 71 of the Order of Conditions. A current log shall be submitted with each Wetland and Construction Monitoring Report described below.

**Post-Construction Restoration Monitoring Reports**

Final Acceptance of the wetland restoration work as specified under Item 755.45 shall initiate the beginning of the Monitoring Period.

The Wetland Specialist, prior to and following each growing season for a minimum of three (3) years and until a Certificate of Compliance is issued, shall submit monitoring reports to the Engineer for review and submittal to Haverhill Conservation Commission.

Inspections and reports shall be performed to ensure compliance with mitigation requirements defined under the relevant Wetland Mitigation items and with all applicable environmental permits. Monitoring reports shall cover the following:

- Identification of all plant species present

- Percent cover for each plant species and overall percent surface area cover by indigenous wetland plant species for the restoration areas
- Description of the viability, health, and vigor of installed plants as well as volunteer plant species within the restoration areas
- Description of remedial measures taken to ensure criteria are met
- Depth to apparent water table and/or depth of surface inundation, both as measured from the soil surface and data loggers, as appropriate.
- A conclusion regarding the success of the wetland mitigation area relative to the performance standards at 310 CMR 10.55(4)(b) (unless varied), the design plans, and the reference wetland.
- Recommendation for a corrective plan of action if needed.
- Presence of invasive species.

Reports shall be submitted to the Engineer as a digital copy in Portable Document Format (PDF) unless otherwise requested. Hard copies shall be provided as requested by the Engineer. All reports shall be marked with the applicable permit numbers and identifying information as required in the permits. Reports shall include photo documentation of the wetlands being monitored and shall include a minimum of 3 views from different orientations. Views shall be labeled.

Within a week of completing construction of the project, at final stabilization, the Wetland Specialist shall submit a status report describing the status of the resource areas and their immediate surroundings as detailed in Special Condition 69 of the Order of Conditions

Spring Reports shall be submitted to the Engineer by May 17 for dispersal to the appropriate permitting agencies by May 31 as required for permits.

Fall Reports shall be submitted to the Engineer by September 16 for dispersal to the appropriate permitting agencies by September 30 as required for permits.

Monitoring Reports shall be as follows for 3 years:

- *Haverhill Conservation Commission: 2 Reports per year for 3 years (to reflect spring and fall monitoring events)*

#### BASIS OF PAYMENT AND METHOD OF MEASUREMENT

Item 755.76 Wetland Monitoring Reports and associated inspections shall be at the Contract unit price per Lump Sum and shall include all labor, materials, equipment, and all incidental costs required to complete the work. Lump Sum will be paid in equal installments of the Lump Sum divided by the number of reports submitted. Payment shall be upon submittal and acceptance of each report, based on the following schedule:

##### Construction Monitoring Reports

- Up to 78 Reports

No payment shall be made for additional reports required due to non-compliance with the Order of Conditions but shall be provided by the Contractor without additional compensation.

Post-Construction Wetland Monitoring Reports

- Year 1 = **2 Reports**
- Year 2 = **2 Reports**
- Year 3 = **2 Reports**
- Construction Completion Report = **1 Report**

The work under this item shall conform to the relevant provisions of Section 765 of the Standard Specifications and the following:

The work shall consist of planting and establishing 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.

All seeding shall be done by a company having a minimum of five years of experience with native grass establishment. Prior to beginning work, the applicator shall furnish proof of qualifications to the Engineer for approval. Proof of qualifications includes providing documentation to demonstrate knowledge and expertise with native seeding and proof of having completed successful native seeding projects.

### **SEEDING SEASON**

Seeding seasons shall be April 1 through May 15 and October 1 through November 15 for dormant seeding. For seeding that occurs outside of these periods, the seed rate shall be increased by 50%.

### **MATERIALS**

#### **Seed**

#### **Samples and Submittals**

- 1) Certificate of Materials. Prior to ordering, the Contractor shall submit to the Engineer the manufacturer or supplier’s notarized Certificate of Materials. This document shall not be used as proof of purchase, proof of material delivered, or proof of material seeded, but simply to verify supplier availability of seed listed on the date certified. The species listed shall match those specified on the plans or herein, however, cultivars may vary due to availability. Substantial substitutions or changes in the mix from that specified on the plans or herein shall be approved by the Engineer.
- 2) Seed Tag Certification. All seed lots have a seed analysis tag as required by State and Federal law. The contractor shall submit seed tags for each bag of seed used on the project site or ensure that each tag is photo documented by the Engineer. Number of tags shall match number of bags sent by the supplier to meet rate of Pure Live Seed specified on the plans. Tag must include: kind and variety of seed; lot number; origin of seed; net weight; % purity; germination; dormant seed; germination test date; inert matter; weed, noxious and other crop seed; and name and address of company responsible for the analysis. Seeding may be considered unacceptable for payment if no tags are submitted.

- 3) Certificate of Compliance. Prior to payment, contractor shall submit a signed, dated and notarized Certificate of Compliance from the Supplier that serves as proof of purchase or bill of lading. This document shall include kind and variety of seed, lot number, net weight shipped, date of sale, invoice number under which seed was purchased, and name and address of Supplier or Manufacturer. All information must be included on the notarized form, including lot number and net weight shipped for specified job. This information shall match Seed Tag Certification and quantity of seed applied on the job. Seeding may be considered unacceptable for payment if information is incomplete.
  
- 4) Seed Sample. Contractor may be asked, prior to seeding, to submit a seed sample for testing. Testing shall be incidental to this item.

Quantities specified are Pure Live Seed (PLS). Greater quantities of ordered seed may be required to achieve actual specified seeding rates. Pure Live Seed is defined as the fraction of pure seed species within the mix that, by standard seed testing practices, will germinate. This is determined by multiplying the percent of seed purity by the percent of seed germination.

Seed mix shall be a custom blend as consistent with Item 765.442. Seed cultivars shall be those that are as regional to New England or the local ecotype as possible.

<u>Botanical Name</u>	<u>Common Name</u>	<u>% PLS By Weight</u>
Grass		
Elymus virginicus	Virginia Wild Rye	27.00%
Schizachyrium scoparium 'Albany Pine'	Little Bluestem 'Albany Pine'	20.00%
Andropogon gerardii NY Eco	Big Bluestem NY Eco	14.00%
Elymus riparius	Riverbank Wild Rye	14.00%
Panicum virgatum	Switch Grass	5.00%
Dichanthelium clandestinum 'Tioga'	Deertongue grass 'Tioga'	5.00%
Carex vulpinoidea	Fox Sedge	2.00%
Agrostis perennans	Upland Bentgrass	1.50%
Carex vulpinoidea	Fox Sedge	0.50%
Poa palustris	Fowl Bluegrass	0.30%
Juncus tenuis	Path Rush	0.10%
Juncus effusus	Soft Rush	0.10%
		<hr/> 92.00%

Herb/Forb

Chamaecrista fasciculata	Partridge Pea	3.00%
Penstemon digitalis	Beard-tongue	1.00%
Vernonia noveboracensis	New York Ironweed	0.60%
Helenium autumnale	Common Sneezeweed	0.50%
Verbena hastata	Blue Vervain	0.40%
Aster puniceus	Aster - Swamp	0.40%
Aster cordifolius	Blue Wood Aster	0.30%
Asclepias incarnata	Swamp Milkweed	0.30%
Monarda fistulosa	Wild Bergamot	0.20%
Aster novae-angliae	New England Aster	0.20%
Solidago rigida	Rigid Goldenrod	0.20%
Desmodium canadense	Showy Tick Trefoil	0.20%
Eupatorium perfoliatum	Boneset	0.20%
Eupatorium maculatum	Joe-pye Weed	0.20%
Solidago juncea	Early Goldenrod	0.10%
Euthamia graminifolia	Grass-leaved Goldenrod	0.10%
Lobelia siphilitica	Great blue lobelia	0.10%
		<hr/> 8.00%
		100.00%

Seeding Rate:

Apply this mix at 20 lbs PLS/acre on areas of less than 3:1 slope and 25 lbs PLS on areas of greater than 3:1 slope.

Add 30 lbs/acre of a cover crop. For a cover crop use either grain oats (1 Jan to 31 July) or grain rye (1 Aug to 31 Dec). Cover crop shall be incidental to seeding item.

Any species substitutions shall be with a species having similar characteristics and native to New England. Substantial changes in the mix shall be approved by the Engineer.

**Fertilizer**

No fertilizers shall be applied.

**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.

**Mulch**

Seed areas shall be separately mulched with hydromulch, straw or as specified below when incorporated with compost topsoil.

### **Photo Documentation**

Contractor shall submit photo documentation to the Engineer. Each photo shall be date stamped. Photos shall be submitted after the following stages of construction:

- Soil preparation
- Seed and hydromulch/Compost topsoil and seed
- Germination
- Grass establishment after one full growing season (June-September)

## **CONSTRUCTION**

### **Surface Preparation**

Soil preparation and seeding shall occur only when the bed is in a friable condition, not muddy or hard. Bare soils shall be raked to remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. All ruts and any depressions caused by settlement, erosion or rolling shall be filled with additional loam or compost and the soil shall be re-graded to a smooth and even finish corresponding to the required grades. No tracking or rolling shall be done on wet soil.

Prior to seeding, site preparation shall be approved by the Engineer.

### **Seeding Methods**

#### **Seeding on Loam**

Seeding application shall be by broadcast methods followed by hydromulching. Seed may be broadcast by using a cyclone or whirlwind seeder, or by hand.

If spread by hand, small or light-seeded species such as bluestem may be mixed with approved filler (e.g., sawdust, rice, kitty litter, or clean damp sand) to achieve an even distribution. 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. Seed shall be incorporated 1/8 to 1/4-inch deep by raking or dragging, culti-packing, or tracking with heavy machinery. Raked areas shall be rolled with a weighted roller to provide good seed to soil contact. Do not roll or track the seed if the soil is wet.

Immediately following completion of broadcast seeding and packing, area shall be hydromulched. Hydromulch shall be per the Standard Specifications and per the manufacturer's directions. Mulch for hydroseeding shall be wood fiber only.

## **Seeding in Combination with Compost Topsoil**

If proposed in the contract, compost topsoil shall be as specified under Item 751.7 Compost Topsoil.

Seeding shall be done as a second operation after placement of compost has been approved by the Engineer. Seeding shall be broadcast followed by hydro-mulching.

Contractor shall notify Engineer prior to seeding operation to obtain written approval of site preparation and compost topsoil application.

## **Irrigation**

After seeding and mulching, water seeded areas to moisten soil to a depth of at least 2 inches.

No seeding shall be done if soils are muddy or dry and compacted.

## **Care during Seed Germination**

Contractor shall care for seeded areas as required. Care shall include irrigation and weed removal as necessary for germination and healthy growth.

## **Over-seeding**

If there are numerous areas of bare ground greater than 10-12 inches, these areas shall be over-seeded. Areas where seed fails to germinate and that become invaded by weeds shall be mowed as low as possible and over-seeded. Soil that is compacted shall be raked or roughened prior to seeding to ensure seed to soil contact.

Over-seeding application rates and methods shall be the same as those listed above. After seeding, areas shall be mulched with straw mulch or ¼ - ½ inch compost topsoil and watered with a fine mist to moisten soil to a depth of at least 2 inches.

Over-seeding shall be incidental and shall not be paid for separately.

## **Care during Grass Establishment**

Following germination of seeded species, the contractor shall maintain the stand of grasses to ensure healthy growth.

Work shall include mowing or weed-whacking for weed control, irrigation if necessary, and monitoring for invasive plants. Watering shall provide uniform coverage without eroding soil or grassed surfaces. Treatment of invasive plants shall be per the requirements of the Engineer.

The Contractor shall provide all labor, equipment, materials, and water required for establishment. Contractor shall water all seeded areas as necessary to a depth of 2 inches or greater.

## EXPECTATIONS OF ESTABLISHMENT

Native upland grasses and forbs will not look like turf grass. Many of the native grasses are bunch type grasses and will not form a uniform growth or have a sod-type appearance. However, seeded area shall show general uniform growth of the seeded species throughout the area. Areas with gaps of bare soil greater than 10-12 inches will be considered unacceptable and shall be over-seeded.

A well-established stand of grasses at the end of one full growing season (June-September), as determined by the Engineer, will be required for acceptance. At least 80-90 percent of the grass established shall be the seeded species and any invasive or aggressive weeds (mugwort, ragweed, or knapweed) shall have been cut or otherwise managed.

## METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 765.442 will be measured for payment by the square yard at the end of one full growing season upon approval of establishment by the Engineer.

Item 765.442 will be paid for at the Contract unit price per Square Yard upon receipt of required submittals as specified above and upon approval of established stand of grass as specified above. This price shall include surface preparation prior to seeding as specified under Surface Preparation, and as required by the Engineer, seeding, reseeding, irrigation, care during germination and establishment, labor materials, equipment, photo documentation, and all incidental costs required to complete the work.

The work under this item shall conform to the relevant provisions of Sections 751 and 767 of the Standard Specifications and Section 670 of the Standard Supplemental 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 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;

- Straw tubes/wattles which shall be trenched
- Straw bales which shall be trenched

Additional barriers (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.

Where specified or required by permits, silt fence shall be used in addition to compost filter tubes or straw bales and shall be incidental to the item.

### **MATERIALS AND CONSTRUCTION**

Prior to initial placement of barriers, the Contractor and the Engineer shall review locations specified on the plans to ensure that the placement will provide maximum effectiveness.

Barriers shall be staked, trenched and/or wedged as specified herein and shall be securely in contact with existing soil such that there is no flow beneath the barrier.

#### **Compost Filter Tube**

Compost material inside the filter tube shall meet M1.06.0, except for the following: no 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 a knitted mesh with 1/8 - 3/8" openings and made of 100% biodegradable materials (i.e., cotton, hemp or jute).

Compost filter tubes shall be a minimum of 12 inches in diameter installed. Tubes shall be placed, filled, and staked in place as required to ensure stability against water flows. All tubes shall be tamped, but not trenched, to ensure good contact with soil.

Where reinforcement is necessary, additional tubes shall be installed as shown on the plans.

#### Straw Bales

Straw bales shall conform to the requirements of Section M6.04.3 of the Standard Specifications and the following:

Bales should be a minimum size of 12 x 16 x 36 inches and shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.

The bales shall be trenched and backfilled. The trench shall be excavated the width of the bale and the length of the proposed barrier to a depth of 4 inches. After the bales are staked the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier.

#### Straw Wattle

Straw wattle shall be a minimum of 12 inches in diameter. Straw filling shall conform to the requirements of Section M6.04.3, shall be encased in durable netting, and shall have a density of 3 lb/foot.

Straw wattle shall be trenched in 3 inches deep and staked according to the plans. The wattles shall be sufficiently secure on the upstream side to prevent water flowing underneath the wattle.

#### Silt Fence

Materials and Installation shall be per Section 670.40 of the Standard Supplemental Specifications and the following:

Silt fence shall be used when specified by Orders of Condition or other permitting.

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 driven 16 inches into the ground 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.

#### Stakes

Stakes for anchoring Compost Filter Tubes, Straw Wattles, and Straw Bales shall be as shown on the plans and shall be a minimum of 1x1 inch diameter x 4 feet hardwood stakes.

When used with Silt Fence, stakes for Compost Filter Tubes shall be driven 12 inches into the ground, Stakes for Straw Bales shall be driven 16 inches into the ground.

Stakes of other material of equivalent strength may be used if approved by the Engineer.

### MAINTENANCE

Maintenance of Sediment Control Barriers shall be per Section 670.40 of the Standard Supplemental Specifications or per the Stormwater Pollution Prevention Plan (SWPPP).

The contractor shall inspect the sediment barrier after each rain event and as specified in relevant permits to ensure that they are working effectively and as intended. Contractor shall be responsible for ensuring that an effective barrier is in place for all phases of the contract.

Barriers that decompose naturally due to weatherization over time 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 water and sediment control, barrier does not necessarily require replacement.

### DISMANTLING & REMOVING

Barriers shall be dismantled and/or removed when construction work is complete and when site conditions are sufficiently stable to prevent surface erosion and after receiving permission to do so from the Engineer.

For all instances, all non-biodegradable material, including photo-biodegradable fabric, plastic netting, nylon twine, and silt fence, shall be removed and disposed off-site by the Contractor regardless of site context.

For naturalized areas, biodegradable, natural fabric and material may be left in place to decompose on-site. Compost filter tubes may be left as they are with stakes removed. Straw bales shall be broken down and spread evenly. All nylon or non-biodegradable twine shall be removed along with silt fence. Wooden stakes may be left on site, placed neatly and discretely.

In urban, residential, and other locations where aesthetics is a concern, the following shall apply:

- Filter tube fabric shall be cut and removed, and compost shall be raked to blend evenly (similar to a soil amendment or mulch). Not 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 grasses (i.e., lawn or native grass mix).
- Silt fence, stakes, and other debris shall be removed and disposed off-site. Site shall look neat and clean upon completion.

### 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.

Silt fence, when used in conjunction with compost filter tubes or straw bales, will be incidental to this item.

Additional barrier, such as double or triple stacking of compost filter tubes, shall 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.

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

Jute Mesh will be measured by the number of Square Yards complete in place, including anchoring, as 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.

#### BASIS OF PAYMENT

Item 767.9 will be 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, reseeded of trenched and disturbed areas, and all incidental costs required to complete the work.

<b><u>ITEM 801.32</u></b>	<b><u>3 INCH ELECTRICAL CONDUIT – TYPE NM (DOUBLE)</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 801.42</u></b>	<b><u>4 INCH ELECTRICAL CONDUIT – TYPE NM (DOUBLE)</u></b>	<b><u>FOOT</u></b>
	<b><u>3 TO 4 INCH ELECTRICAL</u></b>	
<b><u>ITEM 801.461</u></b>	<b><u>CONDUIT TYPE NM (6 BANK)</u></b>	
	<b><u>3 INCH ELECTRICAL</u></b>	<b><u>FOOT</u></b>
<b><u>ITEM 804.3</u></b>	<b><u>CONDUIT TYPE NM – PLASTIC (UL)</u></b>	<b><u>FOOT</u></b>
	<b><u>3 INCH ELECTRICAL CONDUIT TYPE NM</u></b>	
<b><u>ITEM 810.3</u></b>	<b><u>-PLASTIC- (UL) CONCRETE ENCASED</u></b>	<b><u>FOOT</u></b>
	<b><u>4 INCH ELECTRICAL CONDUIT TYPE NM-</u></b>	
<b><u>ITEM 810.42</u></b>	<b><u>-PLASTIC- (UL) (DOUBLE) CONCRETE ENCASED</u></b>	<b><u>FOOT</u></b>

Work under these Items shall conform to the relevant provisions of Subsection 801 of the Standard Specifications and the following:

Conduit, whether shown on the plans or additional lengths placed as directed by the Engineer, may be increased or decreased by the Engineer depending upon actual conditions encountered, as provided for in Section 4.06 of the Standard Specifications.

All conduit material shall be Schedule 80 Polyvinyl Chloride (PVC) and must meet or exceed the requirements of NEMA specifications TC-2, TC-8 and ASTM F512 (NEMA TC-6), all latest revisions.

Conduit fittings shall be joined by means of solvent cement meeting the requirements of ASTM D 2564.

The Contractor shall make efforts to install parallel conduits in the same trench. However, in the case of multiple conduits/utilities in a trench, a 12” clear width shall be provided between communication conduit and electric conduit. All road crossings shall be perpendicular to the centerlines of the road.

Conduits shall be mounted on interlocking spacers (3000 SI). Spacers shall not exceed eight foot intervals and shall be placed at each coupling. Where noted or specified, electrical conduit shall be encased in concrete, as detailed on the plans. Conduit joints shall be staggered to provide at least 12” longitudinal separation between joints between any two adjacent conduits. Conduit must be located at least 30” below final grade to the top of the duct bank/encasement.

Tracer tapes, as shown on the plan details (Caution Electric Line Buried Below), shall be installed in the trench 12 inches minimum above and directly over the conduit. No additional payment will be made for furnishing and installing tracer tape. A polyester pulling tape, 2500 lb test w/footage shall be installed in each conduit and all ends shall be plugged until ready to pull cable.

National Grid, Verizon and Comcast personnel must inspect respective duct lines before they are encased in concrete (minimum of 3000 psi) in roadway. No direct traffic load is allowed on road crossings for 12 hours after backfilling.

When there is an interval of 4 or more hours between placing of adjacent concrete and the duct bank, #4 reinforcement bars shall be installed across the construction joint. All conduits must be placed in a dry trench. Dewatering may be necessary to install conduit and conduit encasement. No additional payment will be made for dewatering, but shall be incidental to the unit price of these Items.

A minimum separation between communications and electrical conduit shall be 12". Minimum vertical separation between water, gas and sewer lines shall be 12" of concrete encasement, whenever the electrical conduits intersect with these utilities at right angles. A minimum separation of 24" shall be maintained between parallel placement of these utilities and electrical conduits.

The minimum depth for electrical and lighting conduit shall be maintained not less than 30 inches from top of the concrete encasement to grade during all phases of the construction. All other conduits depth shall be minimum 24 inches or as shown in details. The depth of conduit may need to be deeper than the typical excavation depth to avoid conflicts with these existing utilities. The work under these Items shall include these field adjustments.

All conduits shall be rodded with a mandrell no less than a quarter inch smaller than the inside diameter of the conduit.

The work shall consist of furnishing and installing a number of risers on a utility pole to connect underground conduit system also riser at the buildings as shown on the plans. At the riser, the conduit shall terminate in bend not less than 12 inches above finished grade and having a radius of not less than 36 inches. Sweeps for Communication, Telephone and Cable shall be Schedule 80 PVC.

#### Conduit On Temporary Utility Bridge

Item 801.461 shall be 6 conduits (2 – 4 inch Electric, 1 – 3 inch Verizon, 1 – 3 inch Comcast, 1 – 3 inch Fire Alarm, and 1 – 4" empty conduit) in a 6 bank over the Temporary Utility Bridge.

The electrical conduits shall have a minimum of 12" separation with other conduits.

#### METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Payment under these Items will be at the respective Contract Unit Price bid per Foot for furnishing and installing utility approved conduit of the appropriate size and type, which price shall be full compensation for all necessary or incidental work including saw-cutting, excavation including increased depths to pass under other utilities and/or enter structures, pull wires, tracer tape, sand bedding, amping, spacers, riser at poles, conduit caps, dewatering, forming and providing concrete encasement in case of those items so identified, gravel borrow backfill and compaction complete in place. Backfill material shall correspond construction details based upon the final conduit location under proposed condition. Required conduit sweeps at buildings, and at riser poles shall be considered incidental to these Items.

When installing more than two conduits in the same trench, additional conduit shall be paid as a single or double as per the configuration of total conduits.

Galvanized Sweeps riser at Pole shall be paid for under Electric Service Riser items, where required. PVC conduit for other utilities risers shall be paid under respective conduit items.

Temporary payment for surface restoration to match existing surface, where required and authorized in advance by the Engineer shall be paid under Item 472, Temporary Asphalt Paving.

Permanent HMA patch in mill and overlay area to match the existing surface, where required shall be paid under Item 451.

**ITEM 811.95**  
**ITEM 811.96**

**VERIZON HANDHOLE 24X36X24**  
**ELECTRIC HANDHOLE 17X30X17**

**EACH**  
**EACH**

The work under these Items shall conform to the relevant provisions of Section 801 of the Standard Specifications and the following:

The work shall consist of furnishing and installing handholes for the use of involved utility companies. In all cases, handholes must meet the requirements of the respective utility company. Additional requirements are provided by the utility companies are located in Appendix C.

The cover and the handhole shall be capable of carrying vehicle load in accordance with NESC, Section 32, Article 323.A1 and the latest Massachusetts DPU Safety code. The minimum loading shall be capable of 20,000 lb.

The handhole sizes and uses shall be used as follows:

24" x 36" X 24"	Verizon
17" x 30" X 17"	National Grid

17" x30"x17" Handholes shall apply to National Grid facilities, and be as shown referenced pages in the Appendix. They shall meet the requirements of National Grid, Bulletin No. 759B and as manufactured by Highline. Covers for Type E handholes shall be heavy duty and have the word "ELECTRIC" cast into the cover. The handhole color shall be grey.

24"x36"x24" Handholes shall apply to Verizon, shall be of precast concrete box with heavy duty metal (gray iron) frame and cover and have the word "VERIZON" cast into the cover.

All covers shall be furnished with: skid resistant surface; provisions for lifting during removal; four 1/2" pentahead self-centering stainless steel bolts complete with washers and "floating" nut assembly, and an interlock mechanism. Bolt heads shall be recessed in metal cup embedded in cover assembly. Covers shall fit to box such that no objects can be pushed into the box from the outside.

**BASIS OF PAYMENT**

Work under these Items shall be at the Contract Unit Price bid per Each per type, which price shall include the furnishing and installing of handhole complete with covers. The quantity of handholes may be increased or decreased by the Engineer depending upon actual conditions encountered, as provided for in the Standard Specifications. No separate payment shall be made for excavation, sawcutting, bedding, gravel borrow backfill and compaction, ground rods (for National Grid) or other incidental materials to complete the installation.

The Contractor shall bore predrill knockouts as required for proper conduit size at each location.

**ITEM 813.812**

**ELECTRIC SERVICE RISER – STA 12+44 RT**

**EACH**

**ITEM 813.813**

**ELECTRIC SERVICE RISER – STA 13+80 RT**

**EACH**

The work shall conform to the relevant provisions of Section 813 and the following:

The work under this Item shall consist of moving and relocating the existing underground utility services from existing poles to new poles.

This item is only for electrical risers at utility poles.

New utility poles will be installed “By Others”. The underground conduit shall be extended by the Contractor to where the new utility poles are installed. New conduit risers and wiring shall be installed and connected to the newly relocated utility poles and power lines. The utility company will connect the risers to the power lines and not the contractor.

Sweeps for the National Grid primary shall be galvanized steel.

Mechanical protection with rigid metal conduit shall be provided for the cable at least 10’ – 2” above finished grade and a grounding connector installed at the top of the conduit by the Contractor. Spare conduits shall be capped at the top of the bend at ground level. The riser location shall be on a quarter of the pole away from traffic flow, and on the side of the pole away from telephone cable. The involved Utility Companies shall pre-approve riser locations.

The 90 degree rigid steel bends and caps for the spare conduits shall be included as part of the active conduit riser. No separate payment shall be made for excavation, 90 degree rigid steel bends and caps for conduits or other incidental materials, and all costs in connection therewith.

PVC conduit for other utilities risers shall be paid under respective conduit items.

The work shall include all excavation and backfill, compaction, concrete encasement and materials or any other requirements set by the respective utility company, local codes and guidelines.

The work associated with disconnecting power and reconnecting power services to the buildings should be performed overnight between midnight and 5:00 AM or 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 will be agreed upon between the Engineer, Power Company and the property owner/tenant during construction.

**BASIS OF PAYMENT**

Payment for Electrical Service Riser will be at the respective Contract Unit Price bid Each regardless of number of risers per pole and shall be full compensation for the furnishing of all labor, materials, tools and equipment associated with the work complete in place.

The work associated with the removal of utility poles, transfer of wiring to the new utility poles, and supplying and installing the new utility poles, new wiring and new riser shall be the responsibility of the respective utility companies and shall not be paid for under this Item.

**ITEM 825.01**

**SERVICE CONNECTION FOR PUMP STATION**

**EACH**

The work under these Items shall include all labor, materials, and equipment necessary to convert overhead services connections for Electric power for Town Sewer pump station. **Replacement of overhead service for Verizon will be done by them.** The work shall be in accordance with the applicable provisions of the Standard Specifications, and the following.

The work of this Item is to perform and complete the changeover of overhead service connections for properties at the addresses listed. The Contractor installed utility company approved conduits and handholes from utility poles located to the pump station located on Rosemont Street. The work includes furnishing and installing all materials, equipment and labor necessary to make service connections from previously installed handholes to the involved property, as detailed herein.

Once the service rework has been completed on the property side of the handholes, the Contractor shall arrange for the utility companies to schedule and install wiring and complete the change over of service.

#165 (Item 825.02)	Electric, & Telephone	Connect to existing overhead service UP# 298/20 to new underground secondary service from NGRID UP # 21/298
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A general outline of the work follows:

The Contractor shall furnish/install conduits, wiring, splice boxes and devices associated with the modification of the existing overhead electrical service connection for an underground installation, as indicated on the drawings and herein specified.

The Contractor shall furnish/install hot dipped galvanized steel channels and hardware as necessary for mounting of all equipment. In addition, all outside mounted electrical equipment and hardware shall be hot dipped galvanized. All electrical outdoor enclosures and wiring shall meet the NEMA 3R construction and installation requirements.

The Contractor shall be required to obtain permits from the City’s Building Department for the property and pay all fees for this permit. He shall be required to arrange for inspections, as required by the Building Department, complete the work in accordance with the local requirements and meet with the approval of the City Electrical Inspector.

All work shall conform to the requirements of National Grid, and Verizon, and the National Electrical Code. Other references are as follows:

- UL: Underwriters Laboratories, Inc., 33 Pfingsten Road, Northbrook, IL
- NEMA: National Electrical Manufacturers Association, 2101 L Street, Northwest, Washington, DC
- FM: Factory Mutual Engineering Corporation, Factory Mutual System, 1151 Boston/Providence Turnpike, Norwood, MA

## PRODUCTS

### Acceptable Manufacturers of Miscellaneous Equipment:

1. General Electric Company
2. Cutler/Hammer Company
3. Square D Company
4. Or approved acceptable equivalent.

### Acceptable Manufacturers of Steel Channel:

1. Unistrut Corp., Wayne, MI
2. Power-Strut Division, Van Huffel Tube Corp., Warren, OH
3. T.J. Cope, Div. of Cyprus Mines Corp., Collegetown, PA
4. Or approved acceptable equivalent.

Electrical Wireway: Galvanized steel, hinged, NEMA 3R electrical service wireway. as indicated on the electrical drawings. The wireway shall be sized as required by the NEC based on the conduits size and configuration (i.e. Straight pull, Angle pull, U Pull, etc.). The wireway shall have interior insulated connectors for the electrical splices.

Insulated Multi-cable Conductor: Electrical connector blocks shall be molded with high-dielectric insulation which is abrasion/chemical resistant, UV and cold temperature rated. Connector blocks shall be supplied with removable access plugs over the hex screws and mounting holes at each end of the connector for a direct mounting inside the wireway. Acceptable manufacturers are:

1. Polaris Electrical Connectors.
2. Raychem / TE Connectivity

Conduit and Wiring: The Contractor's work includes coordination with the "Existing" service handholes and service entrance equipment at the property. All conduit and wire must meet or exceed all applicable NEC, NEMA, UL, ASTM and ANSI applicable technical standards C. Conduit and wire shall be as follows:

1. Rigid steel conduit: hot dipped galvanized with threaded couplings (ANSI Std C80.1) and schedule 40 PVC raceways.
2. Flexible metal conduit: hot dipped galvanized flexible inner jacket and watertight synthetic outer jacket (UL Std 360) including flexible PVC raceways.
3. Power wire: copper conductors with type "THHN/THWN" insulation (600 Volts rated).

## EXECUTION

Contractor shall install conduit and wiring and make all necessary electrical connections between all external equipment and devices, meters, disconnects, splitter boxes, etc., are indicated. Conduit and wire shall be installed as follows:

1. All outside exposed wiring at the buildings and utility poles shall be rigid galvanized raceways. Use PVC-80 concealed duct bank raceways between the utility handholes and the buildings (completed under current contract).
2. All interior exposed wiring in the buildings shall be galvanized electric metallic tubing if necessary.
3. All wires shall be color coded by voltage and use.
4. All wires shall be installed without any intermediate splices.
5. All wiring shall be installed in strict accordance with the manufacturer's recommendations.

All power wiring shall be field 1000 volt megger tested by Contractor. Also, the driven ground rods shall be field tested in order to verify low grounding impedance. All field testing shall be submitted with a certification letter and field testing forms by the Contractor to the Engineer.

The Contractor shall provide all required technical field assistance during the start-up and field acceptance testing including verifying the operation of the telephone and other services.

The work associated with disconnecting power and reconnecting power services to the sewer pump station shall be coordinated with the water and sewer department. The disconnect and reconnect may be required to be performed overnight between midnight and 5:00 AM or at a time convenient to the city. The actual time of day or night for the disconnecting and reconnecting will be agreed upon in advance between the Contractor, City, Power Company, and the Engineer during construction without any additional compensation.

#### COMPENSATION

Payment under this Item shall be at the Contract Lump Sums bid for the pump station property, which sums shall constitute full compensation for furnishing and installing all labor, materials and equipment to convert the identified overhead service connections to underground, as detailed in the plans and as specified herein. In general, the work shall extend from the new handholes to the location of the overhead connection at the buildings or at utility pole. The work shall include the removal of unneeded overhead lines and related appurtenances mounted on building wall once the utility companies have completed the service changeover. Damage caused by the Contractor to the building will be corrected by the Contractor at his expense. The utility companies will remove the abandoned aerial lines from the properties to the pole.

Utility company customary fees for the changeover will be borne by the City, including the removal of aerial lines from the properties to the poles under the utility force account. However, payment under these Items shall include the Contractor's notification of and coordination with the Utility Companies and the barring of premium charges to minimize service impacts to the properties by the changeovers. The Contractor shall be responsible for obtaining NGRID Electrical workorder, local permits and approval of the work and shall bare the cost of local permit fees. The Contractor shall be responsible for NGRID work requests fee for disconnect/reconnect the services.

Payment for electrical service risers, and handhole shall be paid under separate items.

**ITEM 853.22****STEEL BARRIER REMOVED AND DISCARDED****FEET**

The work under this Item shall conform the relevant provisions of the Standard Specifications and the following:

Work under this item consists of removing the existing steel barriers from the project site. Steel barriers shall be removed with all fittings, anchors, and appurtenances. The steel barriers shall be returned to the city DPW department or if rejected by the city shall become the property of the Contractor or disposed of. Coordination shall be made with the DPW if barriers are to be stacked and picked up by the DPW or delivered to a facility.

**METHOD OF MEASUREMENT & BASIS OF PAYMENT**

Steel Barrier Removed and Discarded shall be paid at the contract unit price per foot of Steel Barrier Removed and Discarded, incidental of all fittings, and appurtenances.

**ITEM 859.1**

**REFLECTORIZED DRUMS WITH  
SEQUENTIAL FLASHING WARNING LIGHTS**

**EACH**

The work under this Item shall conform the relevant provisions of Subsection 850 of the Standard Specifications and the following:

Work under this item consists of furnishing, installing, maintaining in proper operating conditions, and removing reflectorized drums, and any necessary ballast, equipped with sequential flashing warning lights.

**MATERIALS**

Reflectorized drums shall be listed on the MassDOT Qualified Traffic Control Equipment List. Reflective sheeting on drums shall meet or exceed ASTM D4956 Type VIII. All drums shall be maintained in a satisfactory manner including the removal of oils, dirt, and debris that may cause reduced retroreflectivity.

The Contractor shall use one of the following sequential flashing warning light systems unless otherwise approved by the Engineer:

1. Empco-Lite LWCSO.
2. pi-Lit® Sequential Barricade-Style Lamp; or
3. Unipart Dorman SynchroGUIDE.

Sequential flashing warning lights shall be secured to reflectorized drums per the light manufacturer's specifications.

**CONSTRUCTION METHODS**

The first ten (10) drums in any merging or shifting taper as designated in the Temporary Traffic Control Plan shall be equipped with sequential flashing warning lights. These lights shall be operating, at a minimum, between dusk and dawn when the taper is deployed.

The successive flashing of the sequential warning lights shall occur from the upstream end of the merging or shifting taper to the downstream end of the taper in order to identify the desired vehicle path. Each warning light in the sequence shall be flashed at a rate of not less than 55, nor more than 75 times per minute.

Warning lights shall be powered off when drums are not deployed in a taper.

**METHOD OF MEASUREMENT**

A group of ten (10) reflectorized drums with sequential flashing warning lights is considered one (1) unit and will be measured by the day. Each period of up to 24 hours during which this unit is in use will be measured as one day regardless of the number of times that the drums are positioned, repositioned, removed, or returned to service.

## BASIS OF PAYMENT

Reflectorized Drums with Sequential Flashing Warning Lights will be paid for at the contract unit price per day, which shall include full compensation for furnishing, positioning, repositioning, and removing the group of ten (10) drums as directed by the Engineer.

**ITEM 866.104**

**4-INCH REFLECTORIZED  
WHITE LINE (THERMOPLASTIC)**

**FOOT**

**ITEM 867.104**

**4-INCH REFLECTORIZED  
YELLOW LINE (THERMOPLASTIC)**

**FOOT**

The work to be done under these Items shall consist of the placement of reflectORIZED thermoplastic lines, in accordance with the relevant provisions of Section 860 and M7.01.

White and yellow markings shall be provided as shown on the plans.

Payment for four inch lines shall be made at the Contract Unit Price bid per Foot.

**ITEM 874.51 MISCELLANEOUS SIGNS REMOVED AND DISCARDED LUMP SUM**

Work under this Item includes the dismantling, removal, transportation and discarding of the existing roadside signs shown on the Plans and removal and disposal of the sign supports and their foundations.

The existing signs shall not be removed until the new signs and structures replacing them are ready for traffic or until the Engineer shall permit.

The work described above will constitute one lump sum unit.

Payment for work to be done under this Item will be by the LUMP SUM price, which price will be full compensation for dismantling, loading, transporting, and discarding of the signs as designated above, the excavating and disposal of the existing foundation and supports of the same, and the supplying and placing of compacted gravel backfill where foundations and posts are removed and restoration of surface.

**ITEM 945.10**  
**ITEM 948.60**  
**ITEM 948.61**

**DRILLED MICROPILES**  
**MICROPILE VERIFICATION LOAD TEST**  
**MICROPILE PROOF LOAD TEST**

**FOOT**  
**EACH**  
**EACH**

**GENERAL**

This item shall conform to the requirements of all relevant Sections of the Standard Specifications and Supplemental Specifications.

This work shall consist of constructing micropiles as shown on the plans, approved working drawings, and as specified herein. The Contractor is responsible for furnishing all materials, equipment, labor, services, and supervision; and for selecting means and methods for the installation and testing of micropiles for this project. The Contractor shall submit for approval the selection of, installation and testing methods of the micropiles prepared and stamped by a professional engineer registered in the Commonwealth of Massachusetts.

Micropiles shall consist of permanent casing sections and fully reinforced grout sections bonded with bedrock. Permanent casings shall be included as part of the micropiles and shall remain in place after grouting is complete. Temporary casings shall be installed if necessary to facilitate micropile construction and shall be removed during or after grouting. The Contractor is responsible for drilling through obstructions encountered during pile installation.

The micropiles load capacities shall be confirmed by verification and proof load testing. Testing must meet the test acceptance criteria specified herein. The bond length of the micropile may be modified by the Engineer, pending results of load testing performed as an initial part of the work.

**MATERIALS**

The materials for micropiles shall meet the following requirements:

Permanent/Drill Steel Casing used as Reinforcement: Permanent steel casing/pipe used as reinforcement shall be new "Prime" steel meeting the requirements of any API 5L PSL1 pipe with a yield strength of 52 ksi with SR15 supplemental requirements. The grade of the prime steel casing shall conform to the properties shown on the Plans. For steel pipe that is to be welded, the Carbon Equivalency, as defined in AWS D1.1 Section XI.1, shall be less than or equal to 0.45, as demonstrated by mill certificates. The sulfur content shall not exceed 0.05%, as demonstrated by mill certificates.

Permanent steel casing shall consist of ERW (Electric Resistance Welded) and/or seamless steel casing and shall be designed to withstand the design loadings determined by the Engineer or shown on the Plans and the verification/proof test loading described in this specification. Joints shall develop the full vertical capacity, and at least 60% of the moment capacity of the casing. As installed, there shall be no joints within three feet or as shown on the plans from the bottom of the pile cap.

The steel casing shall have certified mill test reports and shall be submitted for record purposes as the materials are delivered. The steel shall be traceable back to the mill certifications, and be free from defects (dents, cracks, tears, etc.).

New “mill secondary” steel pipe/casing will not be accepted regardless if they are accompanied by coupon test results.

Permanent steel casing shall be installed a minimum of 12 inches into intact bedrock.

Reinforcing Bars: Central reinforcing steel shall be full-length, continuously threaded bars. The bars shall conform to AASHTO M 31 Grade 60 or Grade 75, or AASHTO M 275 Grade 150 as shown on the Contract Documents. The grade and size of the central reinforcement shall conform to any minimum and/or maximum properties shown on the Plans.

Reinforcing Bar Couplings: Reinforcing bar couplers shall be in accordance with Subsection M8.01.9 but are not required to be listed on the Qualified Construction Materials List (QCML). Where reinforcing bars are not specified with corrosion protection, bar couplers shall not be required to be epoxy coated or galvanized.

Independent testing shall be performed by a nationally recognized testing laboratory, approved by the Engineer, which shall provide certified test results showing that the reinforcing bar coupler meets the requirements of Subsection M8.01.9. Acceptance of the couplers shall be approved by the Engineer.

Centralizers and Spacers: Centralizers and spacers shall be fabricated from schedule 40 PVC pipe or tube, or material non-detrimental to the reinforcing steel. Wood shall not be used.

They shall be securely attached to the reinforcement; sized to position the reinforcement to provide the grout cover specified in the table below; sized to allow grout tremie pipe insertion to the bottom of the drill hole; and sized to allow grout to freely flow up the drill hole and casing.

Table 1 - Minimum Grout Cover for Steel Reinforcement

Condition	Minimum Cover on Bar (in.)	Minimum Cover on Coupler (in.)
Micropiles in Soil	1	¼
Micropiles in Rock	½	¼
Coated or Encapsulated Bars	½	¼

Admixtures for Grout: Admixtures shall conform to the requirements of AASHTO M 194 and shall be selected from the QCML where applicable. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations or micropile top connections. Accelerators are not permitted. Admixtures containing intentionally added chlorides are not permitted. Admixtures shall be from the same Manufacturer and shall be compatible with the grout and mixed in accordance with the Manufacturer’s recommendations.

Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to review and acceptance by the Engineer.

Cement: All cement shall conform to AASHTO M 85 Type I, Type II, Type III, or Type V and shall be the product of one Manufacturer.

Grout: Neat cement mixture with a minimum 3-day compressive strength of 50 percent of the 28-day unconfined compressive strength. The grout shall be proportioned and mixed as to provide a fluid grout capable of maintaining the solids in suspension without appreciable bleed. Preparation and placement of grout shall be in accordance with the recommendations of “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete,” ACI 304.

A minimum of 60 calendar days prior to the start of micropile construction the grout mix design shall be submitted to the Engineer and a trial batch shall be performed. The trial batch shall take place at a location approved by the Engineer and be performed in the presence of Department personnel. It shall be representative of the production grout placement and shall consist of the same materials, equipment, methods of mixing, and sample preparation and curing methods.

Trial batch samples will be tested to verify that the material meets all grout criteria specified in Table 2. The quantity of material batched shall be sufficient to perform all required tests specified.

Table 2 – Grout Material Acceptance Criteria for Trial Batch Testing

Quality Characteristic	Test Method	Engineering Limit
Minimum Compressive Strength:	AASHTO T 106	
3 days	Or	≥ 2,500 psi
7 days	AASHTO T	For information only
28 days	22	≥ 5,000 psi
Consistency	API RP-13B-1	± 10% of the density specified in the mix design

Plates and Shapes: Structural steel plates and shapes for pile top attachments shall conform to M8.05.0, AASHTO M 270, and have minimum yield strength of 50 ksi.

Water: Water for mixing grout shall be potable, clean, and free from substances that may be injurious to cement and steel.

Fillers: Inert fillers such as sand (conforming to AASHTO M 45) may be used in the grout in special situations, such as presence of large voids in the ground or when grout take and travel are to be limited, with prior written approval by the Engineer.

## **CONSTRUCTION METHODS**

### **QUALIFICATIONS**

The Micropile Contractor must be experienced in the construction and load testing of micropiles and have successfully constructed at least 5 projects in the last 5 years involving construction

totaling at least 100 micropiles with similar capacity and requirements specified in these plans and specifications. The Micropile Contractor shall have previous micropile drilling and grouting experience in soil/rock similar to project conditions and shall have available and be thoroughly familiar with the specialized type of equipment needed to perform work of this type.

The on-site foremen and drill rig operators shall also have experience on at least 3 projects over the past 5 years installing micropiles of equal or greater capacity than required in these plans and specifications.

Prior to the Pre-construction Meeting, the Micropile Contractor shall submit the following information to verify the firm's experience and the qualifications of personnel scheduled to perform the micropile design (load test frame) and construction:

1. Submit a list of at least five micropile projects successfully completed in the last five years. Include construction details, structural details, load test reports, and client contact for each project listed.
2. Submit a list of the equipment and resources the Micropile Contractor plans to mobilize and utilize for the performance of the project.
3. Provide the names and detail the experience of the micropile designer, on-site supervisor, foremen, and drill rig operators for this project.
4. A signed statement that the Micropile Contractor has inspected both the project site and all the subsurface information including any soil or rock samples made available in the Contract Documents.

Work on any micropiles shall not be started, nor materials ordered until the qualifications and submittals have been accepted by the Engineer. The Engineer may suspend the micropile construction if the Micropile Contractor substitutes unapproved personnel during construction. Requests for substitution of field personnel shall be submitted to the Engineer for acceptance. Additional costs resulting from the suspension of work will be the Micropile Contractor's responsibility, and no extension in contract completion date resulting from the suspension of work will be allowed.

The Micropile Contractor shall have, on site during all micropile construction activity, a minimum of one Quality Control (QC) inspector. This person shall be responsible for quality control of the micropiles during all phases of construction and will monitor and document all QC inspection and testing activities required by the specifications and outlined in the accepted procedures and Working Drawings. The QC person shall be a certified NETTCP Concrete Technician.

## **MICROPILE PRE-CONSTRUCTION SUBMITTALS**

The Contractor shall prepare and submit to the Engineer: shop drawings, a micropile installation plan, construction procedures, load testing procedures, and equipment calibrations for review and acceptance. The Contractor shall verify the limits of the micropile structure before preparing the detailed working drawings and allow the Engineer four (4) weeks to review the submittal after a complete set has been received. Work shall not begin, nor materials ordered until all submittals have been received, reviewed, and accepted in writing by the Engineer.

The micropile submittals shall include:

A. Plans

1. A plan view of the micropile layout identifying the locations of micropiles, numbering system for records, and verification test and proof test micropile locations.
2. An elevation view of the test micropile(s) showing:
  - i. A typical detail of test micropiles defining the micropile length, reinforcement, inclination, and load test bonded and unbonded test lengths.
  - ii. Permanent casing length and diameter, casing plunge length, and grout bond zone length.
  - iii. Estimated soil/bedrock strata.
  - iv. Instrumentation to be installed.
  - v. Minimum drill hole diameter.
  - vi. Splice type and locations.
  - vii. Centralizers and spacers.
  - viii. Corrosion protection details.
  - ix. Grout design strength.
3. Details for constructing micropile structures around utilities, as applicable.

B. Construction Procedures

1. Detailed step-by-step description of the proposed micropile construction procedure, including personnel, testing, and equipment to assure quality control. This step-by-step procedure shall be shown in sufficient detail to allow the Engineer to monitor the construction and quality of the micropiles. Include methods of drilling the holes, advancing the casing, drilling through or removing obstructions, flushing drilled holes, installing reinforcement, and grout pressures.
2. If welding of casing is proposed, submit the welding procedure. All welding shall be done in accordance with the current AWS Structural Welding Code.
3. Information on space requirements for installation equipment that verify the proposed equipment can perform at the site.
4. Plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed.
5. Certified mill test reports for the central reinforcing steel. The ultimate strength, yield strength, elongation, and material properties composition shall be included.
6. Certified mill test reports for the permanent casing. Certification that the permanent casing meets the supplemental requirements of SR15 shall be included.

7. Quality Control Plan. The QC Plan should sufficiently document the QC processes of all Contractor parties (i.e. Prime Contractor and Subcontractors) performing work required under this specification. The QC Plan shall be structured to follow the format and section headings outlined in the MassDOT Model QC Plan. It shall be submitted to the Engineer for review and approval a minimum of 30 days prior to the start of work.

The QC Plan shall include complete descriptions, and details for the following:

- i. Micropile installation including drilling method and grouting procedure.
- ii. Grout mix design and type of materials to be used in the grout including certified test data and trial batch reports. The Micropile Contractor shall also provide specific gravity and density of the wet mix design.
- iii. Methods and equipment for accurately monitoring and recording the grout depth and grout volume as the grout is being placed.
- iv. Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance, and start of production work. During production, grout shall be tested in accordance with the Grout Testing Requirement specified herein.
- v. Procedure and equipment for Micropile Contractor monitoring of grout quality. At a minimum, the Micropile Contractor shall verify the specific gravity of the mixed grout prior to placement of the grout into each drilled micropile.

#### C. Load Testing Procedures

Detailed plans and procedures for the proposed micropile load testing method. This shall include all drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and pile top movements in accordance with the Micropile Load Testing section of this specification.

#### D. Equipment Calibration

Calibration reports and data for each test jack, pressure gauge, master pressure gauge, and electronic load cell to be used. The calibration tests shall have been performed by a certified testing laboratory, and tests shall have been performed within 90 calendar days of the date submitted. Testing shall not commence until the Engineer has reviewed and accepted the jack, pressure gauge, master pressure gauge, and electronic load cell calibration data.

### **PRE-CONSTRUCTION MEETING**

A mandatory pre-construction meeting will be scheduled by the Engineer and held prior to the start of micropile construction. The Design Consultant, Resident Engineer, Prime Contractor, and Micropile Contractor, including QC personnel, shall attend the meeting. The preconstruction meeting will be conducted to clarify the construction and QC requirements for the work, to coordinate the construction schedule and activities, specifically those pertaining to excavation for micropile structures, installation of temporary sheeting, anticipated subsurface conditions, micropile installation and testing, micropile structure survey control, and site drainage control.

## **SITE DRAINAGE CONTROL**

The Contractor shall control and properly dispose of drill flush and construction related waste, including excess grout, in accordance with related specifications within the Contract Documents, and all applicable local codes and regulations. Provide positive control and discharge of all surface water that will affect construction of the micropile installation. Maintain all pipes or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost. Upon substantial completion of the work, remove surface water control pipes or conduits from the site.

## **EXCAVATION**

Coordinate the work and the excavation so the micropile structures are safely constructed and remain stable at all times. Perform the micropile construction and related excavation in accordance with the plans and accepted submittals. No excavation deeper than those specified herein or shown on the plans will be made above or below the micropile structure locations without written acceptance of the Engineer.

## **MICROPILE INSTALLATION**

### **A. General**

The Micropile Contractor shall select the drilling method, the grouting procedure, and the grout pressure used for installation of the micropiles. The construction method shall incorporate any special construction requirements specified on the plans. The production micropiles and its construction method shall be identical to the accepted verification test piles.

When the plans require uncased drilling of the micropile into bedrock, the permanent and/or temporary casing shall be drilled a minimum 12 inches into intact bedrock or to a depth within the bedrock so as to prevent subsidence of over burden into the uncased and/or bond zone portion of the drill hole (i.e. the rock socket).

Piles shall be installed only in the presence of the Engineer's or MassDOT's Representative.

### **B. Location and Survey**

Micropiles shall be located and marked using survey and a template by the Contractor who shall maintain and be responsible for all location and elevation stakes.

### **C. Drilling**

The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to overlying or adjacent structures, buried structures, or utilities.

Temporary casing or other accepted method of pile drill hole support is required, when drilling within 10 feet of an existing foundation, or utility, and/or in caving or unstable ground, to permit

the pile shaft to be formed to the minimum design drill hole diameter. The casing shall be of the type and thickness that can be installed without distortion. Casings that fail, fracture, or otherwise distort during drilling or after drilling shall, unless otherwise directed, be withdrawn or replaced at the Contractor's expense. The drill hole must be open along its full length to at least the design minimum drill hole diameter prior to placing grout and reinforcement. The Contractor's proposed method(s) to provide drill hole support and to prevent detrimental ground movements shall be reviewed by the Engineer. Detrimental ground movement is defined as movement which requires remedial repair measures, in order to maintain site conditions as determined by the Engineer. Do not progress a new hole, pressure-grout, or post-grout, within a radius of 5 pile diameters or 5 feet, whichever is greater, of a micropile until the grout for that micropile has set 24 hours or longer. Do not allow vibration or excessive wheel loads to influence piles during installation and construction.

Use of drilling fluid containing bentonite or any other non-reverting drilling fluid is not permitted. Use of polymer slurry to remove cuttings from the cased hole shall be approved by the Engineer.

Piles shall be installed using equipment capable of penetrating boulders, cobbles, bedrock, dense till material, granite blocks, timber, concrete, or other man-placed materials that hinder the advance of the pile.

Use of drop-type impact hammers and blasting are not permitted. Prior to the use of down the hole air drilling methods the Contractor shall provide temporary fencing or barriers as necessary to prevent cuttings from leaving the work area and entering the adjacent traffic lanes.

Micropiles shall not be installed using auger cast methods.

Permanent casing must be installed in a manner which will not loosen the adjacent soils and will result in intimate contact between the casing and the soil. Driving of casing will not be allowed. Drilling shall be performed such that cuttings and/or wash fluid return through the inside of the casing. External flush will not be allowed. The method of drilling used shall prevent the loss of ground due to erosion, jetting, or blow-in at the bottom of the casing. No open-hole drilling will be allowed unless accepted by the Engineer.

#### D. Ground Heave or Subsidence

During construction, the Contractor shall observe the ground conditions in the vicinity of the micropile construction site on a daily basis for signs of ground heave or subsidence. Immediately notify the Engineer if signs of movements are observed. The Contractor shall immediately suspend or modify drilling or grouting operations if ground heave or subsidence is observed, if the micropile structure is adversely affected, or if adjacent structures are damaged from the drilling or grouting. If the Engineer determines that the movements require corrective action, the Contractor shall take corrective actions necessary to stop the movement or perform repairs. When due to the Contractor's methods or operations or failure to follow the specified/accepted construction sequence, as determined by the Engineer, the costs of providing corrective actions will be borne by the Contractor.

#### E. Pipe Casing and Reinforcing Bars Placement and Splicing

Reinforcement shall be placed prior to grouting the drill hole. Reinforcement surface shall be free of deleterious substances such as soil, mud, grease, or oil that might contaminate the grout or coat the reinforcement and impair bond. Reinforcement in the bond zone [i.e. rock socket] shall extend the minimum required length.

The Contractor shall install all micropiles to the planned elevations.

Centralizers and spacers shall be provided at a maximum spacing of 10 feet on center. The upper- and lower-most centralizers shall be located a maximum of 5 feet from the top and bottom of the micropile, respectively. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bar(s) and permanent casing. The reinforcing steel shall be inserted into the drill hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. The Contractor shall re-drill and reinsert reinforcing steel when necessary to facilitate insertion.

Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity or angle between the axes of the two lengths to be spliced. Splices and threaded joints shall meet the requirements of the Material section. Threaded pipe casing joints shall be located at least two casing outside diameters (O.D.) from a splice in any reinforcing bar. When multiple bars are used, bar splices shall be staggered at least 1 foot.

#### F. Grouting

Micropiles shall be grouted the same day the load transfer bond length is drilled, or the bond length shall be flushed prior to grouting procedures commence. The grouting equipment shall produce a grout free of lumps and undispersed cement. Admixtures, if used, shall be mixed in accordance with Manufacturer's recommendations. The Contractor shall have means and methods of measuring the grout quantity and pumping pressures during the grouting operations. The grout pump shall be a positive displacement pump equipped with a pressure gauge to monitor grout pressure. A second pressure gauge shall be placed at the point of injection into the pile top. The pressure gauge shall be capable of measuring pressures of at least 145 psi or twice the actual grout pressure used, whichever is greater. The grout shall be kept in agitation prior to pumping. Grout shall be placed within one hour of mixing. The grouting equipment shall be sized to enable each pile to be grouted in one continuous operation. The grout volume being pumped shall be measured to an accuracy of 10 percent.

The hole shall be flushed with clean water immediately prior to grouting, to remove all contaminated water and cuttings. The hole shall be flushed through the grout pipe fully extended to the bottom of the hole with the temporary casing (if any) in place. The water shall be pumped at a high velocity until the wash water at the top of the casing is clear. After flushing, the depth of the hole shall be measured to confirm that the hole is clean and no sediment exists at the bottom of the drilled rock-socket/bond length. Installation of the steel reinforcing and grouting shall be done immediately after flushing. In case of delay, the hole shall be re-flushed and rechecked prior to grouting as directed by the Engineer.

The grout shall be injected from the lowest point of the drill hole, and injection shall continue until uncontaminated grout flows from the top of the pile. Temporary casing, if used, shall be extracted in stages ensuring that, after each length of casing is removed, the grout level is brought back up to the proposed level before the next length is removed. The use of compressed air to directly pressurize the fluid grout takes is not permissible. The tremie pipe or casing shall always extend below the level of the existing grout in the drill hole during grouting procedures. The grout takes shall be controlled to prevent excessive heave or fracturing of rock or soil formations. The entire micropile shall be grouted to the design cut-off level. Upon completion of grouting, the grout tube may remain in the hole, but must be filled with grout.

If the Contractor elects to use a post-grouting system, Working Drawings and relevant details including grouting pressure, volume, location and mix design, shall be submitted to the Engineer for review.

#### G. Construction Tolerance

Unless otherwise stated on the Plans, the following shall be the maximum construction tolerances for micropiles:

1. Centerline of piling shall not be more than 3 inches from indicated plan location.
2. Pile shall be plumb within 2 percent of total-length design plan alignment.
3. Battered piles inclined up to 1:6 shall be within 4 percent of design plan alignment.
4. Battered piles inclined greater than 1:6 shall be within 7 percent of design plan alignment.
5. Top elevation of pile shall be plus 1 inch or minus 2 inch maximum from vertical design elevation indicated.
6. Centerline of reinforcing steel shall not be more than 3/4 inches from indicated center of pile.
7. Minimum volume of grout placed shall be the 110% of the theoretical volume of the whole micropile length from bottom to top at time of grouting.

#### H. Micropile Installation Records

The Contractor shall prepare and submit to the Engineer full-length installation records for each micropile installed. The records shall be submitted within one work shift after that pile installation is completed. The data shall be recorded on a micropile installation log. A separate log shall be provided for each micropile. The log for each micropile shall contain the following minimum information:

1. Project name, structure name, micropile number, and contract number.
2. Date and time of drilling, grouting, and completion.
3. Bottom elevation of the proposed footing and final top elevation of the micropile, to the nearest 0.1 feet.
4. Plumbness and deviation from design location and batter.
5. Micropile as-built information such as pile inclination, casing diameter and wall thickness, reinforcement size and length, casing length below bottom of footing, taped measurement inside casing to check cleanout, plunge length (cased bond length), bond length below casing, total pile length below and above bottom of footing, All dimensions shall be provided to the nearest 0.1 feet.
6. Drilling method, drill bit type and size, and drill operator's name.

7. Table showing the descriptions and approximate top and bottom elevation of each soil or rock layer encountered during pile drilling.
8. Grout mix, density, and quantity used, for initial grout and post-grout (if any) including cement type and admixtures.
9. Maximum and average grout pressure used during installation.
10. Damage (if any) to pile, description of any deviations from the design location and batter or from the approved pile design and installation procedures, and description of any unusual occurrences during drilling (including obstructions), installation, and grouting.

The example micropile installation log in the “Micropile Design and Construction Guidelines Manual,” Report No. FHWA-NHI-05-039 or FHWA-SA-97-070 can be used as a reference in developing the micropile installation log.

The Contractor shall also submit within 2 weeks after installation of all piles, an as-built plan, certified by a surveyor, showing the as-installed location of all piles to the nearest ½ inch.

## **CONSTRUCTION QUALITY ASSURANCE**

### **Contractor Quality Control**

The Contractor’s QC personnel will perform Quality Control inspection, sampling, and testing to ensure that the processes are providing work conforming to the contract requirements. Inspection, sampling, and testing shall be documented on appropriate forms and provided to the Engineer. The Engineer will not sample or test for Quality Control or assist in controlling the Contractor’s operations.

#### **A. Testing**

1. Grout consistency: As measured by grout density shall be determined by the Contractor per API RP-13B-1 at a frequency of at least one test per pile, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout. The measured grout density shall be within  $\pm 10\%$  of the density specified in the grout mix design submittal.
2. Compressive Strength: Grout within the micropiles shall be tested by the Contractor’s Quality Control Inspector to ensure that it attains the minimum required compressive strength.

Micropile grout shall be sampled and cured in accordance with AASHTO R 64 (for 2 inch by 2 inch cubes) or T 23 (for 3 inch by 6 inch cylinders) and tested for compressive strength in accordance with AASHTO T 106 (for cubes) or T 22 (for cylinders). Grout samples shall be taken directly from the grout plant (on-site mixer and pump).

The QC Technician will take the following sets of grout samples for QC testing:

- i. Verification Test Piles – three (3) sets of three (3) cubes or cylinders for 3-, 7-, and 28-day strength testing.
- ii. Proof Test Piles – three (3) sets of three (3) cubes or cylinders for 3-, 7-, and 28-day strength testing.
- iii. Production Piles – one (1) set of three (3) cubes or cylinders for 28-day strength testing for every two (2) micropiles or one set from each grout plant on each day of operation; whichever occurs more frequently.

The Contractor shall provide grout cube compressive strength, grout density, can grout volume results to the Engineer within 24 hours of testing.

**Table 3 – Grout Material Acceptance Criteria**

Quality Characteristic	Test Method	Engineering Limit
Minimum Compressive Strength:	AASHTO T 106	
3 days	or	≥ 2,500 psi
7 days	AASHTO T	For information only
28 days	22	≥ 5,000 psi
Consistency	API RP-13B-1	± 10% of the density specified in the mix design
Volume		≥ Theoretical volume of hole

**Engineer/City Acceptance**

The Engineer is responsible for performing all Acceptance activities and making the final Acceptance determination. The Engineer’s Acceptance system will include monitoring the Contractor’s QC activity, performing Acceptance inspection, and utilizing available sampling and testing data.

**A. Inspection**

The Engineer will perform Acceptance inspection of all work items to ensure that all materials and completed work are in conformance with the contract requirements.

**B. Testing**

The Engineer/City will determine whether it will test 2-inch cubes or 3-inch by 6-inch cylinders for its Acceptance testing. The Contractor will be required to provide to The Engineer/City a sufficient amount of approved 2-inch cube molds or 3-inch cylinders. If it is determined that The Engineer/City will test 3-inch cylinders then a correlation between the 2-inch cube results and the 3-inch cylinders shall be determined by The Engineer/City.

The Engineer/City will take the following sets of grout samples for Acceptance testing:

- i. Verification Test Piles – 3 sets of cubes or cylinders for 3-, 7-, and 28-day strength testing.

- ii. Proof Test Piles – three (3) sets of three (3) cubes or cylinders for 3-, 7-, and 28-day strength testing.
- iii. Production Piles – one (1) set of three (3) cubes or cylinders for 28-day strength testing for every two (2) micropiles or one set from each grout plant on each day of operation; whichever occurs more frequently.

Pile verification or proof load testing shall not be performed until the Engineer has confirmed the grout has reached the minimum 3-day design strength specified in Table 4.

Table 4 – Grout Material Acceptance Criteria

Quality Characteristic	Test Method	Engineering Limit
Minimum Compressive Strength:	AASHTO T 106	
3 days	or	≥ 2,500 psi
7 days	AASHTO T	For information only
28 days	22	≥ 5,000 psi

## **MICROPILE LOAD TESTING**

### **A. General**

The Contractor shall perform pre-production verification pile load testing on one sacrificial pile per bond zone bearing stratum. The number and location of the verification test(s) shall be as specified on the Plans. In general, the location of the verification test(s) shall be within 10 feet of the footprint of a substructure unit, but at least 5 feet from any production pile as selected by the Contractor and accepted by the Engineer.

Pile proof load testing shall be performed on actual production micropiles and shall be performed on one pile per substructure unit or five percent of the total number of piles, whichever is greater, in conformance with the approved working drawings and testing procedures. The production proof test pile(s) shall be at a location selected by the Contractor and accepted by the Engineer.

The load tests shall conform to the requirements of ASTM D1143 (vertical compression load testing) or ASTM D3689 (vertical tension load testing) except as modified herein. The maximum test loads shall be 150% of the Factored Design Load (FDL) for the micropile verification test and 100% of the FDL for Micropile Proof Test. The Factored Design Load is defined as the Factored Axial Design Load (compression and/or tension) as shown on the Plans. The maximum test loads shall be as specified above but not more than 80% of the structural capacity of the micropile elements, to include steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. The structural elements of the verification test micropile may be modified for testing the FDL of the micropile as accepted by the Engineer. The Alignment Load (AL) should not be more than 0.04 FDL.

Before starting the work, the Contractor shall submit to the Engineer for acceptance, a pile load test plan including a written description of the equipment and methods which are intended to be used. The methods must be of an accepted type and shall be altered as necessary to meet the

acceptance of the Engineer. The pile load test plan and description shall be prepared and stamped by a professional engineer registered in the Commonwealth of Massachusetts.

Grout within the micropile verification test pile shall attain the minimum required 3-day compressive strength prior to load testing. The top elevation of the test pile shall be determined immediately before the load testing. The head of each micropile shall be cut-off level or capped to produce a level horizontal bearing surface.

The Contractor shall provide all personnel and equipment needed to perform the test, measure loads and movements, and record test data. A representative of the Department or the Engineer may observe and witness the test and record data independently. No testing is to be performed unless all the agreed representatives are present.

Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The Contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves in accordance with the submittals Section.

Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Provide a reaction frame capable of safely supporting 125 percent of the maximum test load. Align the jack, bearing plates and stressing anchorage such that unloading and repositioning of the equipment will not be required during the test.

Apply and measure the test load with a hydraulic jack and pressure gauge. The pressure gauge shall be graduated in 100 psi increments or less. The jack pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required.

Calibrate the test load jacking system including the hydraulic jack couplings, gas pump, pressure gauge, and hydraulic load cell prior to the test so that the load applied is controlled to within 3 percent of the total applied load. Submit calibration reports prior to the start of the pile load test. Monitor the creep test load hold during verification tests with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the verification test.

Readings of settlement and rebound shall be referred to a fixed benchmark and shall be made using at least three dial gauges (micrometer dial extensometers) graduated to 0.001 inches and located 120 degree intervals around the micropile. The gauges shall be mounted on a reference beam supported at each end by reliable supports located at least 10 feet from the center of the test pile and independent from the jack, pile, or reaction frame.

The dial gauges shall have a travel sufficient to allow the test to be done without having to reset the gauges. Visually align the gauges to be parallel with the axis of the micropile. Readings shall be taken at intervals specified in the Verification Test and Proof Test section.

The Contractor shall establish a survey reference point on the test pile and another reference point at the center of the reference beam. The reference points shall consist of graduated scales machine-divided into 0.02 inch and attached securely to the pile and reference beam. The reference points shall be monitored using survey equipment during the pile load test.

Protect the settlement measuring system against rain, wind, frost, and any other disturbances that could affect the reliability of the settlement observations. Provide sun shading for the measuring system for the duration of the test and for a minimum of 1 hour prior to the start of the test.

#### B. Micropile Verification Test

The Contractor shall perform pre-production verification pile load testing on sacrificial piles at a location selected by the Contractor and accepted by the Engineer. The location of the verification tests shall be within 10 feet of footprint of a substructure unit but at least 5 feet away from any production pile. Testing shall be performed in compression or tension in accordance with ASTM D1143 or ASTM D3689, respectively, except as modified herein.

Verification load tests shall be performed to verify that the Contractor installed micropiles will meet the required FDL and load test acceptance criteria and to verify that the length of the micropile bond zone is adequate. The drilling-and-grouting method and casing outside diameter shall be identical to those specified for the production piles as indicated on the Plans.

Verification test piles shall be installed at the location accepted by the Engineer. The steel core may need to have a higher strength or a larger diameter than for the production piles to accommodate the test load.

Verification test piles shall include at least two, ¾-inch diameter PVC Schedule 40 pipes cast into the test pile to allow telltales to be installed for load testing. The pipes shall be securely fastened in straight alignment to prevent displacement during grouting. The pipes shall be sealed at the bottom with threaded steel caps and at the top with threaded PVC plugs. The pipes shall extend within one foot of the top and bottom of the bearing stratum (i.e. unbonded zone of the pile) at the test pile location. Strain gages may be substituted for telltales.

The micropile verification load test results must verify the micropile design and installation methods, and be reviewed and accepted by the Engineer prior to beginning installation of production micropiles. The verification test pile and reaction piles shall not be used as production piles.

Test verification pile to a maximum Test Load of 150% of the Factored Design Load (FDL) defined above, as indicated on the Plans. The verification pile load test shall be made by incrementally loading the micropile in accordance with the following cyclic load schedule:

Step	Loading	Applied Load	Hold Time (min.)
1	Cycle 1	AL	-
		0.075 FDL	4
		0.15 FDL	4
		0.225 FDL	4
		0.30 FDL	4
		0.375 FDL	4
2	Cycle 2	AL	1
		0.15 FDL	1
		0.30 FDL	1
		0.375 FDL	1
		0.45 FDL	4
		0.525 FDL	4
		0.60 FDL	4
		0.675 FDL	4
		0.75 FDL	4
3	Cycle 3	AL	1
		0.30 FDL	1
		0.60 FDL	1
		0.675 FDL	1
		0.75 FDL	1
		0.875 FDL	4
		0.90 FDL	4
		0.975 FDL	10 or 60 (Creep Test)
4	Cycle 4	AL	1
		0.30 FDL	1
		0.60 FDL	1
		0.90 FDL	1
		0.975 FDL	1
		1.05 FDL	4
		1.125 FDL	4
		1.20 FDL	4
		1.275 FDL	4
		1.35 FDL	4
		1.425 FDL	4
		1.50 FDL	4
		1.20 FDL	4
		0.90 FDL	4
		0.60 FDL	4
0.30 FDL	4		
AL	15		

Creep Test: Pile top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be

monitored for creep at the 0.975 FDL. Depending on performance, either a 10 minute or 60 minute creep test shall be performed at the 0.975 FDL test load where movements shall be recorded at 1, 2, 3, 5, 6, and 10 minutes. When the pile top movement between 1 and 10 minutes exceeds 0.04 inches, the 0.975 FDL test load shall be maintained an additional 50 minutes. Movements shall be recorded at 20, 30, 50, and 60 minutes. Dial gauges shall be reset to zero after the initial AL is applied.

The Acceptance criteria for micropile verification load tests are:

1. If the pile is tested in compression, acceptance will be based on the Davisson criteria. For this criterion, the ultimate load is defined as the load at which settlement measured relative to the top of the pile prior to the start of testing exceeds the sum of:
  - I. The theoretical elastic compression of the pile assuming the load applied at the top of the pile act over the full length of the pile, and
  - II. 0.15 inches plus 1 percent of the pile tip diameter.
2. If the pile is tested in tension, the ultimate load is defined as the load that produces an upward movement under load of 0.5 inch at the pile tip. The movement at the pile tip is:
  - I. Measured directly by tell-tale, or
  - II. Computed by deducting the theoretical elastic elongation of the pile from the upward movement measured relative to the top of the pile prior to the start of testing.
3. At the end of the 0.975 FDL increment, the test pile shall have a creep rate not exceeding 0.04 inch/log cycle time (1 to 10 minutes) or 0.08 inch/log cycle time (6 to 60 minutes or the last log cycle if held longer). The creep rate shall be linear or decreasing throughout the creep load hold period.
4. Failure does not occur at any load increment up to and including the maximum test load, 1.50 FDL. Failure is defined as load where the slope of the load versus head settlement curve first exceeds 0.025 in/kip.

At the completion of verification testing, test piles shall be removed down to the elevation specified on the plans or by the Engineer.

For the verification load tests, reports must be written and submitted to the Engineer within 3 working days of the load test completion. This report will either confirm the micropiles' resistance and bond lengths specified on the plans or reject the piles based upon the test results. This report shall be reviewed and acceptance by the Engineer prior to beginning installation of production micropiles. The contents of the verification load test report shall include:

1. Brief project description.
2. Description of site and subsurface conditions including information on the ground conditions at the location of the load test and a comparison to actual conditions encountered.
3. Key personnel including the drill rig operator, the superintendent, the grout plant operator, and any other personnel involved in the installation and testing of the micropile.
4. Micropile installation data including information such as length of the micropile (cased and uncased), number of bags of cement used to construct the micropile, size and type of

casing and reinforcement, geology encountered (e.g. soil material, rock material, and water levels) during drilling, grouting record and grout testing results.

5. Results of load test including load-movement curves/figures and filled-out data sheets.
6. Statement of load test requirements and acceptance criteria.
7. Comparison of load test requirements and acceptance criteria.
8. Summary statement on the load test results.

If a tested micropile fails to meet the Acceptance criteria, the Contractor shall modify the design, the construction procedure, or both. These modifications may include but not limited to modifying the installation methods, increasing the bond length, regrouting the pile via preplaced regROUT tubes or changing the micropile type. Any modification that necessitates changes to the structure design shall be submitted as a revision to the Working Drawings and require the Engineer's review and acceptance. Additional load testing may be required until an acceptable pile load test meets the designated load test requirements.

C. Micropile Proof Test

Proof test piles to a maximum test load of 1.00 FDL as defined above. Proof tests shall be made by incrementally loading the micropile in accordance with the following cyclic load schedule:

Step	Loading	Applied Load	Hold Time (min.)
1	Cycle 1	AL	-
		0.10 FDL	4
		0.20 FDL	4
		0.30 FDL	4
		0.40 FDL	4
		0.50 FDL	4
		0.60 FDL	4
		0.70 FDL	4
		0.80 FDL	4
		0.90 FDL	4
		1.00 FDL	10 or 60 (Creep Test)
		0.75 FDL	4
		0.50 FDL	4
		0.25 FDL	4
AL	4		

Creep Test: Pile top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. The proof test pile shall be monitored for creep at the 1.00 FDL. Depending on performance, either a 10 minute or 60 minute creep test shall be performed at the 1.00 FDL test load where movements shall be recorded at 1, 2, 3, 5, 6, and 10 minutes. When the pile top movement between 1 and 10 minutes exceeds 0.04 inches, the 1.00 FDL test load shall be maintained an additional 50 minutes. Movements shall be recorded at 20, 30, 50, and 60 minutes. Dial gauges shall be reset to zero after the initial AL is applied.

The Acceptance criteria for Micropile Proof Load Test are the same as those for the Micropile Verification Load Test, except as modified below:

1. The creep test shall be held at the end of the 1.00 FDL increment.
2. Failure does not occur at any load increment up to and including the maximum test load, 1.00 FDL

Within 3 days of the completion of each proof load, the Contractor shall submit a report confirming the micropiles' capacities and bond lengths specified on the plans or reject the piles based upon the test results. The contents of the proof load test report shall be the same as those in the report for the Micropile Verification Load Test.

If a proof-tested micropile fails to meet the Acceptance criteria, the Contractor shall immediately proof test another micropile within that substructure. For failed piles and further construction of other piles, the Contractor shall modify the construction procedure. Failed micropiles shall be replaced at the Contractor's expense. Any modification that necessitates changes to the structure design shall require the Engineer's prior review and acceptance. Verification and proof tests will be re-performed if the micropile type is changed.

### **NON-CONFORMING PILES**

Non-conforming piles include piles that are installed out of tolerance, are damaged, the volume of grout placed is less than the theoretical volume of the hole, or the grout tests do not indicate the specified strength has been achieved. The Contractor shall submit a written remedial action plan to the Engineer for approval. The remedial action plan shall indicate how to correct the problem and prevent its reoccurrence. To mitigate or remediate non-conforming piles, the Contractor may be required to provide additional piles or supplement piles to meet specified requirements at no additional cost to the Owner.

### **METHOD OF MEASUREMENT**

Drilled Micropiles will be paid for at the contract unit price per Foot.

Micropile Verification Load Test and Micropile Proof Load Test shall be measured for payment per Each.

### **BASIS OF PAYMENT**

Drilled Micropiles shall be paid at the contract unit price per Foot, complete in place and accepted. Payment for drilled micropiles shall be considered complete compensation for providing all materials, labor, equipment, proper disposal of drilling spoil, and incidentals to complete the work. There will be no separate measurement for mobilization and demobilization associated with this item. Any difference in the required length of permanent casing and micropile installed and accepted by the Engineer from the estimated lengths shall be measured for payment and/or credit. There will be no payment for differences in required length of temporary casing. The Micropile Contractor is also responsible for estimating the grout take. There will be no extra payment for grout overruns.

The Contractor shall anticipate encountering obstructions as noted herein and shall utilize equipment and methods necessary to advance through or remove the obstructions. The presence of obstructions, any lost production, replacement piles, and the removal of obstructions, if necessary, shall not be measured or paid for separately. Any costs associated with the presence of obstructions shall be considered incidental to the Drilled Micropiles Item.

Drilling tools that are lost during the drilling shall not be considered obstructions and shall be promptly removed by the Contractor without compensation. If removal will degrade the hole, the hole shall be abandoned with a new hole located by the Engineer. All costs due to lost tool removal, drilling a new hole and filling the abandoned hole shall be borne by the Contractor.

Micropile Verification Load Test and Micropile Proof Load Test shall be paid at the contract unit price per each completed and accepted test, for which payment shall be considered complete compensation for providing all design, materials, labor, equipment, load test report, and incidentals to complete the work including the installation and materials of the test pile and reaction piles, if used. This payment shall also include full compensation for cutting the pile to the elevation necessary to properly incorporate the pile in the structure. If a pile is not to be incorporate in the structure, this payment item includes cutting the pile to the grade necessary to avoid its interference with the proposed construction. Payment for Micropile Verification Load Tests shall also include full compensation for installing the test pile. Micropiles installed as test piles for Proof Load Tests, if incorporated in the final structures, the length of pile installed in place shall be paid for at contract unit price of Drilled Micropiles.

**ITEM 986.**

**MODIFIED ROCKFILL**

**TON**

The work under this Item shall conform to the relevant provisions of Section 983 of the Standard Specifications and following:

The work to be performed under this Item shall consist of the furnishing and installing of Modified Rockfill at the locations and details shown on the plans and specified herein. The modified rockfill slope treatment shall be constructed in accordance with these specifications and in conformance with the lines, grades, design, and dimensions shown on the plans or established by the Engineer.

Stone for Modified Rockfill shall meet the material requirements of M2.02.4.

The Modified rock fill is in very close proximity of the wetland; therefore, the Contractor shall use caution when working in the area avoid disturbance of the wetland area.

Modified Rockfill will be measured for payment by Ton, complete in place, including all labor, materials, equipment and incidental costs required to complete the work.

The work under this Item shall conform to the relevant provisions of Section 140, 901, 950, 960 and the following:

The work under this Item consists of constructing a cofferdam as required for the construction of the abutments and wingwalls as well as existing abutment removal as shown on the Plans. Temporary shoring for any other work in this Contract shall not be included here, but shall be considered incidental to the Item for which it pertains unless specifically included in a separate Item.

The cofferdam shown on the Plans is intended to provide a pre-defined structure for bidding purposes only. The Contractor shall be solely responsible for reviewing, verifying and designing a cofferdam that is consistent with his/her means and methods. Design of the cofferdam shall be in accordance with allowable stress method conforming to AASHTO Standard Specifications and shall be stamped by a Professional Structural Engineer registered in the Commonwealth of Massachusetts.

The tremie concrete, as shown on the Plans and specified under Item 901, shall be placed directly on the bedrock. Prior to placing the tremie concrete, the bedrock surface shall be cleaned using an air-lift and inspected by divers to confirm that any loose material has been removed.

Prior to any work, the Engineer must approve complete detailed drawings and complete calculations for the excavation support system in writing. The cofferdam shall include all sheeting, bracing, control of water and other excavation support and controls as necessary to provide for excavation support, and dry construction of the abutments and wingwalls. Control of water shall comply with all submittal and permitting requirements specified under Item 991.1.

#### CONSTRUCTION METHODS

Cofferdam construction shall conform to the requirements of Section 140 and the following: Cofferdam work shall be entirely enclosed within turbidity screens as specified herein. Portions of sheet piling and/or other materials used for cofferdams shall be left in place as shown on the Plans, or as directed by the Engineer, and the cutoff portions are removed from the site.

Because of the shallow bedrock at this site, Portions of the cofferdam may be required to be anchored to the bedrock. No separate payment shall be made for any such anchorage.

Cofferdam shall be cut of a minimum of 2 feet below finish grade, except adjacent to tremie it shall be cut off at the top of tremie.

Any part of the cofferdam that protrudes into the supporting soil below the bridge structure shall not be removed, but shall be cut off and left in place with no additional payment. Supporting soil shall be defined as all soil directly below the footing contained within a series of planes that originate at the perimeter of the bottom of the footing and project down and away from the footing at an angle of 45° from the horizontal.

#### Installation of Turbidity Screens

With the exception of the channel between the abutments, where turbidity screens will not be required, at other locations where sheeting is to be installed in the waterway or excavation is to occur; where cofferdams are to be installed; or where other work is undertaken within the water, turbidity screens shall be installed for the full depth of water to completely enclose the work area unless the perimeter of the work is partially bounded by the shore or impermeable shore structure. Under those circumstances the turbidity screens shall occupy the remainder of the perimeter open to the channel. Installation and removal of turbidity screens shall be performed by skilled workers experienced in this type of operation. No work at a particular location in the channel shall be undertaken until the installation of turbidity screens has been completed.

The turbidity screens shall be deployed such that the navigational traffic in the channel will not be disrupted. The Contractor shall maintain the turbidity screens in good operating condition, acceptable to the Engineer and the Department of Environmental Protection, and repair or replace the screens, buoyancy equipment, tensile cable and ballast chain as needed to maintain the integrity of the enclosures.

Turbidity screens shall remain in place at individual work locations for a minimum of 24 hours after completion of the work including removal of sheeting, cofferdams and other temporary in-water construction.

#### Submittals

Submittals shall conform to the requirements of the Standards and the additional requirements specified herein. Catalogue cuts and shop drawings showing the materials to be used as turbidity screens and the means and methods for installation/removal of turbidity screens.

The Contractor shall submit shop drawings showing complete details designed and stamped by a Professional Structural Engineer registered in conformance with the laws of the Commonwealth of Massachusetts.

#### BASIS OF PAYMENT

Cofferdam Structure No. H-12-024 shall be paid for at the Contract lump sum price, which price will constitute full compensation for all materials, tools, equipment, and all labor including but not limited to, constructing, maintaining and removing cofferdam, and all incidental items required to complete the work. Turbidity screens (silt curtains) will not be separately measured for payment but all costs will be considered incidental to this Item. Upon installation of the Cofferdam, 70 percent of the Contract unit price Lump Sum will be paid and the remaining 30 percent will be paid upon removal or cut off as specified on the Plans. Payment for control of water within the cofferdam shall be under Item 991.1.

Work under this Item shall conform to the relevant provisions of Sections 7.02 and 140 of the Standard Specifications, all applicable environmental regulations and permits, and the following:

The work to be performed under this Item shall include all work necessary for the control of water within the excavations and cofferdam to construct the project in the dry. The work shall include designing, furnishing, installing, maintaining, operating, and removing temporary dewatering systems as required, to lower and control water levels. Work also includes properly disposing of pumped water, constructing, maintaining, observing, and removing of equipment and instrumentation for control of the system. Water shall be discharged as specified in the environmental permits obtained for this project. No direct discharge shall be allowed into the Little River during the dewatering operations.

It is the responsibility of the Contractor to determine the need and extent of dewatering required, sedimentation and dewatering techniques and controls and submit method and materials he/she proposes to use for approval by the Engineer.

The Contractor is cautioned that flow rates in the river can increase substantially during and after storm events. The flow diversion and bypass pumping operations shall include contingencies for accommodating the increased flow during such events. At a minimum, the flow diversion and bypass pumping operations shall be designed to accommodate a 2-year storm event with a flow rate of 419 cubic feet per second. In the event of a storm exceeding this capacity, the contractor shall be responsible for stabilizing the work zone and allowing the excess flow to overflow the diversion/bypass mechanisms and flow through the work zone.

Plans and calculations for the water control measures shall be developed by the Contractor for this Item. These plans and calculations shall be prepared and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts and shall be submitted for review and approval prior to the start of construction.

The Contractor shall use such equipment and shall perform the operations in such a manner that boiling or other disturbances of the soil in the foundation area will be prevented. The Contractor shall keep the excavated area dry by such means that the water will be prevented from entering the excavations and adversely affecting the stability of the foundation material or supporting soils.

The pumping discharge shall not be allowed to enter directly into the water from the work areas, rather it shall be pumped to a temporary stilling basin or other appropriate treatment or containment device. The criteria that shall be implemented for the control of water must meet the following:

1. The enclosure shall be adequately sized and designed to achieve adequate water quality treatment/sedimentation trapping and prevent overtopping from dewatering and to provide the required filtering or containment.

2. The outlet from the containment structure shall not cause erosion of the surrounding area. An approved method of controlling erosion, such as an erosion control blanket, stone, etc. shall be used at the outlet.
3. Impacts from dewatering will be minimized by designing support walls for minimal leakage, covering trucks, barges and stockpiles during rain events and land contouring to limit surface runoff from leaving the dewatering site.
4. There shall be no placement of dewatering equipment within wetland or water resource areas.
5. Dewatered excavated material will be transported to the disposal site in accordance with local, state, and federal regulations.
6. The control of water containment structure shall be maintained as follows:
  - a. Inspect at least twice daily during dewatering operations.
  - b. Repair any damage immediately.
  - c. Clean containment structure daily. Remove any debris immediately.
  - d. Remove sediments when accumulated deposits reach a depth of 6 inches
  - e. Dispose sediments outside of saltwater marsh area limits at a location approved by the Engineer.

The Contractor shall inspect the outlet daily and maintain the erosion controls at the outfall.

Placement of the dewatering stilling structure will be specified in the dewatering plan and will be submitted for approval by the Engineer. Pumping shall be conducted in a manner which will not adversely affect the freshly placed concrete within the excavation.

The Contractor shall provide and maintain pumps, pipes and other devices to promptly and continually remove and dispose of water from the excavation areas. The size and configuration of pumps and pipes shall be selected by the Contractor.

The Contractor is advised that the effectiveness of the water control method used will vary based on the field conditions and the time at which the actual excavation work is being performed. The Engineer shall to order the Contractor to stop all excavation operations when in his judgment the Contractor's water control operations are failing to produce adequate results or are posing a threat to the environment.

#### BASIS OF PAYMENT

Payment for work under this Item shall be paid at the contract unit bid price lump sum. Payment for all water control work, including design for the dewatering and treatment operations, used to maintain a water free excavation for construction of the proposed work shall include all labor, tools and equipment materials and installation, piping, pumping, maintenance, subsequent removal of all related materials and equipment all as outlined above; and restoration of site shall be included in the lump sum contract price bid under this Item. This work will include preparation of the Construction Dewatering Plan.

**ITEM 992.32****TEMPORARY SUPPORTS FOR PIPING****LUMP SUM**

Work under this Item shall consist of designing, furnishing, fabricating, erecting, maintaining, and the subsequent removal of temporary supports for piping to support temporary sewer, gas, electric, telecommunications, and fire alarm lines. The temporary utility bridge supports shall be installed and placed into operation prior to the existing bridge demolition. The Contractor shall properly coordinate and sequence the installation of the utilities on the south side of the bridge.

The temporary supports for piping are to be placed on the south side of the existing Rosemont Street Bridge within the easements obtained for the project. The Contractor shall coordinate with the City of Haverhill Fire Department, City of Haverhill Water and Wasterwater Division, Comcast, Verizon, and National Grid Gas and Electric Company as to the required loading, layout and location of the temporary supports for piping to support the temporary utilities such that they will not impede nor hinder the Contractor's operations, work, or progress on the project.

The temporary supports for pipe shall not be placed within the Little River. Supports/foundations shall be placed outside the retaining walls. The east side temporary support shall bridge over the existing drain line. The bottom chord of the temporary supports for piping shall be no lower than the low chord of the existing Rosemont Street Bridge.

It is the responsibility of the Contractor to determine the appropriate means, methods, and materials to provide the temporary supports for piping to support the sewer, gas, electric, telecommunications, and fire alarm lines. References to temporary supports for piping should not be construed as to require a prefabricated or complex structure and may, at the Contractor's option, simply consist of supports and a beam(s) spanning the river.

**SUBMITTALS**

The Contractor shall submit shop drawings, working drawings, and associated design calculations, stamped by a Professional Structural Engineer registered in Massachusetts, of all components of the temporary supports for piping to the Engineer for review. The temporary supports for piping shall be designed in accordance with the 9<sup>th</sup> edition of the American Association of State Highway and Transportation Officials LRFD Specifications for Highway Bridges.

Upon approval of the Engineer, the Contractor shall submit the final shop drawings, working drawings, and associated design calculations to National Grid Gas and Electric for their submission and approval. Any revisions or modifications to the submission required by National Grid Gas and Electric will be provided by the Contractor.

**MEASUREMENT AND PAYMENT**

Temporary Supports for Piping shall be paid for once at the contract Lump Sum bid price which price shall be full compensation for the design, furnishing, installing, maintenance, and subsequent removal and disposal of all temporary supports for piping and associated items of work, including soil and rock anchors and temporary riprap, regardless of the actual system utilized. National Grid Gas will be responsible for the cutting, capping and purging of the temporary gas main but the Contractor will be responsible for the removal of the abandoned pipe. National Grid Electric will be responsible for transferring power to the temporary electric

lines. All other utility companies will be responsible for moving wires to the temporary conduits and back to the final condition. The Contractor will be responsible for the removal of the abandoned conduits.

Fifty percent of the contact lump sum price shall be paid upon the installation of the temporary supports for piping and fifty percent upon its removal as approved by the Engineer.

Work under this Item shall consist of designing, furnishing, fabricating, erecting, maintaining, and subsequent removal of temporary side and deck underside protective shielding to provide for the safety beneath the bridge from falling debris during the removal of the existing bridge and construction of the new bridge.

**CONSTRUCTION METHODS**

The Contractor is responsible for preventing any debris resulting from demolition, excavation or construction from falling into the river below. All precautions and costs to install netting, scaffolding, shielding, etc., necessary to assure this shall be considered incidental to this Item. Any debris that falls to the river below shall be immediately removed by the Contractor at his/her expense, as directed by the Engineer.

The temporary shielding shall be placed in a manner as to prevent it from being blown out by the wind. If, in the opinion of the Engineer, the shielding is not secure, then the Contractor shall remove it and install it to the satisfaction of the Engineer at no additional cost.

The shielding shall at a minimum conform to the following:

1. Shielding shall be in place prior to the start of any demolition.
2. Shielding shall extend the full length of the bridge and a sufficient distance above and beyond the deck overhang at the fascias and vertically adjacent to the bridge fascias.
3. Shielding shall have all spaces along the perimeter and at the seams sealed to prevent dust and debris from escaping and falling below the bridge.
4. Shielding shall be designed to safely withstand all loads that it will be subjected to. The allowable design stresses shall be in accordance with AASHTO Standard Specifications for Highway Bridges. The design shall also include a complete description of the equipment and construction methods proposed for the deck removal and also indicate the maximum size of deck area being excavated. The shielding shall also be designed to withstand the maximum size of excavated area should it fall during excavation or removal.
5. Shielding shall be installed or removed only upon approval of the Engineer.
6. Shielding design, calculations and sketches shall be stamped by a Professional Engineer registered in Massachusetts.

All materials used in the shielding system shall become the property of the Contractor and shall be removed from the site at the completion of the project.

**SUBMITTALS**

The Contractor shall submit shop drawings, working drawings, and associated design calculations, stamped by a Professional Engineer registered in Massachusetts, of all proposed

shielding to the Engineer for approval prior to installation. The drawings shall include all details of all connections, brackets, and fasteners. The protective shielding shall be designed to support all construction and dead loads safely; and to be sealed tightly at all joints.

#### MEASUREMENT AND PAYMENT

There will be no measurement for payment of this item.

Payment under this Item shall be at the lump sum bid price, which shall include all labor materials, equipment, tools, and incidentals to carry out the work.

The first payment of 70 percent of the lump sum bid price of this Item will be made upon completion of the installation of the shielding system to the satisfaction and approval of the Engineer. The second payment of 30 percent of the lump sum bid prices of this Item will be made upon the complete construction of the proposed bridge and proper disposal of the shielding from the project site.

**ITEM 995.01****BRIDGE STRUCTURE, BRIDGE NO. H-12-024****LUMP SUM**

The work under this Item shall conform to the applicable provisions of Section 995 of the Standard Specifications and the specific requirements stipulated below for the component parts of this Item. For those component parts where no specific requirement is stipulated, the Standard Specifications shall apply except for payment.

Work under this item includes all material, equipment and labor needed to construct the following: concrete abutments, wingwalls, and approach slabs; prestressed concrete Northeast Extreme Tee (NEXT F) Beam superstructure; bridge barriers; precast highway guardrail transitions; bearings; controlled density fill around the precast highway guardrail transitions; structural steel; damp-proofing; membrane waterproofing; and all other items not specifically provided for in the contract.

The work does not include any items listed separately in the proposal. Payment for materials shown on the Plans as being part of this bridge structure or which may be incidental to its construction and are not specifically included for payment under another item shall be considered incidental to the work performed under this Item and shall be included in the unit price of the component of which they are a part.

**CONTROLLED DENSITY FILL –NON-EXCAVATABLE**

Work under this Item shall conform to the relevant provisions of Section 150 of the Standard Specifications for Highways and Bridges and the following:

Controlled Density Fill material to be used on this project shall be Type 1 Very Flowable/Non-Excavatable (M4.08.0).

**SAWING & SEALING JOINTS IN ASPHALT PAVEMENT AT BRIDGES**

The work to be done under this Item consists of making a sealed kerf across the full width of the finished asphalt pavement at bridge abutments where called for on the Plans. The shape, width, and depth of the kerf shall be as shown on the Plans.

Prior to the start of the asphalt pavement operation, the Contractor shall place a mark on each curb or barrier on either side of the paved roadway. These marks shall be aligned with the actual end of the bridge deck and shall be placed so that they will not be covered or otherwise obscured by the asphalt pavement.

After the completion of the paving operation, the Contractor shall snap a straight chalk line on the pavement between these two marks. The Contractor shall then saw cut the pavement along this line to the depth, width and shape as shown on the Plans. The equipment shall be approved by the Engineer prior to commencing work.

After completing the saw cutting, the Contractor shall clean the saw groove of any dust and debris with an oil free air blast. If the groove was wet sawn, the groove shall be cleaned with a water blast to remove any remaining slurry and debris, vacuumed with a Wet-or-Dry vacuum to remove any standing water, and then dried with an air blast from a Hot-Air-Lance.

Once the groove is clean and dry, the Contractor shall fill it completely with a hot-applied bituminous crack sealer meeting the requirements of M3.05.4 in accordance with the manufacturer's application instructions and restrictions regarding ambient and material temperatures. The crack sealer shall be thoroughly cured prior to opening the road to traffic. To reduce tackiness, only boiler slag aggregate (black beauty) shall be scattered over the sealer when required by the Engineer. Conventional sand shall not be used for this purpose.

## **PRESTRESSED NORTHEAST EXTREME TEE (NEXT F) CONCRETE BEAMS**

### **General.**

The work under this Heading consists of fabricating, transporting and installing prestressed northeast extreme tee (NEXT F) concrete beams, and includes all necessary labor, materials, and equipment to complete the work as shown on the Plans. The work shall conform to the MassDOT Standard Specifications and the requirements of the current AASHTO LRFD Bridge Construction Specifications, supplemented by the current relevant provisions of the latest edition of PCI MNL-116 (The Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products), except as noted herein. MassDOT contract documents shall take precedence over the AASHTO LRFD Bridge Construction Specifications and PCI MNL-116. Section 930, M4.02.14, and M4.03.00 through M4.03.14 of the MassDOT Standard Specifications are superseded in their entirety by the requirements specified below.

## **QUALITY ASSURANCE**

### **General.**

Quality Assurance includes all the planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service. It is an all-encompassing term that includes Quality Control (performed by the Fabricator) and Acceptance (performed by MassDOT). Quality Control is the system used by the Contractor and Fabricator to monitor and assess their production processes at the plant facility and installation activities at the project site to ensure that the final product will meet the specified level of quality. Acceptance includes all factors used by MassDOT to determine the corresponding value for the product. MassDOT Acceptance inspection at the plant facility is intended as a means of evaluation of compliance with contract requirements. Contractor and Fabricator Quality Control activities and MassDOT Acceptance activities shall remain independent from one another. MassDOT Acceptance activities shall not replace Fabricator Quality Control activities.

### **Fabricator Quality Control.**

Quality Control shall be performed by the Fabricator to ensure that the product is fabricated in conformance with the specifications herein. The Fabricator shall maintain a Quality Control system to monitor, assess, and adjust placement and fabrication processes to ensure the Prestressed Concrete Beam(s) meet the specified level of quality, through sufficient Quality Control sampling, testing, inspection, and corrective action (where required). The Fabricator's Quality Control system shall address all key activities during the placement and fabrication and shall be performed in conformance with the Fabricator's PCI Certification. Quality Control documentation shall meet the requirements of the *Fabricator Quality Control – Documentation* section below. Upon request, Fabricator Quality Control documentation shall be provided to the MassDOT Plant Inspector.

**Plant.**

Prior to the fabrication of Prestressed Concrete Beams, the Fabricator's precast concrete plant shall obtain the following:

- (a) Certification by the Precast/Prestressed Concrete Institute (PCI) Plant Certification Program, for Prestressed Concrete Beam fabrication, Category B3 level or higher
- (b) MassDOT Prequalification
- (c) MassDOT Mix Design Approval

All concrete for a given Prestressed Concrete Beam shall be produced by a single company and plant, unless otherwise approved by the Engineer.

**Personnel.**

The Fabricator shall provide adequate training for all QC personnel in accordance with PCI certification. There shall be sufficient personnel trained and certified to perform the tests listed under Subsection M4.02.13, Part D. At a minimum, the Fabricator's Quality Control Personnel shall maintain the following qualifications and certifications:

- (a) QC Manager with an active Precast/Prestressed Concrete Institute (PCI) Technician/Inspector Level II or higher, and a minimum of 5 years continuous experience in the manufacture of Prestressed Concrete Beams for state transportation departments. The QC Manager shall be on site while the batch plant is producing and placing concrete for MassDOT projects.
- (b) A Technician/Inspector having the Precast/Prestressed Concrete Institute (PCI) Technician/Inspector Level II or higher

The Contractor shall submit to the Engineer a copy of the Fabricator's Quality Control Personnel required qualifications, as specified above.

**Laboratory.**

The Fabricator shall provide a room of sufficient size to house all equipment and to adequately perform all testing. The room shall have either a separate moisture storage room or curing box for concrete cylinders, and it shall be thermostatically controlled to maintain temperatures consistent with AASHTO T 23. It shall include a desk and file cabinet for proper record keeping, and have good lighting and ventilation. This room shall be kept for testing and quality control and not used for any other purpose. An additional desk and file cabinet shall be provided for exclusive use of the Engineer. No exception from these requirements will be allowed without the express written permission of the Engineer.

**Testing Equipment.**

At a minimum, the Fabricator's plant facility shall have the following testing equipment:

- (a) Air Content Meter Type A or B: AASHTO T 152
- (b) Air Content Meter Volumetric Method: AASHTO T 196 (Required for Lightweight Concrete)
- (c) Slump Cone: AASHTO T 119
- (d) Cylinder Molds AASHTO M 205
- (e) Concrete Testing Machine: AASHTO T 22
- (f) Screening Sieve: AASHTO T 27, AASHTO T 11
- (g) Curing Box: AASHTO T 23

- (h) Spread Test Base Plate for Self-Consolidating Concrete (SCC): ASTM C1611
- (i) All other equipment prescribed by AASHTO and ASTM standards for the tests to be performed by the Fabricator as specified

**Inspection.**

Quality Control personnel shall monitor and inspect the fabrication of each Prestressed Concrete Beam. Quality Control personnel shall report all inspection activities on Quality Control Inspection Reports and non-conformances on Non-Conformance Reports (NCRs) throughout the entire fabrication process, as specified herein.

**Temperature Monitoring.**

At a minimum, the Fabricator shall monitor, record, and report the temperatures of the form, ambient temperatures surrounding the concrete, and temperatures of the concrete continuously, without interruption as specified below:

- (a) Prior to placement of concrete to verify that  $T_i \geq 50^\circ\text{F}$ .
- (b) Immediately after placement to verify that  $T_i \geq 50^\circ\text{F}$  is maintained.
- (c) Throughout the entire duration of the curing cycle, at regular intervals not to exceed one hour until 100% Design Strength ( $f'_c$ ) is attained and concrete has cooled to within  $40^\circ\text{F}$  of the ambient temperature surrounding the Prestressed Concrete Beam.

At a minimum, the temperature measuring devices shall record and report the temperature of the concrete to the nearest  $2^\circ\text{F}$ . At least two temperature sensors (thermocouples) shall be positioned to record the maximum and minimum anticipated concrete temperatures. The anticipated minimum temperature shall be measured with one or more thermocouples at a distance no greater than 2 inches from the surface of the thinnest section. The anticipated maximum temperature shall be measured with one or more thermocouples at the center of the thickest section. Proposed temperature measurement locations shall be submitted to the Engineer for approval. Temperature recording devices shall be located within the curing enclosure and calibrated as required by PCI MNL-116 Section 4.18.4. Maximum heat increase and cool down rates shall comply with PCI MNL-116, Section 4.19. The Contractor shall furnish temperature logs recorded at a minimum frequency of once per hour to the Inspector as required, with each post-pour QC inspection report.

**Sampling and Testing.**

At a minimum, the Fabricator shall perform random Quality Control sampling and testing as specified in *Table 1: Quality Control Sampling and Testing*. The Fabricator shall perform additional Quality Control sampling and testing on concrete that has been retempered with admixtures or hold-back water during fabrication. Test Specimens shall conform to the requirements of Section M4.02.13 of the MassDOT Standard and Supplemental Specifications and AASHTO R 60, with the exception of the Stripping (80%  $f'_c$ ) set of cylinders. Stripping (80%  $f'_c$ ) cylinders shall be cured in the same location and environment as the Prestressed Concrete Beam they represent. If approved by the Engineer, compressive strength cylinder match curing equipment, that maintains the same concrete conditions that the corresponding Prestressed Concrete Beam is exposed to, may be utilized in lieu of Stripping (80%  $f'_c$ ) field cured cylinders, with the use of thermocouples, controllers, and heaters.

**Table 1: Quality Control Sampling and Testing**

Quality Characteristic	Test Method	Sample Size	Specification Limit	Lot Size <sup>(c)</sup>	Sublot Size <sup>(d)</sup>	Frequency	Point of Sampling
Slump (in.) <sup>(a)</sup>	AASHTO T 119	Per AASHTO	≤ 8 in. or as approved by the Engineer	Total Quantity of Beams fabricated on a Contract, per Bid Item, per Mix Design	One (1) Beam	One (1) per Sublot or fraction thereof	Point of Discharge
Air Content (%)	AASHTO T 152	Per AASHTO	5% ≤ % ≤ 8%				
Temperature (°F)	AASHTO T 309	Per AASHTO	50°F ≤ °F ≤ 90°F				
Compressive Strength (psi)	AASHTO T 22	Stripping Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 80% f <sub>c</sub> at Stripping				
		7-day Cylinders: One (1) set of Three (3) 4 x 8 in.	For Information at 7 days				
		28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% f <sub>c</sub> at 28 days				
		56-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% f <sub>c</sub> at 56 days <sup>(b)</sup>				

**Notes:**

- (a) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (b) 56-day Compressive Strength test specimens shall require testing only when 28-day Compressive Strength test specimens have failed to meet Design Strength (f<sub>c</sub>).
- (c) Lot shall be defined as a specific quantity of material from a single source, produced or placed by the same controlled process.
- (d) Sublot shall be defined as an equal division or part of a Lot from which a sample of material is obtained in order to assess the Quality Characteristics of the Lot.

**Certificate of Compliance.**

The Fabricator shall provide a Certificate of Compliance in accordance with Standard Specifications, Division I, Section 6.01, stating that QC test cylinders have achieved the design strength, f<sub>c</sub>. A Certificate of Compliance shall accompany each shipment and shall be presented to the MassDOT Resident Engineer or designee upon delivery to the site.

**Documentation.**

At a minimum, the Fabricator shall maintain a filing system for the following QC records and documentation. All QC records and documentation shall be made available to MassDOT upon the request of the Department.

- (a) Current MassDOT Approved Mix Design Sheet(s) and Approval Letter(s)

- (b) PCI Certification
- (c) Current Qualifications and Certifications for QC Manager(s) and QC Technician(s)
- (d) Most current set of Approved Shop Drawings
- (e) Approved Placement, Finishing and Curing Plan
- (f) Approved Dunnage Plan
- (g) Fabricator Certificate of Compliance for each fabricated Prestressed Concrete Beam
- (h) Admixture Manufacturer's Certification of Compliance for each approved Admixture
- (i) Completed QC Inspection Report for each fabricated Prestressed Concrete Beam
- (j) Identification Number for each fabricated Prestressed Concrete Beam
- (k) Time and date of casting of each fabricated Prestressed Concrete Beam
- (l) Date of stripping of each fabricated Prestressed Concrete Beam
- (m) Batch Ticket Printout reporting the quantity of concrete produced for each batch of concrete produced
- (n) Concrete temperature records for each fabricated Prestressed Concrete Beam
- (o) QC Test Report Forms for each subplot of concrete produced
- (p) Non-Conformance Reports (NCRs)
- (q) Documentation of Repairs (if applicable)

**Acceptance.**

MassDOT will perform Acceptance inspection, sampling, and testing during fabrication and installation, to evaluate the quality and degree of compliance of the fabricated Prestressed Concrete Beam to MassDOT specifications. Additionally, MassDOT Inspectors will monitor the Fabricator's Quality Control activities to ensure the Fabricator is properly administering Quality Control in conformance with the Fabricator's NPCA or PCI Certification. Acceptance inspection and test results not meeting MassDOT specifications will result in Non-conformance Reports (NCR) being issued by MassDOT to the Fabricator or Contractor for corrective action. Final Acceptance for the fabricated Prestressed Concrete Beams shall be determined by MassDOT.

**Inspection.**

A MassDOT MassDOT Inspector will be assigned to perform Acceptance activities during fabrication, which includes the inspection of the materials, work procedures, and Prestressed Concrete Beams. At least seven (7) days prior to the scheduled start of fabrication, the Fabricator shall contact the MassDOT Research and Materials Section (RMS) to provide notice of the scheduled fabrication start date. The Fabricator shall complete the following activities prior to notifying MassDOT RMS of the scheduled start date:

- (a) Receive approval for all submitted Fabricator cement concrete mix designs from the MassDOT Research and Materials Section for the current year, as specified under the *Mix Design* section and *Table 3: Trial Batch Sampling Testing for New Mix Designs*. Self-consolidating concrete shall meet the requirements of M4.02.17.
- (b) Receive approval for the submitted Fabricator Placement, Finishing, and Curing Plan from the MassDOT Research and Materials Section, as specified under the *Placement, Finishing, and Curing Plan* section.
- (c) Receive Engineer of Record approved shop drawings from the MassDOT Research and Materials Section as specified under the *Shop Drawings* section.
- (d) Participate in the pre-production meeting, as described under the *Pre-Production Meeting* section (if required).

Prior to the start of fabrication, the Fabricator shall review the fabrication schedule with the MassDOT Inspector. Fabrication shall only proceed when:

- (a) The QC Inspector and MassDOT Inspector are present to inspect the Prestressed Concrete Beam(s) being fabricated.
- (b) The QC Manager is present at the Fabricator's plant.

The Fabricator shall grant access to all required areas of the Fabricator's plant to the MassDOT Inspector, during the hours of fabrication. Fabrication without MassDOT Inspector access to required areas is prohibited, and will result in the rejection of the Prestressed Concrete Beam(s).

Additionally, the MassDOT Inspector will monitor the adequacy of the Fabricator's Quality Control activities. MassDOT Inspector Acceptance activities performed at the Fabricator's plant shall remain independent from the Fabricator, and does not replace the Fabricator's required Quality Control activities.

### Sampling and Testing.

At a minimum, the MassDOT Inspector will perform random Acceptance sampling and testing for each Sublot of concrete produced as specified in *Table 2: Acceptance Sampling and Testing*. The MassDOT Inspector will also perform Acceptance sampling and testing on concrete that has been retempered with admixtures or hold-back water during production. Test Specimens will conform to the requirements of Section M4.02.13 of the MassDOT Standard and Supplemental Specifications and AASHTO R 60.

**Table 2: Acceptance Sampling and Testing**

Quality Characteristic	Test Method	Sample Size	Specification Limit	Lot Size <sup>(c)</sup>	Sublot Size <sup>(d)</sup>	Frequency	Point of Sampling
Slump (in.) <sup>(a)</sup>	AASHTO T 119	Per AASHTO	≤ 8 in. or as approved by the Engineer	Total Quantity of Beams fabricated on a Contract, per Bid Item, per Mix Design	One (1) Beam	One (1) per Sublot or fraction thereof	Point of Discharge
Air Content (%)	AASHTO T 152	Per AASHTO	5% ≤ % ≤ 8%				
Temperature (°F)	AASHTO T 309	Per AASHTO	50°F ≤ °F ≤ 90°F				
Compressive Strength (psi)	AASHTO T 22 AASHTO T 23	7-day Cylinders: One (1) set of Three (3) 4 x 8 in.	For Information at 7 days				
		28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% $f_c$ at 28 days				
		56-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% $f_c$ at 56 days <sup>(b)</sup>				

**Notes:**

- (a) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (b) 56-day Compressive Strength test specimens shall require testing only when 28-day Compressive Strength test specimens have failed to meet Design Strength ( $f'_{c}$ ).
- (c) Lot shall be defined as a specific quantity of material from a single source, produced or placed by the same controlled process.
- (d) Sublot shall be defined as an equal division or part of a Lot from which a sample of material is obtained in order to assess the Quality Characteristics of the Lot.

**MATERIALS**

**Materials.**

Materials shall meet the following specifications (if applicable):

General	M4.00.00
Portland Cement	M4.01.0
Blended Hydraulic Cements	M4.01.1
Fly Ash	M4.01.2
Cement Concrete	M4.02.00
Cement	M4.02.01
Cement Mortar	M4.02.15
Aggregates	M4.02.02
Lightweight Aggregates	M4.02.03
Water	M4.02.04
Cement Concrete Additives	M4.02.05
Proportioning	M4.02.06
Mixing and Delivery	M4.02.10
Test Specimens	M4.02.13
Mortar for Filling Keyways	M4.04.0
Slag	AASHTO M 302
High Performance Cement Concrete	M4.06.1
Self-Consolidating Concrete (SCC)	M4.02.17
Prestressing Strands	AASHTO M 203
Reinforcing Bars	M8.01.0
Epoxy Coated Reinforcing Bars	M8.01.7
Welded Wire Reinforcement	M8.01.2
Mechanical Reinforcing Bar Splicer	M8.01.9
Strand Chuck	M8.15.0
Lifting Devices	PCI MNL-116

**1. Cement Concrete Mix Design.**

The cement concrete shall be comprised of specified proportions of water and MassDOT approved aggregates, cement, supplementary cementitious materials (SCMs), and admixtures to form a homogenous composition. When used, self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

The Fabricator is responsible for developing the concrete mix to be used for fabricating prestressed beams and having it prequalified by the MassDOT Research and Materials Section. The mix design

compressive strength shall be as shown on the plans and as prequalified by the MassDOT Research and Materials Section. Prequalification shall include the trial batch testing shown in Table 3. For previously prequalified mixes, the Fabricator shall perform any tests specified in Table 3 that were not previously performed.

If the concrete mix has not been prequalified by the MassDOT Research and Materials Section, the Fabricator shall design and submit for approval, the proportions and test results for a concrete mix that shall attain the requirements specified in Table 3. The proposed mix design and all required test results shall be submitted to the MassDOT Research and Materials Section for approval. Requirements for additional testing and receipt of additional documentation from the Fabricator will be determined by RMS. Unsatisfactory results or other conditions identified during this additional testing and additional documentation review, will require re-submission of a new mix design for review and approval.

The mix shall be formulated with calcium nitrite corrosion inhibitors, which shall be added at a rate of 3 gallons per cubic yard of concrete in order to increase the active corrosion threshold to 9.9 pounds of chloride per cubic yard of concrete at the reinforcing bar level. Prior to production of cement concrete, the Fabricator shall report and submit all proposed mix design formulations and its constituent materials onto the MassDOT Cement Concrete Mix Design Sheet to the MassDOT Research and Materials Section for review and approval. All mix design yields shall be designed for 1.0 cubic yards of concrete, with an allowable tolerance of +/- 1.0 %. All liquids incorporated into the proposed mix design(s) shall include both water and admixtures in the liquid mass calculation.

During production of cement concrete, the Fabricator shall not alter the previously approved mix design formulation or its constituent materials. Proposed alterations in source, type, batch quantity, or gradation to any of the constituent materials of the previously approved mix design formulation shall require a new MassDOT Mix Design Sheet submission to the MassDOT Research and materials Section for review and approval. Fabrication shall not occur without prior MassDOT mix design approval. All concrete used for prestressed concrete beams shall be batched by the Fabricator producing the prestressed concrete beams. The use of ready-mix concrete batched by others shall not be permitted.

The Fabricator shall notify MassDOT RMS to schedule trial batch testing for the new mix design(s). Trial batch testing shall meet the following requirements:

- (a) Performed by a qualified laboratory and/or AASHTO accredited laboratory.
- (b) Performed and/or sampled in the presence of a MassDOT Inspector.
- (c) Meet the requirements as specified in *Table 3: Trial Batch Sampling Testing for New Mix Designs*. Self-consolidating concrete (SCC) shall meet M4.02.17.

Failure to perform all of the required trial batch testing or provide MassDOT RMS trial batch test results within the Specification Limits (as specified in Table 3) will result in the disqualification of the Fabricator's proposed mix design(s).

**Table 3: Trial Batch Sampling and Testing for New Mix Designs**

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Slump <sup>(a)</sup>	AASHTO T 119	Per AASHTO	Max. 8 inches or as approved by the Engineer	Quality Control
Air Content (AC)	AASHTO T 152	Per AASHTO	$5\% \leq AC \leq 8\%$	Quality Control
Temperature (°F)	AASHTO T 309	Per AASHTO	$50^{\circ}\text{F} \leq \text{°F} \leq 90^{\circ}\text{F}$	Quality Control
Compressive Strength <sup>(b)</sup>	AASHTO T 22 AASHTO T 23	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Lab Mixed $f'_{cr} = 1.3 f'_c$ at 28 days	MassDOT
			Batch Mixed $f'_{cr} = 1.2 f'_c$ at 28 days	
Alkali-Silica Reaction (ASR) <sup>(d)</sup>	ASTM C 1567	Per ASTM	M4.02.00	Quality Control
Resistance to Chloride Ion Penetration Chloride Ion Penetration <sup>(e)</sup>	AASHTO T 358 <sup>(f)</sup>	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Resistivity $\geq 21 \text{ k}\Omega\text{-cm}$ at 28 days	MassDOT
Freeze/Thaw Durability <sup>(c)</sup>	AASHTO T 161 (Procedure A)	Per AASHTO	Relative Dynamic Modulus of Elasticity after 300 cycles $\geq 80\%$	Quality Control

**Notes:**

- (a) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (b) Trial batch compressive strength testing shall be performed by MassDOT. Acceptance will be based on compressive strength testing performed by MassDOT. For mixes requiring  $f'_c > 8,000$  psi, three consecutive trial batches shall be performed, all achieving  $f'_{cr} \geq 1.1 f'_c$ , for MassDOT approval.
- (c) If an AASHTO accredited laboratory is preparing the trial batch test specimens, MassDOT Acceptance presence is not required. If the Fabricator is preparing the trial batch test specimens, MassDOT Acceptance presence is required during trial batch test specimen preparation.
- (d) Alkali Silica Reaction (ASR) testing shall meet the requirements of M4.02.00. Independent laboratories performing ASR testing shall be listed on the MassDOT Quality Construction Materials List (QCML).
- (e) Calcium nitrite shall be removed from mix designs containing the admixture and replaced by an equivalent quantity of water when preparing Chloride Ion Penetration resistance trial batch test specimens.
- (f) The Wenner probe tip spacing “a” shall be 1.5.

**2. Reinforcement and Prestressing Strands.**

The size and grade of steel reinforcement and prestressing strands shall be as indicated on the plans. All reinforcing steel shall be epoxy coated, Grade 60. All prestressing strands shall be uncoated.

**3. Threaded Inserts**

Threaded inserts are permissible in Prestressed Concrete Beams for installing formwork, utility supports, or deck drains. Threaded inserts shall be hot dip galvanized or made of stainless steel and shall not come in contact with the reinforcing steel. The number of threaded inserts installed for the Contractor’s convenience shall be kept to a minimum.

## CONSTRUCTION METHODS – PLANT FABRICATION

### Shop Drawings

Prior to performing any work under this Section, the Contractor shall receive approval for all shop drawings for the Prestressed Concrete Beam being worked on and any special Contract requirements, provided that a complete shop drawing package is provided. The Contractor shall not order materials or begin work before receiving approved shop drawings. MassDOT will reject any Prestressed Concrete Beams that deviate from the approved drawings or are fabricated prior to receiving written approval of the shop drawings. The Contractor shall bear full responsibility and costs for all materials ordered or work performed prior to the approval of the shop drawings or written authorization from MassDOT.

The Contractor shall submit scaled shop drawings to the Engineer of Record for review and approval. Upon approval, the Engineer of Record will forward two (2) sets of scaled, full size (minimum 24x36”) paper copies of the Approved (or Approved As Noted) shop drawings to the MassDOT Director of Research and Materials. Calculations are not to be included in any submittal to the Research and Materials Section. An approval stamp shall appear on every shop drawing sheet. Wet-stamping or wet-signing is not required, provided that the stamp and reviewer name are legible. The Fabricator’s name and address shall appear on each sheet.

Resubmittal of “Approved as Noted” shop drawings is not necessary for minor revisions, provided that the correction can be clearly understood and is unambiguous without possibility of misinterpretation. Shop drawings with questions or comments that require a response and/or additional information from the Fabricator must be resubmitted.

Detailed shop drawings shall be prepared in accordance with the relevant provisions of Subsection 5.02 and shall, at a minimum, contain the following:

- (a) Number and type of Prestressed Concrete Beams including overall length, width and height.
- (b) Skew angle.
- (c) Location and spacing of strands, draped strands and their geometry, and/or location and spacing of strands to be debonded including the length of each strand’s debondment.
- (d) Location, size and geometry of all steel reinforcement, and mechanical reinforcing bar splicers if called for on the plans.
- (e) Location and details of all inserts, anchors, and any other items required to be cast into the Prestressed Concrete Beams (whether detailed on the plans by the Engineer of Record or provided for the Contractor's convenience). Prestressed Concrete Beams shall not be fired or drilled into for attachment purposes. All hardware shall be galvanized except as noted.
- (f) Locations and details of the lifting devices, including supporting calculations, type and amount of any additional reinforcing required for lifting. The Fabricator shall design all lifting devices based on the no cracking criteria in Chapter 8 of the PCI Design Handbook (7<sup>th</sup> edition).
- (g) The minimum compressive strength required prior to release of prestressing and prior to handling the Prestressed Concrete Beam.

The shop drawings shall not include procedures for placement, finishing, and curing of concrete. These details shall be included in the Placement, Finishing and Curing Plan that is to be submitted to MassDOT Research and Materials Section as described under *Placement, Finishing, and Curing Plan*.

### Fabrication.

All Prestressed Concrete Beams shall be fabricated in accordance with the latest edition of PCI MNL-116 as modified herein.

### **Placement, Finishing and Curing Plan.**

At least 30 days prior to start of fabrication, the Contractor shall submit the Fabricator's proposed Placement, Finishing and Curing Plan to the Engineer for approval by MassDOT Research and Materials Section. This shall be an independent submittal, separate from the fabrication shop drawings. The Placement, Finishing and Curing Plan shall include the following:

- (a) Method of Mixing
- (b) Method of Placement
- (c) Method of Consolidation
- (d) Method of Finishing
- (e) Method of Initial Curing
- (f) Method of Intermediate Curing
- (g) Method of Final Curing
- (h) Moisture Retention Materials and Equipment (water spray equipment, saturated covers, sheet materials, liquid membrane-forming compounds, accelerated curing equipment, etc.)
- (i) Cylinder Curing Methods, Location, and Environmental Control (temperature, humidity, etc.)
- (j) Temperature Monitoring, Recording, and Reporting

### **Dunnage Plan Shop Drawings.**

At least 30 days prior to the start of fabrication, the Contractor shall submit proposed Dunnage Plan Shop Drawings to the Engineer of Record for review and approval. This shall be an independent submittal, separate from the fabrication shop drawings. Upon approval, the Engineer of Record will forward two (2) sets of scaled, full size (minimum 24"x36") paper copies of the Approved (or Approved As Noted) Dunnage Plan Shop Drawings to the MassDOT Director of Research and Materials. Calculations are not to be included in any submittal to the Research and Materials Section. The Dunnage Plan Shop Drawings shall include the following:

- (a) Proposed layout of the Prestressed Concrete Beams for storage in yard and during shipping
- (b) Support and blocking point locations
- (c) Support and blocking materials

### **Pre-Production Meeting.**

The Contractor shall notify the MassDOT Research and Materials Section to determine if a pre-production meeting will be required to review the specification, shop drawings, curing plan, schedule, and discuss any specific requirements. The meeting shall be held prior to scheduling a MassDOT Inspector (refer to Section *Quality Assurance – Precast Concrete, C. Acceptance, A. Inspection*), and at least seven (7) days prior to the scheduled casting of any Prestressed Concrete Beam or control section. The Contractor shall schedule the meeting, which shall include representatives of the Fabricator and MassDOT.

### **Reinforcement.**

The reinforcing bars shall be installed in accordance with Section 901.62 of the Supplemental Specifications, including tolerances for cover and horizontal spacing of bars. Components of mechanical reinforcing bar splicers shall be set with the tolerances shown on the plans. The reinforcing bars and mechanical reinforcing bar splicers shall be assembled into a rigid cage that will maintain its shape in the form and which will not allow individual reinforcing bars to move during the placement of concrete. This cage shall be secured in the form so that the clearances to all faces of the concrete, as shown on the plans, shall be maintained.

### **Placing and Tensioning Strands.**

Placing and tensioning strands shall be in accordance with PCI MNL-116. The location of all prestressing strands shall be as indicated on the plans.

### **Tolerances.**

Fabrication shall comply with tolerances specified on the plans. Tolerances for steel reinforcement placement shall be in accordance with 901.62. In the absence of specifications on the plans, tolerances shall comply with the latest version of the PCI MNL 135, Precast Tolerance Manual.

### **Forms.**

Concrete shall be cast in rigidly constructed forms, which will maintain the Prestressed Concrete Beams within specified tolerances to the shapes, lines and dimensions shown on the approved fabrication drawings. Forms shall be constructed from flat, smooth, non-absorbent material and shall be sufficiently tight to prevent the leakage of the plastic concrete. When wood forms are used, all faces in contact with the concrete shall be laminated or coated with a non-absorbent material. All worn or damaged forms, which cause irregularities on the concrete surface or damage to the concrete during form removal, shall be repaired or replaced before being reused. Any defects or damage of more than "Category 2, Minor Defects" made to the concrete, due to form work, stripping or handling, shall be subject to repair or rejection, as defined in the *Repairs and Replacement* section. If threaded inserts are cast into the elements for support of formwork, the inserts shall be recessed a minimum of 1 inch and shall be plugged after use with a grout of the same color as that of the precast cement concrete.

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### **Mixing of Concrete.**

The concrete shall be proportioned and mixed in conformance with the Fabricator's MassDOT approved mix design and M4.02.10 Mixing and Delivery. Fabrication shall not occur without prior MassDOT mix design approval. The Fabricator shall provide copies of batch tickets to the MassDOT Plant Inspector. The MassDOT Plant Inspector will verify if the batch ticket quantities are within the tolerances of the Fabricator's MassDOT approved mix design.

### **Placement of Concrete.**

Prior to the placement of concrete, the temperature of the forms shall be greater than or equal to 50°F. Quality Control inspection shall be performed by the Fabricator as specified in the *Fabricator Quality Control* section. Placement of the concrete shall not proceed until the MassDOT Plant Inspector is present to perform inspection and begin monitoring Fabricator Quality Control inspection activities and is in compliance with specifications. The MassDOT Plant Inspector shall inspect and accept the placement of the reinforcing steel and prestressing strands prior to the placement of concrete into the forms. The Fabricator shall verify all materials and equipment required for protecting and curing the concrete are readily available and meet the requirements of the *Final Curing Methods* section below. All items encased in the concrete shall be accurately placed in the position shown on the Plans and firmly held during the placing and setting of the concrete. Clearance from the forms shall be maintained by supports, spacers, or hangers and shall be of approved shape and dimension.

During placement, the concrete shall maintain a concrete temperature range between 50°F and 90°F. The Fabricator shall minimize the time to concrete placement (measured from start of mixing to completion of placement). In no event shall time to placement exceed 90 minutes. The Fabricator shall perform additional Quality Control sampling and testing on concrete that has been retempered with admixtures or hold-back water during the placement of the concrete as specified in the *Fabricator*

*Quality Control* section above. Delays or shutdowns of over 30 minutes shall not be allowed during the continuous filling of individual forms.

#### **Consolidation of Concrete.**

Suitable means shall be used for placing concrete to prevent segregation or displacement of reinforcing steel or forms. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both. Vibrators shall not be used to move concrete within the forms. Vibrators shall be used as specified in 901.63C and as directed by the Engineer. Concrete shall be placed and consolidated in a way that minimizes the presence of surface voids or bug holes on the formed surfaces. When used, self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

#### **Finishing of Concrete.**

The top of the prestressed concrete beams shall be given a rake finish with a ¼” amplitude applied transversely across the beam to the limits shown on the plans.

#### **Exposed Surfaces of Prestressed Concrete Beams.**

As soon as conditions permit, before the concrete has fully hardened, all dirt, laitance, and loose aggregate shall be removed from the exposed concrete surfaces. Contractor shall not allow foot traffic on the uncured concrete until it has reached sufficient strength to prevent damage.

#### **Initial Curing Methods.**

After the placement of concrete and prior to concrete finishing, the Fabricator shall initiate initial curing methods when the concrete surface begins to dry, to reduce moisture loss from the surface. Application of one or more of the following initial curing methods shall occur immediately after the bleed water sheen has disappeared.

##### **1. Fogging.**

Fogging nozzles shall atomize water into a fog-like mist. The fog spray shall be directed and remain visibly suspended above the concrete surface, to increase the humidity of the air and reduce the rate of evaporation. Water from fogging shall not be worked into the surface during finishing operations and shall be removed or allowed to evaporate prior to finishing.

##### **2. Liquid-applied Evaporation Reducers**

Evaporation reducers shall be sprayed onto the freshly placed concrete surface to produce an effective monomolecular film that reduces the risk of plastic-shrinkage cracking and rate of evaporation of the bleed water from the concrete surface. Evaporation reducers shall be applied in accordance with manufacturer’s recommendations.

#### **Intermediate Curing Methods.**

The Fabricator shall initiate intermediate curing methods if concrete finishing has taken place prior to the concrete reaching final set. The freshly finished concrete surface shall be protected from moisture loss, by the continuation of initial curing methods (fogging and evaporation reducers) until final curing methods are applied or by the use of liquid membrane-forming curing compounds (see *Liquid Membrane-Forming Compounds for Curing* section).

#### **Final Curing Methods.**

The Fabricator shall initiate and apply final curing methods to the concrete immediately after the following conditions are met:

- (a) Completion of concrete finishing
- (b) Final set of concrete
- (c) Concrete has hardened sufficiently enough to prevent surface damage

During fabrication of Prestressed Concrete Beams, the Fabricator shall maintain the required concrete temperature ranges throughout the entire duration of the final curing method cycle as specified herein. Controlled and gradual termination of the final curing method shall occur after all specified conditions are met. The concrete temperature shall be reduced at a rate not to exceed 36°F per hour until the concrete temperature is within 20°F of the ambient temperature outside of the final curing method enclosure. The Fabricator shall maintain a minimum concrete temperature of 40°F until 100% f'c is attained (see *Handling and Storage* section below).

**1. Water Spray Curing.**

All exposed concrete surfaces shall remain moist with a continuous fine spray of water throughout the entire duration of the final curing method cycle (see *Table 4: Final Curing Method Cycle for Water Spray*).

**Table 4: Final Curing Method Cycle for Water Spray**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Five (5) days	≥ 80% f'c

**Saturated Covers for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of saturated covers throughout the entire duration of the final curing method cycle (see *Table 5: Final Curing Method Cycle for Saturated Covers*). Saturated covers shall be allowed to dry thoroughly before removal to provide uniform, slow drying of the concrete surface.

**Table 5: Final Curing Method Cycle for Saturated Covers**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Three (3) days	≥ 80% f'c

Saturated covers, such as burlap, cotton mats, and other coverings of absorbent materials shall meet the requirements of 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 concrete. 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 the concrete. Saturated covers shall have sufficient thickness and proper positioning onto the concrete surface to maximize moisture retention.

Saturated covers shall contain a sufficient amount of moisture to prevent moisture loss from the surface of the concrete. Saturated covers shall be kept continuously moist so that a film of water remains on the concrete surface throughout the entire duration of the final curing method cycle. The Fabricator shall not permit the saturated covers to dry and absorb water from the concrete. Use of

polyethylene film (see *Polyethylene Film* section) may be applied over the saturated cover to potentially decrease the need for continuous watering.

**Sheet Materials for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of curing sheet materials throughout the entire duration of the final curing method cycle (see *Table 6: Final Curing Method Cycle for Curing Sheet Materials*).

**Table 6: Final Curing Method Cycle for Sheet Materials**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Three (3) days	≥ 80% f <sub>c</sub>

Sheet Materials used for curing, such as polyethylene film, white burlap-polyethylene sheeting, and reinforced paper shall meet the requirements of ASTM C171 and the specifications 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 covers shall be secured to maintain a moist environment.

**Polyethylene Film.**

Polyethylene film shall meet the requirements of ASTM C171, consist of a single sheet manufactured from polyethylene resins, be free of visible defects, and have a uniform appearance. Careful considerations shall be taken by the Fabricator to prevent the film from tearing during storage and application, so as to not disrupt the continuity of the film (polyethylene film reinforced with glass or other fibers is more durable and less likely to be torn). The Fabricator shall monitor the application of the film to prevent uneven spots from appearing (mottling) on the concrete surface, due to variations in temperature, moisture content, or both. The Fabricator shall prevent mottling from occurring on the concrete surface by applying additional water under the film or applying a combination of polyethylene film bonded to absorbent fabric to the concrete surface to retain and evenly distribute the moisture. Immediately following final finishing, polyethylene film shall be placed over the surface of the fresh concrete surface, so as to not damage the surface of the concrete and shall be placed and weighted so that it remains in contact with the concrete throughout the entire duration of the final curing method cycle. The film shall extend beyond the edges of the concrete surface. The film shall be placed flat on the concrete surface, avoiding wrinkles, to minimize mottling. 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.

**White Burlap-Polyethylene Sheeting**

White burlap-polyethylene sheeting shall meet the requirements of ASTM C171, be securely bonded to the burlap so to avoid separation of the materials during handling and curing of the concrete, and be applied in the same manner as the polyethylene film.

**Reinforced Impervious Paper.**

Reinforced impervious paper shall meet the requirements of ASTM C171, 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, and be white in color. Reinforced impervious paper shall be treated to prevent tearing when wetted and dried.

Reinforced impervious paper can be reused so long as it is effective in retaining moisture on the concrete surface. The Fabricator shall visually inspect the reinforced impervious paper for all holes, tears, and pin holes from deterioration of the paper through repeated use by holding the paper up to the light. The paper shall be discarded and prohibited from use when the moisture is no longer retained.

After the concrete has hardened sufficiently to prevent surface damage, the concrete surface shall be thoroughly wetted prior to the application of the reinforced impervious paper, and be applied in the same manner as the polyethylene film.

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

All exposed concrete surfaces shall remain moist with a continuous application of liquid membrane-forming compounds throughout the entire duration of the final curing method cycle (see *Table 7: Final Curing Method Cycle for Liquid Membrane-Forming Compounds*).

**Table 7: Final Curing Method Cycle for Liquid Membrane-Forming Compounds**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Seven (7) days	≥ 80% f <sub>c</sub>

Liquid membrane-forming compounds shall meet the requirements of ASTM C 1315, Type I, Class A and shall exhibit specific properties, such as alkali resistance, acid resistance, adhesion-promoting quality, and resistance to degradation by ultraviolet light, in addition to moisture-retention capabilities. Liquid membrane-forming compounds shall consist of waxes, resins, chlorinated rubber, or other materials to reduce evaporation of moisture from concrete. Liquid membrane-forming compounds shall be applied in accordance with the manufacturer’s recommendations.

Liquid membrane-forming compounds shall be applied immediately after the disappearance of the surface water sheen following final finishing. All exposed surfaces shall be wetted immediately after form removal and kept moist to prevent absorption of the compound, allowing the curing membrane to remain on the concrete surface for proper membrane moisture retention. The concrete shall reach a uniformly damp appearance with no free water on the surface prior to the application of the compound.

If patching or finishing repairs are to be performed prior to the application of the compound, the Precast Concrete Bridge Element shall be covered temporarily with saturated covers until the repairs are completed and the compound is applied. Only areas being repaired shall be uncovered during this period. While the saturated covers are removed to facilitate the patching process, the work shall continue uninterrupted. If for any reason the work is interrupted, saturated covers shall be placed onto the uncovered concrete surface, until the work continues and is completed, at which time the curing compound shall be applied to the repaired area.

Careful considerations shall be made by the Fabricator 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. Under such conditions, the application of liquid membrane-forming compounds to the concrete surface shall be delayed, in order to prevent bleed water from being sealed below the concrete surface and avert map cracking of the membrane films, reduction in moisture-retention capability, and reapplication of the compound. To diagnose and prevent this condition, the Fabricator shall 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.

The compound shall be applied in two applications at right angles to each other to ensure uniform and more complete coverage. On very deeply textured surfaces, the surface area to be treated shall be at least twice the surface area of a troweled or floated surface. In such cases, two separate applications may be needed, each at 200 ft<sup>2</sup>/gal., with the first being allowed to become tacky before the second is applied.

The curing compound shall be applied by power sprayer, using appropriate wands and nozzles with pressures between 25 and 100 psi. For very small areas such as repairs, the compound shall be applied with a wide, soft-bristled brush or paint roller. The compound shall be stirred or agitated before use and applied uniformly in accordance with the manufacturer's recommended rate. The Fabricator shall verify the application rates are in accordance with the manufacturer's recommended rate.

When the concrete surface is to receive paint, finishes, or toppings that require positive bond to the concrete, it is critical that the curing procedures and subsequent coatings, finishes, or toppings be compatible to achieve the necessary bond.

After the termination of the final curing method cycle has occurred, liquid membrane-forming compounds shall be removed by blast-cleaning from any concrete surface that is to receive paint, finishes, plastic concrete from secondary pour, grout, or any other toppings that require bonding to the concrete surface. These surfaces shall be further blast-cleaned to remove the cement matrix down to exposed aggregate to ensure proper bonding to the material. The method used to remove the curing compound shall not damage the reinforcement and coating. Compounds are prohibited on any concrete surface that will have a penetrating or coating type treatment such as a sealer, stain, or waterproofing membrane applied to it.

### **Accelerated Curing.**

Accelerated curing shall use live steam or radiant heat with moisture in accordance with PCI MNL-116 as modified herein. The concrete temperature shall meet the maximum heat increase and cool down rates as specified herein. Concrete temperature monitoring shall meet the requirements of the *Temperature Monitoring* section. Excessive and fluctuating rates of heating and cooling shall be prohibited. The concrete temperature shall not exceed 158°F at any time. The Fabricator shall meet the following accelerated curing sequencing and requirements.

### **Initial Delay Period.**

The initial delay period shall be defined as the duration immediately following the placement of the concrete and the attainment of initial set of the concrete. The Fabricator shall determine the time of initial set in accordance with AASHTO T 197 specifications. Throughout the entire duration of the initial delay period, initial curing shall be implemented. The temperature increase period (see *Temperature Increase Period* section) shall not occur until initial set of the concrete is attained. During the initial delay period, the concrete temperature shall meet the following requirements:

- i. Concrete temperature rate of increase shall not exceed 10°F per hour.
- ii. Total concrete temperature increase shall not exceed 40°F higher than the placement concrete temperature or 100°F, whichever is less

### **Temperature Increase Period.**

The temperature increase period shall be defined as the duration immediately following the completion of the initial delay period (after initial set) and immediately prior to the start of the constant maximum temperature period. Application of steam to the enclosure shall not occur until the initial delay period is complete. After the initial delay period is complete, all exposed concrete surfaces shall be cured in a moist environment where the concrete temperature increases at a rate not to exceed 36°F per hour.

**Constant Maximum Temperature Period.**

The constant maximum temperature period shall be defined as the duration immediately following the completion of the temperature increase period and immediately prior to the start of the temperature decrease period. After the temperature increase period is complete, all exposed concrete surfaces shall be cured in a moist environment at a controlled and constant elevated temperature throughout the entire duration of the constant maximum temperature period. Termination of the constant maximum temperature period and the start of the termination decrease period shall occur after all specified conditions are met (see *Table 8: Constant Maximum Temperature Period*).

**Table 8: Constant Maximum Temperature Period**

Sustained Concrete Temperature	Constant Maximum Temperature Period	Compressive Strength
120°F ≤ °F ≤ 158°F	6 hrs ≤ Time ≤ 48 hrs	≥ 80% f <sub>c</sub>

**Temperature Decrease Period.**

After the constant maximum temperature period is complete, the concrete temperature shall be cured in a moist environment at a controlled and reduced rate not to exceed 36°F per hour until the concrete temperature is within 20°F of the ambient temperature outside of the curing enclosure.

**Release.**

The Fabricator shall not release strands or handle the Prestressed Concrete Beam until Quality Control compressive strength cylinders attain a minimum compressive strength of 80% Design Strength (f<sub>c</sub>) or the specified detensioning compression strength as indicated on the approved shop drawings has been achieved. All exposed concrete surfaces shall continue to be cured in conformance with the *Final Curing Methods* sections until completion.

**Handling and Storage of Prestressed Concrete Beams.**

Prestressed Concrete Beams may be exposed to temperatures below freezing (32°F) when the chosen curing cycle has been completed, provided that the following conditions are met:

- (a) Prestressed Concrete Beams are protected from precipitation with polyethylene curing covers until 100% f<sub>c</sub> is attained
- (b) Prestressed Concrete Beams maintain a minimum concrete temperature of 40°F until 100% f<sub>c</sub> is attained

Prestressed Concrete Beams damaged during handling and storage will be repaired or replaced at MassDOT’s direction at no cost to MassDOT. Prestressed Concrete Beams shall be lifted at the designated points by approved lifting devices embedded in the concrete and in accordance with proper

lifting and handling procedures. Storage areas shall be smooth and well compacted to prevent damage due to differential settlement. Prestressed Concrete Beams shall be supported on the ground by means of continuous blocking, in accordance with the approved dunnage plan.

Prestressed Concrete Beams shall be loaded on a trailer with blocking as described above, in accordance with the approved dunnage plan. Shock-absorbing cushioning material shall be used at all bearing points during transportation of the Prestressed Concrete Beams. Blocking shall be provided at all locations of tie-down straps. Prestressed Concrete Beams stored prior to shipment shall be inspected by the Contractor prior to being delivered to the site to identify damage that would be cause for repair or rejection.

### **Repairs and Replacement.**

In the event defects are identified, they shall be classified in the following categories and a non-conformance report (NCR) shall be filed if required. The NCR shall be submitted to MassDOT for review. Defects in all categories shall be documented by plant Quality Control personnel and made available to MassDOT upon request. Any required repairs shall utilize materials listed on the MassDOT QCML.

Where noted, defects shall be repaired according to the PCI Northeast Region Guidelines for Resolution of Non-Conformances in Prestressed Concrete Beams, Report Number PCINE-18-RNPCBE. Please note that reference to PCINE-18-RNPCBE is made for repair details only. In the case of conflicts with this Special Provision, this Special Provision shall govern.

#### **1. Category 1, Surface Defects.**

Category 1 defects do not need to be repaired, and an NCR does not need to be filed. Surface defects are defined as the following:

- (a) Surface voids or bug holes that are less than 5/8-inch in diameter and less than 1/4-inch deep, except when classified as Category 4
- (b) Cracks less than or equal to 0.006 inches wide
- (c) Cracks less than or equal to 0.125 inches wide on surfaces that will receive a concrete overlay or spray-applied membrane waterproofing

#### **2. Category 2, Minor Defects.**

Category 2 defects shall be repaired, but an NCR does not need to be filed. Minor defects are defined as the following:

- (a) Spalls, honeycombing, surface voids that are less than 2 inches deep and have no dimension greater than 12 inches
- (b) Cracks less than or equal to 0.016 inches that will not receive a concrete overlay or spray-applied membrane waterproofing
- (c) Broken or spalled corners that will be covered by field-cast concrete

Minor defects shall be repaired according to PCINE-18-RNPCBE. Cracks shall be sealed according to the PCI Repair Procedure #14 in PCINE-18-RNPCBE.

#### **3. Category 3, Major Defects.**

For Category 3 defects, the Fabricator shall prepare an NCR that documents the defect and describes the proposed repair procedure. The NCR shall be submitted to MassDOT for approval prior to performing the repair. Major defects are defined as the following:

- (a) Spalls, honeycombing and surface voids that are deeper than 2 inches or have any dimension greater than 12 inches, when measured along a straight line
- (b) Concentrated area of defects consisting of four or more Category 2 Defects within a 4-square foot area
- (c) Exposed reinforcing steel
- (d) Cracks greater than 0.016 inches and less than or equal to 0.060 inches in width that will not receive a concrete overlay or spray-applied membrane waterproofing
- (e) Bearing area spalls with dimensions not exceeding 3 inches
- (f) Cracks, spalls and honeycombing that will be encased in cast in place concrete need not be repaired, but the limits and location of the defects shall be documented with an NCR

Upon MassDOT approval, defects and cracks shall be repaired according to PCINE-18-RNPCBE and this specification. All repairs shall be completed at the expense of the Contractor.

#### **4. Category 4, Rejectable Defects.**

Rejectable defects as determined by the MassDOT Inspector, RMS, and Engineer may be cause for rejection. Fabricator may submit an NCR with a proposed repair procedure, requesting approval. Some rejectable defects are defined as the following:

- (a) Surface defects on more than 5% of the surface area which will be exposed to view after installation
- (b) Minor defects that in total make up more than 5% of the surface area of the unit
- (c) Cracks greater than 0.060 inches in width except as noted in Category 1
- (d) Elements fabricated outside of the specified tolerances
- (e) MassDOT compressive strength testing that does not meet the specified Design Strength,  $f'_c$

#### **Loading.**

Prior to the Fabricator loading the Precast Bridge Element on to the truck for shipping, the Fabricator shall provide the MassDOT Plant Inspector and RMS a minimum seven (7) days' notice of the Fabricator's intent to load the Precast Bridge Element. Inspection by the MassDOT Plant Inspector shall take place while the element is still on dunnage in the yard. The element shall not be loaded onto the truck until the MassDOT Plant Inspector has performed the inspection.

#### **Shipping.**

Prior to shipment, the Fabricator shall perform the following actions and provide the required documentation to the MassDOT Plant Inspector:

- (a) Prestressed Concrete Beams shall remain at the Fabricator's plant for a minimum of 7 days after cast date.
- (b) QC Inspection Reports shall be signed by the Quality Control Manager and provided to the MassDOT Plant Inspector.
- (c) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'_c$  for the Prestressed Concrete Beam's representative subplot shall be generated by the Fabricator and provided to the MassDOT Plant Inspector.
- (d) Certificate of Compliance shall be generated by the Fabricator as described under the Fabricator Quality Control section and provided to the MassDOT Plant Inspector.

- (e) All MassDOT RMS approved Corrective Actions submitted on the Non-Conformance Reports (NCR), shall be verified to have been completed by the MassDOT Plant Inspector and Quality Control Manager.
- (f) All NCRs shall be signed off by the Quality Control Manager, MassDOT Inspector and MassDOT RMS.

**Delivery.**

Upon Delivery, the following documentation shall be provided to the MassDOT Resident Engineer or designee:

- (a) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'c$  for the Prestressed Concrete Beam's representative subplot.
- (b) Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
- (c) QC Inspection Reports signed by the Quality Control Manager.

The Contractor shall inspect the Prestressed Concrete Beams upon receipt at the site. Prestressed Concrete Beams damaged during delivery shall be repaired or replaced at MassDOT's direction at no cost to MassDOT.

**CONSTRUCTION METHODS – FIELD CONSTRUCTION**

**General.**

All of the Contractor's field personnel involved in the erection and assembly of the Prestressed Concrete Beams shall have knowledge of and follow the approved Erection Procedure and Quality Control Plan for Prestressed Concrete Beam Assembly.

Prior to installation, the following documentation shall be reviewed and confirmed by the MassDOT Resident Engineer or designee:

- (a) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'c$  for the Prestressed Concrete Beam's representative subplot.
- (b) Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
- (c) QC Inspection Reports signed by the Quality Control Manager.

Field construction staff shall verify that the Resident Engineer has accepted all Prestressed Concrete Beams prior to installation.

**Erection Procedure and Quality Control Plan for Prestressed Concrete Beam Assembly.**

Prior to the erection, the Contractor shall submit an Erection Procedure and a Quality Control Plan for Prestressed Concrete Beam Assembly for approval by the Engineer. This submittal shall include computations and drawings for the transport, hoisting, erection and handling of the Prestressed Concrete Beams. The Erection Procedure and Quality Control Plan for Prestressed Concrete Beam Assembly shall be prepared and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts with working knowledge of the Contractor's equipment, approved shop drawings, and materials to build the bridge. The Erection Procedure and Quality Control Plan for Prestressed Concrete Beam Assembly shall, at a minimum, include the following:

**1. Erection Procedure**

The Erection Procedure shall be prepared to conform to the requirements of 960.61, Erection and the applicable sections in Chapter 8 of the PCI Design Handbook (seventh edition) for handling, erection, and bracing requirements. At a minimum, the Erection Procedure shall provide:

- (a) Steel reinforcing details, and location and details of lifting devices
- (b) Minimum concrete compressive strength for handling the Prestressed Concrete Beams.
- (c) Concrete stresses during handling, transport, and erection.
- (d) Crane capacities, pick radii, sling geometry, and lifting hardware.
- (e) Verification that the equipment can handle all pick loads and weights with the required factor of safety.
- (f) Evaluation of construction sequence and evaluation of any geometric conflicts in the lifting of the Prestressed Concrete Beams and setting them on the abutments and piers.
- (g) Design of crane supports including verification of subgrade for support.
- (h) Location and design of all temporary bracing that will be required during erection.

## **2. Quality Control Plan for Prestressed Concrete Beam Assembly**

The Quality Control Plan for Prestressed Concrete Beam Assembly is a document prepared and submitted by the Contractor prior to the start of work which requires the Contractor to identify and detail the sequence of construction in accordance with the project schedule and which clearly identifies all stages of field construction. The assembly procedures for the Prestressed Concrete Beams shall be submitted on full size 24"x36" sheets. This document will be treated as a Construction Procedure and will be reviewed by both the Designer and the District Construction Office.

At a minimum, the Quality Control Plan for Prestressed Concrete Beam Assembly shall include the following:

- (a) Listing of the equipment, materials, and personnel including their assigned responsibilities that will be used to erect and assemble the Prestressed Concrete Beams on site.
- (b) Documentation of all preparatory work necessary for moving personnel, equipment, supplies, and incidentals to the project site before beginning work.
- (c) Detailed schedule showing the sequence of operations that the Contractor will follow to complete the field construction from setting working points and working lines to the casting of closure pours and the curing of the closure pour concrete, as described below and as called for on the plans.
- (d) Timeline and descriptions of Quality Control activities to be followed throughout the field construction operations including methods and procedures for controlling tolerance limits both horizontally and vertically.

### **Survey and Layout.**

Working points, working lines, and benchmark elevations shall be established prior to placement of all elements. The Contractor is responsible for field survey as necessary to complete the work. MassDOT reserves the right to perform additional independent survey. If discrepancies are found, the Contractor may be required to verify previous survey data.

### **Prestressed NEXT F Beams.**

#### **1. Beam Layout and Erection.**

Prestressed concrete beams shall be installed to the line and grade shown on the plans in accordance with the Contractor's approved Erection Procedure and Assembly Plan.

As the beams are being erected, the Contractor shall monitor the width of the closure pours and the out-to-out width of the beams top flanges so that, after all beams are erected, the actual overall width of the bridge deck shall not deviate from the dimension shown on the plans beyond a tolerance of +0 inches and -1 inches. In order to achieve this, the Contractor may vary the width of the closure pours within the tolerances specified on the plans.

## **2. Concrete Deck Slab Placement.**

Prior to casting the deck, the abutments and piers shall be prepared for the placement of the deck concrete as called for on the plans and the Contractor shall cut the lifting devices off below the top of the beam.

The top of the beam shall be clean and free of all laitance. Deck concrete shall be placed against the beam concrete without the use of any bonding agents.

After the formwork has been removed, all threaded inserts that have been cast into the beams for support of the formwork shall be plugged with a grout of the same color as that of the precast concrete.

## **PRECAST HIGHWAY GUARDRAIL TRANSITIONS**

### **General.**

The work under this Heading consists of fabricating, transporting and installing precast highway guardrail transitions and includes all necessary labor, materials, and equipment to complete the work as shown on the Plans. The work shall conform with the MassDOT Standard, Supplemental, and Interim Specifications and the requirements of the current AASHTO LRFD Bridge Construction Specifications, supplemented by the current relevant provisions of the latest edition of PCI MNL-116 (The Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products), except as noted herein.

## **QUALITY ASSURANCE**

### **General.**

Quality Assurance includes all the planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service. It is an all-encompassing term that includes Quality Control (performed by the Fabricator) and Acceptance (performed by MassDOT). Quality Control is the system used by the Contractor and Fabricator to monitor and assess their production processes at the plant facility and installation activities at the project site to ensure that the final product will meet the specified level of quality. Acceptance includes all factors used by MassDOT to determine the corresponding value for the product. MassDOT Acceptance inspection at the plant facility is intended as a means of evaluation of compliance with contract requirements. Contractor and Fabricator Quality Control activities and MassDOT Acceptance activities shall remain independent from one another. MassDOT Acceptance activities shall not replace Fabricator Quality Control activities.

### **Fabricator Quality Control.**

Quality Control shall be performed by the Fabricator to ensure that the product is fabricated in conformance with the specifications herein. The Fabricator shall maintain a Quality Control system to monitor, assess, and adjust placement and fabrication processes to ensure the Precast Concrete Bridge Element(s) meet the specified level of quality, through sufficient Quality Control sampling, testing, inspection, and corrective action (where required). The Fabricator's Quality Control system shall address all key activities during the placement and fabrication and shall be performed in conformance with the Fabricator's NPCA or PCI Certification. Quality Control documentation shall meet the

requirements of the *Fabricator Quality Control – Documentation* section below. Upon request, Fabricator Quality Control documentation shall be provided to the MassDOT Plant Inspector.

**Plant.**

Prior to the fabrication of Precast Concrete Bridge Elements, the Fabricator's precast concrete plant shall obtain the following:

- (d) Certification by the National Precast Concrete Association (NPCA) Plant Certification Program or Precast/Prestressed Concrete Institute (PCI) Plant Certification Program, for the applicable types of Precast Concrete Bridge Element(s) being fabricated
- (e) MassDOT Prequalification
- (f) MassDOT Mix Design Approval

All concrete for a given Precast Concrete Bridge Element shall be produced by a single company and plant, unless otherwise approved by the Engineer.

**Personnel.**

The Fabricator shall provide adequate training for all QC personnel in accordance with NPCA or PCI certification. There shall be sufficient personnel trained and certified to perform the tests listed under Subsection M4.02.13, Part D. At a minimum, the Fabricator's Quality Control Personnel shall maintain the following qualifications and certifications:

- (c) QC Manager with an active NETTCP Field Technician or ACI Concrete Field Testing Technician – Grade I certification or higher, and a minimum of 4 years continuous experience in the manufacture of Precast Concrete Bridge Elements for state transportation departments. The QC Manager shall be on site while the batch plant is producing and placing concrete for MassDOT projects.
- (d) A Technician/Inspector having the Precast/Prestressed Concrete Institute (PCI) Technician/Inspector Level I or NorthEast Transportation Training and Certification Program (NETTCP) Precast Concrete Inspector, or higher.

The Contractor shall submit to the Engineer a copy of the Fabricator's Quality Control Personnel required qualifications, as specified above.

**Laboratory.**

The Fabricator shall provide a room of sufficient size to house all equipment and to adequately perform all testing. The room shall have either a separate moisture storage room or curing box for concrete cylinders, and it shall be thermostatically controlled to maintain temperatures consistent with AASHTO T 23. It shall include a desk and file cabinet for proper record keeping, and have good lighting and ventilation. This room shall be kept for testing and quality control and not used for any other purpose. An additional desk and file cabinet shall be provided for exclusive use of the Engineer. No exception from these requirements will be allowed without the express written permission of the Engineer.

**Testing Equipment.**

At a minimum, the Fabricator's plant facility shall have the following testing equipment:

- (j) Air Content Meter Type A or B: AASHTO T 152

- (k) Air Content Meter Volumetric Method: AASHTO T 196 (Required for Lightweight Concrete)
- (l) Slump Cone: AASHTO T 119
- (m) Cylinder Molds AASHTO M 205
- (n) Concrete Testing Machine: AASHTO T 22
- (o) Screening Sieve: AASHTO T 27, AASHTO T 11
- (p) Curing Box: AASHTO T 23
- (q) Spread Test Base Plate for Self-Consolidating Concrete (SCC): ASTM C1611
- (r) All other equipment prescribed by AASHTO and ASTM standards for the tests to be performed by the Fabricator as specified

### **Inspection.**

Quality Control personnel shall monitor and inspect the fabrication of each Precast Concrete Bridge Element. Quality Control personnel shall report all inspection activities on Quality Control Inspection Reports and non-conformances on Non-Conformance Reports (NCRs) throughout the entire fabrication process, as specified herein.

### **Temperature Monitoring.**

At a minimum, the Fabricator shall monitor, record, and report the temperatures of the form, ambient temperatures surrounding the concrete, and temperatures of the concrete continuously, without interruption as specified below:

- (d) Prior to placement of concrete to verify that  $T_i \geq 50^\circ\text{F}$ .
- (e) Immediately after placement to verify that  $T_i \geq 50^\circ\text{F}$  is maintained.
- (f) Throughout the entire duration of the curing cycle, at regular intervals not to exceed one hour until 100% Design Strength ( $f'_c$ ) is attained and concrete has cooled to within  $40^\circ\text{F}$  of the ambient temperature surrounding the Precast Concrete Bridge Element.

At a minimum, the temperature measuring devices shall record and report the temperature of the concrete to the nearest  $2^\circ\text{F}$ . At least two temperature sensors (thermocouples) shall be positioned to record the maximum and minimum anticipated concrete temperatures. The anticipated minimum temperature shall be measured with one or more thermocouples at a distance no greater than 2 inches from the surface of the thinnest section. The anticipated maximum temperature shall be measured with one or more thermocouples at the center of the thickest section. Proposed temperature measurement locations shall be submitted to the Engineer for approval. Temperature recording devices shall be located within the curing enclosure and calibrated as required by PCI MNL-116 Section 4.18.4. Maximum heat increase and cool down rates shall comply with PCI MNL-116, Section 4.19. The Contractor shall furnish temperature logs recorded at a minimum frequency of once per hour to the Inspector as required, with each post-pour QC inspection report.

### **Sampling and Testing.**

At a minimum, the Fabricator shall perform random Quality Control sampling and testing as specified in *Table 1: Quality Control Sampling and Testing*. The Fabricator shall perform additional Quality Control sampling and testing on concrete that has been retempered with admixtures or hold-back water during fabrication. Test Specimens shall conform to the requirements of Section M4.02.13 of the MassDOT Standard and Supplemental Specifications and AASHTO R 60, with the exception of the Stripping (80%  $f'_c$ ) set of cylinders. Stripping (80 %  $f'_c$ ) cylinders shall be cured in the same location and environment as the Precast Bridge Elements they represent. If approved by the Engineer, compressive strength cylinder match curing equipment, that maintains the same concrete conditions that

the corresponding Precast Bridge Element is exposed to, may be utilized in lieu of Stripping (80 %  $f'_c$ ) field cured cylinders, with the use of thermocouples, controllers, and heaters.

**Table 1: Quality Control Sampling and Testing**

Quality Characteristic	Test Method	Sample Size	Specification Limit	Lot Size <sup>(c)</sup>	Sublot Size <sup>(d)</sup>	Frequency	Point of Sampling
Slump (in.) <sup>(a)</sup>	AASHTO T 119	Per AASHTO	≤ 8 in. or as approved by the Engineer				
Air Content (%)	AASHTO T 152	Per AASHTO	5% ≤ % ≤ 8%				
Temperature (°F)	AASHTO T 309	Per AASHTO	50°F ≤ °F ≤ 90°F				
Compressive Strength (psi)	AASHTO T 22	Stripping Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 80% $f'_c$ at Stripping				
		7-day Cylinders: One (1) set of Three (3) 4 x 8 in.	For Information at 7 days				
		28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% $f'_c$ at 28 days				
		56-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% $f'_c$ at 56 days <sup>(b)</sup>				
				Total Quantity of Concrete (cy) produced on a Contract, per Type of Element fabricated, per Mix Design	20 cy	One (1) per Sublot or fraction thereof	Point of Discharge

**Notes:**

- (e) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (f) 56-day Compressive Strength test specimens shall require testing only when 28-day Compressive Strength test specimens have failed to meet Design Strength ( $f'_c$ ).
- (g) Lot shall be defined as a specific quantity of material from a single source, produced or placed by the same controlled process.
- (h) Sublot shall be defined as an equal division or part of a Lot from which a sample of material is obtained in order to assess the Quality Characteristics of the Lot.

**Certificate of Compliance.**

The Fabricator shall provide a Certificate of Compliance in accordance with Standard Specifications, Division I, Section 6.01, stating that QC test cylinders have achieved the design strength,  $f'_c$ . A Certificate of Compliance shall accompany each shipment and shall be presented to the MassDOT Resident Engineer or designee upon delivery to the site.

### **Documentation.**

At a minimum, the Fabricator shall maintain a filing system for the following QC records and documentation. All QC records and documentation shall be made available to MassDOT upon the request of the Department.

- (r) Current MassDOT Approved Mix Design Sheet(s) and Approval Letter(s)
- (s) PCI or NPCA Certification
- (t) Current Qualifications and Certifications for QC Manager(s) and QC Technician(s)
- (u) Most current set of Approved Shop Drawings
- (v) Approved Placement, Finishing and Curing Plan
- (w) Approved Dunnage Plan
- (x) Fabricator Certificate of Compliance for each fabricated Precast Concrete Bridge Element
- (y) Admixture Manufacturer's Certification of Compliance for each approved Admixture
- (z) Completed QC Inspection Report for each fabricated Precast Concrete Bridge Element
- (aa) Identification Number for each fabricated Precast Concrete Bridge Element
- (bb) Time and date of casting of each fabricated Precast Concrete Bridge Element
- (cc) Date of stripping of each fabricated Precast Concrete Bridge Element
- (dd) Batch Ticket Printout reporting the quantity of concrete produced for each batch of concrete produced
- (ee) Concrete temperature records for each Precast Concrete Bridge Element fabricated
- (ff) QC Test Report Forms for each subplot of concrete produced
- (gg) Non-Conformance Reports (NCRs)
- (hh) Documentation of Repairs (if applicable)

### **Acceptance.**

MassDOT will perform Acceptance inspection, sampling, and testing during fabrication and installation, to evaluate the quality and degree of compliance of the fabricated Precast Concrete Bridge Element to MassDOT specifications. Additionally, MassDOT Inspectors will monitor the Fabricator's Quality Control activities to ensure the Fabricator is properly administering Quality Control in conformance with the Fabricator's NPCA or PCI Certification. Acceptance inspection and test results not meeting MassDOT specifications will result in Non-conformance Reports (NCR) being issued by MassDOT to the Fabricator or Contractor for corrective action. Final Acceptance for the fabricated Precast Concrete Bridge Elements shall be determined by MassDOT.

### **5. Inspection.**

A MassDOT MassDOT Inspector will be assigned to perform Acceptance activities during fabrication, which includes the inspection of the materials, work procedures, and Precast Concrete Bridge Elements. At least seven (7) days prior to the scheduled start of fabrication, the Fabricator shall contact the MassDOT Research and Materials Section (RMS) to provide notice of the scheduled fabrication start date. The Fabricator shall complete the following activities prior to notifying MassDOT RMS of the scheduled start date:

- (e) Receive approval for all submitted Fabricator cement concrete mix designs from the MassDOT Research and Materials Section for the current year, as specified under the *Mix Design* section and *Table 3: Trial Batch Sampling Testing for New Mix Designs*. Self-consolidating concrete shall meet the requirements of M4.02.17.

- (f) Receive approval for the submitted Fabricator Placement, Finishing, and Curing Plan from the MassDOT Research and Materials Section, as specified under the *Placement, Finishing, and Curing Plan* section.
- (g) Receive Engineer of Record approved shop drawings from the MassDOT Research and Materials Section as specified under the *Shop Drawings* section.
- (h) Participate in the pre-production meeting, as described under the *Pre-Production Meeting* section (if required).

Prior to the start of fabrication, the Fabricator shall review the fabrication schedule with the MassDOT Inspector. Fabrication shall only proceed when:

- (c) The QC Inspector and MassDOT Inspector are present to inspect the Precast Concrete Bridge Element(s) being fabricated.
- (d) The QC Manager is present at the Fabricator’s plant.

The Fabricator shall grant access to all required areas of the Fabricator’s plant to the MassDOT Inspector, during the hours of fabrication. Fabrication without MassDOT Inspector access to required areas is prohibited, and will result in the rejection of the fabricated Precast Concrete Bridge Element(s).

Additionally, the MassDOT Inspector will monitor the adequacy of the Fabricator’s Quality Control activities. MassDOT Inspector Acceptance activities performed at the Fabricator’s plant shall remain independent from the Fabricator, and does not replace the Fabricator’s required Quality Control activities.

**6. Sampling and Testing.**

At a minimum, the MassDOT Inspector will perform random Acceptance sampling and testing for each Sublot of concrete produced as specified in *Table 2: Acceptance Sampling and Testing*. The MassDOT Inspector will also perform Acceptance sampling and testing on concrete that has been retempered with admixtures or hold-back water during production. Test Specimens will conform to the requirements of Section M4.02.13 of the MassDOT Standard and Supplemental Specifications and AASHTO R 60.

**Table 2: Acceptance Sampling and Testing**

Quality Characteristic	Test Method	Sample Size	Specification Limit	Lot Size <sup>(c)</sup>	Sublot Size <sup>(d)</sup>	Frequency	Point of Sampling
Slump (in.) <sup>(a)</sup>	AASHTO T 119	Per AASHTO	≤ 8 in. or as approved by the Engineer	Total Quantity of Concrete (cy) produced on a Contract, per Type of Element fabricated, per Mix Design	20 cy	One (1) per Sublot or fraction thereof	Point of Discharge
Air Content (%)	AASHTO T 152	Per AASHTO	5% ≤ % ≤ 8%				
Temperature (°F)	AASHTO T 309	Per AASHTO	50°F ≤ °F ≤ 90°F				
Compressive Strength (psi)	AASHTO T 22 AASHTO T 23	7-day Cylinders: One (1) set of Three (3) 4 x 8 in.	For Information at 7 days				

		28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	$\geq 100\% f_c$ at 28 days				
		56-day Cylinders: One (1) set of Three (3) 4 x 8 in.	$\geq 100\% f_c$ at 56 days <sup>(b)</sup>				

**Notes:**

- (e) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (f) 56-day Compressive Strength test specimens shall require testing only when 28-day Compressive Strength test specimens have failed to meet Design Strength ( $f_c$ ).
- (g) Lot shall be defined as a specific quantity of material from a single source, produced or placed by the same controlled process.
- (h) Sublot shall be defined as an equal division or part of a Lot from which a sample of material is obtained in order to assess the Quality Characteristics of the Lot.

**MATERIALS**

**Materials.**

Materials shall meet the following specifications (if applicable):

General	M4.00.00
Portland Cement	M4.01.0
Blended Hydraulic Cements	M4.01.1
Fly Ash	M4.01.2
Cement Concrete	M4.02.00
Cement	M4.02.01
Cement Mortar	M4.02.15
Aggregates	M4.02.02
Lightweight Aggregates	M4.02.03
Water	M4.02.04
Cement Concrete Additives	M4.02.05
Proportioning	M4.02.06
Mixing and Delivery	M4.02.10
Test Specimens	M4.02.13
Mortar for Filling Keyways	M4.04.0
Slag	AASHTO M 302
High Performance Cement Concrete	M4.06.1
Self-Consolidating Concrete (SCC)	M4.02.17
Controlled Density Fill – Non-Excavatable	M4.08.0
Reinforcing Bars	M8.01.0
Epoxy Coated Reinforcing Bars	M8.01.7
Galvanized Reinforcing Bars	M8.01.8
Welded Wire Reinforcement	M8.01.2

Mechanical Reinforcing Bar Splicer  
Lifting Devices  
Corrugated Metal Pipe

M8.01.9  
PCI MNL-116  
AASHTO M 36

### **7. Cement Concrete Mix Design.**

The cement concrete shall be comprised of specified proportions of water and MassDOT approved aggregates, cement, supplementary cementitious materials (SCMs), and admixtures to form a homogenous composition. Cement concrete for Precast Concrete Bridge Elements shall meet the requirements of M4.06.1 High Performance Cement Concrete, with the exception that the “Total Cementitious Content” specified shall be considered the “Maximum Allowable Cementitious Content”. When used, self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

Prior to production of cement concrete, the Fabricator shall report and submit all proposed mix design formulations and its constituent materials onto the MassDOT Cement Concrete Mix Design Sheet to the MassDOT Research and Materials Section for review and approval. All mix design yields shall be designed for 1.0 cubic yards of concrete, with an allowable tolerance of +/- 1.0 %. All liquids incorporated into the proposed mix design(s) shall include both water and admixtures in the liquid mass calculation.

During production of cement concrete, the Fabricator shall not alter the previously approved mix design formulation or its constituent materials. Proposed alterations in source, type, batch quantity, or gradation to any of the constituent materials of the previously approved mix design formulation shall require a new MassDOT Mix Design Sheet submission to the MassDOT Research and materials Section for review and approval. Fabrication shall not occur without prior MassDOT mix design approval.

The Fabricator shall notify MassDOT RMS to schedule trial batch testing for the new mix design(s). Trial batch testing shall meet the following requirements:

- (d) Performed by a qualified laboratory and/or AASHTO accredited laboratory.
- (e) Performed and/or sampled in the presence of a MassDOT Inspector.
- (f) Meet the requirements as specified in *Table 3: Trial Batch Sampling Testing for New Mix Designs*. Self-consolidating concrete (SCC) shall meet M4.02.17.

Failure to perform all of the required trial batch testing or provide MassDOT RMS trial batch test results within the Specification Limits (as specified in Table 3) will result in the disqualification of the Fabricator’s proposed mix design(s).

**Table 3: Trial Batch Sampling and Testing for New Mix Designs**

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Slump <sup>(a)</sup>	AASHTO T 119	Per AASHTO	Max. 8 inches or as approved by the Engineer	Quality Control
Air Content (AC)	AASHTO T 152	Per AASHTO	$5\% \leq AC \leq 8\%$	Quality Control
Temperature (°F)	AASHTO T 309	Per AASHTO	$50^{\circ}\text{F} \leq ^{\circ}\text{F} \leq 90^{\circ}\text{F}$	Quality Control
Compressive Strength <sup>(b)</sup>	AASHTO T 22 AASHTO T 23	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Lab Mixed $f'_{cr} = 1.3 f'_c$ at 28 days	MassDOT
			Batch Mixed $f'_{cr} = 1.2 f'_c$ at 28 days	
Alkali-Silica Reaction (ASR) <sup>(d)</sup>	ASTM C 1567	Per ASTM	M4.02.00	Quality Control
Resistance to Chloride Ion Penetration Chloride Ion Penetration <sup>(e)</sup>	AASHTO T 358 <sup>(f)</sup>	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Resistivity $\geq 21$ k $\Omega$ -cm at 28 days	MassDOT
Freeze/Thaw Durability <sup>(c)</sup>	AASHTO T 161 (Procedure A)	Per AASHTO	Relative Dynamic Modulus of Elasticity after 300 cycles $\geq 80\%$	Quality Control

**Notes:**

- (g) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (h) Trial batch compressive strength testing shall be performed by MassDOT. Laboratory mixed trial batch compressive strength results shall achieve 130% Design Strength ( $f'_c$ ). Batch-mixed trial batch compressive results shall achieve 120%  $f'_c$ . Acceptance will be based on compressive strength testing performed by MassDOT.
- (i) If an AASHTO accredited laboratory is preparing the trial batch test specimens, MassDOT Acceptance presence is not required. If the Fabricator is preparing the trial batch test specimens, MassDOT Acceptance presence is required during trial batch test specimen preparation.
- (j) Alkali Silica Reaction (ASR) testing shall meet the requirements of M4.02.00. Independent laboratories performing ASR testing shall be listed on the MassDOT Quality Construction Materials List (QCML).
- (k) Calcium nitrite shall be removed from mix designs containing the admixture and replaced by an equivalent quantity of water when preparing Chloride Ion Penetration resistance trial batch test specimens.
- (l) The Wenner probe tip spacing “a” shall be 1.5.

**Vertical Adjustment Assembly.**

Vertical Adjustment Assembly details and material requirements shall be as shown on the plans. Alternate devices may be used provided that they are adjustable and can support the anticipated loads. The design of the leveling devices, with necessary calculations, shall be submitted to the Engineer of Record for approval.

**Grout.**

Grout used for shear keys, vertical adjustment assembly voids, and hand holes shall be in accordance with M4.04.0.

**Reinforcement.**

All reinforcing steel shall be coated Grade 60 unless otherwise noted on the plans. Mechanical reinforcing bar splicers shall be epoxy coated.

**Threaded Inserts.**

Threaded inserts are permissible to facilitate forming the keyway pours. Threaded inserts shall be hot dip galvanized or made of stainless steel. The number of threaded inserts shall be minimized, and the inserts shall not come in contact with the reinforcing steel.

**Corrugated Metal Pipe.**

Corrugated Metal Pipe to be used for forming voids as specified on the plans shall be fabricated from steel and shall have a protective metallic coating of zinc (galvanizing).

## CONSTRUCTION METHODS – PLANT FABRICATION

**Shop Drawings.**

Prior to performing any work under this Section, the Contractor shall receive approval for all shop drawings for the Precast Concrete Bridge Element being worked on and any special Contract requirements, provided that a complete shop drawing package is provided. The Contractor shall not order materials or begin work before receiving approved shop drawings. MassDOT will reject Precast Concrete Bridge Elements that deviate from the approved drawings or are fabricated prior to receiving written approval of the shop drawings. The Contractor shall bear full responsibility and costs for all materials ordered or work performed prior to the approval of the shop drawings or written authorization from MassDOT.

Contractor shall submit scaled shop drawings to the Engineer of Record for review and approval. Upon approval, the Engineer of Record will forward two (2) sets of scaled, full size (minimum 24x36”) paper copies of the Approved (or Approved As Noted) shop drawings to the MassDOT Director of Research and Materials. Calculations are not to be included in any submittal to the Research and Materials Section. An approval stamp shall appear on every shop drawing sheet. Wet-stamping or wet-signing is not required, provided that the stamp and reviewer name are legible. The Fabricator’s name and address shall appear on each sheet.

Resubmittal of “Approved as Noted” shop drawings is not necessary for minor revisions, provided that the correction can be clearly understood and is unambiguous without possibility of misinterpretation. Shop drawings with questions or comments that require a response and/or additional information from the Fabricator must be resubmitted.

Detailed shop drawings shall be prepared in accordance with the relevant provisions of Subsection 5.02 and shall, at a minimum, contain the following:

- (h) Number and type and/or piece mark of the precast concrete bridge element including overall length, width and height.
- (i) Skew angle.
- (j) Location, size and geometry of all steel reinforcement, including mechanical reinforcing bar splicers to be used for connecting Precast Concrete Bridge Elements together in the field.
- (k) Location and details of all inserts, anchors, Vertical Adjustment Assemblies, and any other items required to be cast into the Precast Concrete Bridge Elements (whether detailed on the plans by the Engineer of Record or provided for the Contractor's convenience). Precast Concrete Bridge

Elements shall not be fired or drilled into for attachment purposes. All hardware shall be galvanized except as noted.

- (l) Locations and details of the lifting devices, including supporting calculations, type and amount of any additional reinforcing required for lifting. The Fabricator shall design all lifting devices based on the no cracking criteria in Chapter 8 of the PCI Design Handbook (7<sup>th</sup> edition).
- (m) The minimum compressive strength required prior to handling the precast concrete bridge element.

The shop drawings shall not include procedures for placement, finishing, and curing of concrete. These details shall be included in the Placement, Finishing and Curing Plan that is to be submitted to MassDOT Research and Materials Section as described under *Placement, Finishing, and Curing Plan*.

### **Fabrication.**

All Precast Concrete Bridge Elements shall be fabricated in accordance with the latest edition of PCI MNL-116 as modified herein.

### **Placement, Finishing and Curing Plan.**

At least 30 days prior to start of fabrication, the Contractor shall submit the Fabricator's proposed Placement, Finishing and Curing Plan to the Engineer for approval by MassDOT Research and Materials Section. This shall be an independent submittal, separate from the fabrication shop drawings. The Placement, Finishing and Curing Plan shall include the following:

- (k) Method of Mixing
- (l) Method of Placement
- (m) Method of Consolidation
- (n) Method of Finishing
- (o) Method of Initial Curing
- (p) Method of Intermediate Curing
- (q) Method of Final Curing
- (r) Moisture Retention Materials and Equipment (water spray equipment, saturated covers, sheet materials, liquid membrane-forming compounds, accelerated curing equipment, etc.)
- (s) Cylinder Curing Methods, Location, and Environmental Control (temperature, humidity, etc.)
- (t) Temperature Monitoring, Recording, and Reporting

### **Dunnage Plan Shop Drawings.**

At least 30 days prior to the start of fabrication, the Contractor shall submit proposed Dunnage Plan Shop Drawings to the Engineer of Record for review and approval. This shall be an independent submittal, separate from the fabrication shop drawings. Upon approval, the Engineer of Record will forward two (2) sets of scaled, full size (minimum 24"x36") paper copies of the Approved (or Approved As Noted) Dunnage Plan to the MassDOT Director of Research and Materials. Calculations are not to be included in any submittal to the Research and Materials Section. The Dunnage Plan shall include the following:

- (d) Proposed layout of the Precast Concrete Bridge Elements for storage in yard and during shipping
- (e) Support and blocking point locations
- (f) Support and blocking materials

**Pre-Production Meeting.**

The Contractor shall notify the MassDOT Research and Materials Section to determine if a pre-production meeting will be required to review the specification, shop drawings, curing plan, schedule, and discuss any specific requirements. The meeting shall be held prior to scheduling a MassDOT Inspector (refer to Section *Quality Assurance – Precast Concrete, C. Acceptance, A. Inspection*), and at least seven (7) days prior to the scheduled casting of any Precast Concrete Bridge Element or control section. The Contractor shall schedule the meeting, which shall include representatives of the Fabricator and MassDOT.

**Reinforcement.**

The reinforcing bars shall be installed in accordance with Section 901.62 of the Supplemental Specifications, including tolerances for cover and horizontal spacing of bars. Components of mechanical reinforcing bar splicers shall be set with the tolerances shown on the plans. The reinforcing bars and mechanical reinforcing bar splicers shall be assembled into a rigid cage that will maintain its shape in the form and which will not allow individual reinforcing bars to move during the placement of concrete. This cage shall be secured in the form so that the clearances to all faces of the concrete, as shown on the plans, shall be maintained.

Where reinforcing bars are to protrude from one Precast Concrete Bridge Element in order to mate with reinforcing bar splicers in a second precast concrete element, the fabricator shall set the reinforcing bars and the reinforcing bar splicers with a template in order to ensure proper fit up within the tolerances specified on the plans.

**Tolerances.**

Fabrication shall comply with tolerances specified on the plans. Tolerances for steel reinforcement placement shall be in accordance with 901.62. In the absence of specifications on the plans, tolerances shall comply with the latest version of the PCI MNL 135, Precast Tolerance Manual.

**Forms.**

Concrete shall be cast in rigidly constructed forms, which will maintain the Precast Concrete Bridge Elements within specified tolerances to the shapes, lines and dimensions shown on the approved fabrication drawings. Forms shall be constructed from flat, smooth, non-absorbent material and shall be sufficiently tight to prevent the leakage of the plastic concrete. When wood forms are used, all faces in contact with the concrete shall be laminated or coated with a non-absorbent material. All worn or damaged forms, which cause irregularities on the concrete surface or damage to the concrete during form removal, shall be repaired or replaced before being reused. Any defects or damage of more than “Category 2, Minor Defects” made to the concrete, due to form work, stripping or handling, shall be subject to repair or rejection, as defined in the *Repairs and Replacement* section. If threaded inserts are cast into the elements for support of formwork, the inserts shall be recessed a minimum of 1 inch and shall be plugged after use with a grout of the same color as that of the precast cement concrete.

**Mixing of Concrete.**

The concrete shall be proportioned and mixed in conformance with the Fabricator’s MassDOT approved mix design and M4.02.10 Mixing and Delivery Fabrication shall not occur without prior MassDOT mix design approval. The Fabricator shall provide copies of batch tickets to the MassDOT Plant Inspector. The MassDOT Plant Inspector will verify if the batch ticket quantities are within the tolerances of the Fabricator’s MassDOT approved mix design.

### **Placement of Concrete.**

Prior to the placement of concrete, the temperature of the forms shall be greater than or equal to 50°F. Quality Control inspection shall be performed by the Fabricator as specified in the *Fabricator Quality Control* section. Placement of the concrete shall not proceed until the MassDOT Plant Inspector is present to perform inspection and begin monitoring Fabricator Quality Control inspection activities, and is in compliance with specifications. The MassDOT Plant Inspector shall inspect and accept the placement of the reinforcing steel prior to the placement of concrete into the forms. The Fabricator shall verify all materials and equipment required for protecting and curing the concrete are readily available and meet the requirements of the *Final Curing Methods* section below. All items encased in the concrete shall be accurately placed in the position shown on the Plans and firmly held during the placing and setting of the concrete. Clearance from the forms shall be maintained by supports, spacers, or hangers and shall be of approved shape and dimension.

During placement, the concrete shall maintain a concrete temperature range between 50°F and 90°F. The Fabricator shall minimize the time to concrete placement (measured from start of mixing to completion of placement). In no event shall time to placement exceed 90 minutes. The Fabricator shall perform additional Quality Control sampling and testing on concrete that has been retempered with admixtures or hold-back water during the placement of the concrete as specified in the *Fabricator Quality Control* section above. Delays or shutdowns of over 30 minutes shall not be allowed during the continuous filling of individual forms.

### **Consolidation of Concrete.**

Suitable means shall be used for placing concrete to prevent segregation or displacement of reinforcing steel or forms. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both. Vibrators shall not be used to move concrete within the forms. Vibrators shall be used as specified in 901.63C and as directed by the Engineer. Concrete shall be placed and consolidated in a way that minimizes the presence of surface voids or bug holes on the formed surfaces. When used, self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

### **Finishing of Concrete.**

The finish of the Precast Concrete Bridge Elements shall be as indicated on the plans. Where Precast Concrete Bridge Elements have keyways for grout or closure pours, the surfaces of these shear keys shall be abrasive blasted prior to shipment. The Fabricator may utilize a surface retarder with water blast, sandblast, or a combination of both to achieve the desired keyway finish. At a minimum, the profile of the keyway surfaces shall be similar to that of 60 grit sand paper. The exposed reinforcing steel in the precast slab shall be protected from damage during the cleaning of the keyways. Damaged epoxy coating of steel reinforcement shall be repaired, and the reinforcing steel shall be cleaned as directed by the Engineer.

The Fabricator shall permanently mark each precast concrete bridge element with its type and/or piece mark, date of casting, and supplier identification either by stamp markings in fresh concrete, waterproof paint, or other approved means on a surface that will not be exposed after assembly.

### **Exposed Surfaces of Precast Concrete Bridge Elements.**

As soon as conditions permit, before the concrete has fully hardened, all dirt, laitance, and loose aggregate shall be removed from the exposed concrete surfaces. Contractor shall not allow foot traffic on the uncured concrete until it has reached sufficient strength to prevent damage.

### **Exposed Surfaces of Closure Pour Shear Keys.**

The closure pour shear key cast in the sides of the beam flanges shall have an exposed aggregate finish. The closure pour reinforcing steel and its coating shall not be damaged by the process for creating the exposed aggregate surface. Fabricator may utilize a surface retarder with water blast, abrasive blast, or a combination of both to achieve the desired shear key finish. The abrasive blast shall use oil free compressed air. The profile of the shear key surfaces shall be similar to that of 60 grit sand paper.

### **Initial Curing Methods.**

After the placement of concrete and prior to concrete finishing, the Fabricator shall initiate initial curing methods when the concrete surface begins to dry, to reduce moisture loss from the surface. Application of one or more of the following initial curing methods shall occur immediately after the bleed water sheen has disappeared.

#### **1. Fogging.**

Fogging nozzles shall atomize water into a fog-like mist. The fog spray shall be directed and remain visibly suspended above the concrete surface, to increase the humidity of the air and reduce the rate of evaporation. Water from fogging shall not be worked into the surface during finishing operations and shall be removed or allowed to evaporate prior to finishing.

#### **2. Liquid-applied Evaporation Reducers**

Evaporation reducers shall be sprayed onto the freshly placed concrete surface to produce an effective monomolecular film that reduces the risk of plastic-shrinkage cracking and rate of evaporation of the bleed water from the concrete surface. Evaporation reducers shall be applied in accordance with manufacturer's recommendations.

### **Intermediate Curing Methods.**

The Fabricator shall initiate intermediate curing methods if concrete finishing has taken place prior to the concrete reaching final set. The freshly finished concrete surface shall be protected from moisture loss, by the continuation of initial curing methods (fogging and evaporation reducers) until final curing methods are applied or by the use of liquid membrane-forming curing compounds (see *Liquid Membrane-Forming Compounds for Curing* section).

### **Final Curing Methods.**

The Fabricator shall initiate and apply final curing methods to the concrete immediately after the following conditions are met:

- (d) Completion of concrete finishing
- (e) Final set of concrete
- (f) Concrete has hardened sufficiently enough to prevent surface damage

During fabrication of Precast Concrete Bridge Elements, the Fabricator shall maintain the required concrete temperature ranges throughout the entire duration of the final curing method cycle as specified herein. Controlled and gradual termination of the final curing method shall occur after all specified conditions are met. The concrete temperature shall be reduced at a rate not to exceed 36°F per hour until the concrete temperature is within 20°F of the ambient temperature outside of the final curing method enclosure. The Fabricator shall maintain a minimum concrete temperature of 40°F until 100% f'c is attained (see *Handling and Storage* section below).

### 1. Water Spray Curing.

All exposed concrete surfaces shall remain moist with a continuous fine spray of water throughout the entire duration of the final curing method cycle (see *Table 4: Final Curing Method Cycle for Water Spray*).

**Table 4: Final Curing Method Cycle for Water Spray**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Five (5) days	≥ 80% f <sub>c</sub>

### 2. Saturated Covers for Curing.

All exposed concrete surfaces shall remain moist with a continuous application of saturated covers throughout the entire duration of the final curing method cycle (see *Table 5: Final Curing Method Cycle for Saturated Covers*). Saturated covers shall be allowed to dry thoroughly before removal to provide uniform, slow drying of the concrete surface.

**Table 5: Final Curing Method Cycle for Saturated Covers**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Three (3) days	≥ 80% f <sub>c</sub>

Saturated covers, such as burlap, cotton mats, and other coverings of absorbent materials shall meet the requirements of 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 concrete. 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 the concrete. Saturated covers shall have sufficient thickness and proper positioning onto the concrete surface to maximize moisture retention.

Saturated covers shall contain a sufficient amount of moisture to prevent moisture loss from the surface of the concrete. Saturated covers shall be kept continuously moist so that a film of water remains on the concrete surface throughout the entire duration of the final curing method cycle. The Fabricator shall not permit the saturated covers to dry and absorb water from the concrete. Use of polyethylene film (see *Polyethylene Film* section) may be applied over the saturated cover to potentially decrease the need for continuous watering.

### 3. Sheet Materials for Curing.

All exposed concrete surfaces shall remain moist with a continuous application of curing sheet materials throughout the entire duration of the final curing method cycle (see *Table 6: Final Curing Method Cycle for Curing Sheet Materials*).

**Table 6: Final Curing Method Cycle for Sheet Materials**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Three (3) days	≥ 80% f <sub>c</sub>

Sheet Materials used for curing, such as polyethylene film, white burlap-polyethylene sheeting, and reinforced paper shall meet the requirements of ASTM C171 and the specifications 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 covers shall be secured to maintain a moist environment.

#### **Polyethylene Film.**

Polyethylene film shall meet the requirements of ASTM C171, consist of a single sheet manufactured from polyethylene resins, be free of visible defects, and have a uniform appearance. Careful considerations shall be taken by the Fabricator to prevent the film from tearing during storage and application, so as to not disrupt the continuity of the film (polyethylene film reinforced with glass or other fibers is more durable and less likely to be torn). The Fabricator shall monitor the application of the film to prevent uneven spots from appearing (mottling) on the concrete surface, due to variations in temperature, moisture content, or both. The Fabricator shall prevent mottling from occurring on the concrete surface by applying additional water under the film or applying a combination of polyethylene film bonded to absorbent fabric to the concrete surface to retain and evenly distribute the moisture. Immediately following final finishing, polyethylene film shall be placed over the surface of the fresh concrete surface, so as to not damage the surface of the concrete and shall be placed and weighted so that it remains in contact with the concrete throughout the entire duration of the final curing method cycle. The film shall extend beyond the edges of the concrete surface. The film shall be placed flat on the concrete surface, avoiding wrinkles, to minimize mottling. 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.

#### **White Burlap-Polyethylene Sheeting**

White burlap-polyethylene sheeting shall meet the requirements of ASTM C171, be securely bonded to the burlap so to avoid separation of the materials during handling and curing of the concrete, and be applied in the same manner as the polyethylene film.

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

Reinforced impervious paper shall meet the requirements of ASTM C171, 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, and be white in color. Reinforced impervious paper shall be treated to prevent tearing when wetted and dried.

Reinforced impervious paper can be reused so long as it is effective in retaining moisture on the concrete surface. The Fabricator shall visually inspect the reinforced impervious paper for all holes, tears, and pin holes from deterioration of the paper through repeated use by holding the paper up to the light. The paper shall be discarded and prohibited from use when the moisture is no longer retained.

After the concrete has hardened sufficiently to prevent surface damage, the concrete surface shall be thoroughly wetted prior to the application of the reinforced impervious paper, and be applied in the same manner as the polyethylene film.

#### **4. Liquid Membrane-Forming Compounds for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of liquid membrane-forming compounds throughout the entire duration of the final curing method cycle (see *Table 7: Final Curing Method Cycle for Liquid Membrane-Forming Compounds*).

**Table 7: Final Curing Method Cycle for Liquid Membrane-Forming Compounds**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Seven (7) days	≥ 80% f <sub>c</sub>

Liquid membrane-forming compounds shall meet the requirements of ASTM C 1315, Type I, Class A and shall exhibit specific properties, such as alkali resistance, acid resistance, adhesion-promoting quality, and resistance to degradation by ultraviolet light, in addition to moisture-retention capabilities. Liquid membrane-forming compounds shall consist of waxes, resins, chlorinated rubber, or other materials to reduce evaporation of moisture from concrete. Liquid membrane-forming compounds shall be applied in accordance with the manufacturer's recommendations.

Liquid membrane-forming compounds shall be applied immediately after the disappearance of the surface water sheen following final finishing. All exposed surfaces shall be wetted immediately after form removal and kept moist to prevent absorption of the compound, allowing the curing membrane to remain on the concrete surface for proper membrane moisture retention. The concrete shall reach a uniformly damp appearance with no free water on the surface prior to the application of the compound.

If patching or finishing repairs are to be performed prior to the application of the compound, the Precast Concrete Bridge Element shall be covered temporarily with saturated covers until the repairs are completed and the compound is applied. Only areas being repaired shall be uncovered during this period. While the saturated covers are removed to facilitate the patching process, the work shall continue uninterrupted. If for any reason the work is interrupted, saturated covers shall be placed onto the uncovered concrete surface, until the work continues and is completed, at which time the curing compound shall be applied to the repaired area.

Careful considerations shall be made by the Fabricator 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. Under such conditions, the application of liquid membrane-forming compounds to the concrete surface shall be delayed, in order to prevent bleed water from being sealed below the concrete surface and avert map cracking of the membrane films, reduction in moisture-retention capability, and reapplication of the compound. To diagnose and prevent this condition, the Fabricator shall 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.

The compound shall be applied in two applications at right angles to each other to ensure uniform and more complete coverage. On very deeply textured surfaces, the surface area to be treated shall be at least twice the surface area of a troweled or floated surface. In such cases, two separate applications may be needed, each at 200 ft<sup>2</sup>/gal., with the first being allowed to become tacky before the second is applied.

The curing compound shall be applied by power sprayer, using appropriate wands and nozzles with pressures between 25 and 100 psi. For very small areas such as repairs, the compound shall be applied with a wide, soft-bristled brush or paint roller. The compound shall be stirred or agitated before use and applied uniformly in accordance with the manufacturer's recommended rate. The Fabricator shall verify the application rates are in accordance with the manufacturer's recommended rate.

When the concrete surface is to receive paint, finishes, or toppings that require positive bond to the concrete, it is critical that the curing procedures and subsequent coatings, finishes, or toppings be compatible to achieve the necessary bond.

After the termination of the final curing method cycle has occurred, liquid membrane-forming compounds shall be removed by blast-cleaning from any concrete surface that is to receive paint, finishes, plastic concrete from secondary pour, grout, or any other toppings that require bonding to the concrete surface. These surfaces shall be further blast-cleaned to remove the cement matrix down to

exposed aggregate to ensure proper bonding to the material. The method used to remove the curing compound shall not damage the reinforcement and coating. Compounds are prohibited on any concrete surface that will have a penetrating or coating type treatment such as a sealer, stain, or waterproofing membrane applied to it.

**5. Accelerated Curing.**

Accelerated curing shall use live steam or radiant heat with moisture in accordance with PCI MNL-116 as modified herein. The concrete temperature shall meet the maximum heat increase and cool down rates as specified herein. Concrete temperature monitoring shall meet the requirements of the *Temperature Monitoring* section. Excessive and fluctuating rates of heating and cooling shall be prohibited. The concrete temperature shall not exceed 158°F at any time. The Fabricator shall meet the following accelerated curing sequencing and requirements.

**Initial Delay Period.**

The initial delay period shall be defined as the duration immediately following the placement of the concrete and the attainment of initial set of the concrete. The Fabricator shall determine the time of initial set in accordance with AASHTO T 197 specifications. Throughout the entire duration of the preset period, initial curing shall be implemented. The temperature increase period (see *Temperature Increase Period* section) shall not occur until initial set of the concrete is attained. During the initial delay period, the concrete temperature shall meet the following requirements:

- iii. Concrete temperature rate of increase shall not exceed 10°F per hour.
- iv. Total concrete temperature increase shall not exceed 40°F higher than the placement concrete temperature or 100°F, whichever is less

**Temperature Increase Period.**

The temperature increase period shall be defined as the duration immediately following the completion of the initial delay period (after initial set) and immediately prior to the start of the constant maximum temperature period. Application of steam to the enclosure shall not occur until the initial delay period is complete. After the initial delay period is complete, all exposed concrete surfaces shall be cured in a moist environment where the concrete temperature increases at a rate not to exceed 36°F per hour.

**Constant Maximum Temperature Period.**

The constant maximum temperature period shall be defined as the duration immediately following the completion of the temperature increase period and immediately prior to the start of the temperature decrease period. After the temperature increase period is complete, all exposed concrete surfaces shall be cured in a moist environment at a controlled and constant elevated temperature throughout the entire duration of the constant maximum temperature period. Termination of the constant maximum temperature period and the start of the termination decrease period shall occur after all specified conditions are met (see *Table 8: Constant Maximum Temperature Period*).

**Table 8: Constant Maximum Temperature Period**

Sustained Concrete Temperature	Constant Maximum Temperature Period	Compressive Strength
120°F ≤ °F ≤ 158°F	6 hrs ≤ Time ≤ 48 hrs	≥ 80% f <sub>c</sub>

### **Temperature Decrease Period.**

After the constant maximum temperature period is complete, the concrete temperature shall be cured in a moist environment at a controlled and reduced rate not to exceed 36°F per hour until the concrete temperature is within 20°F of the ambient temperature outside of the curing enclosure.

### **Stripping.**

The Fabricator shall not strip forms or handle the Precast Concrete Bridge Element until Quality Control compressive strength cylinders attain a minimum compressive strength of 80% Design Strength ( $f'_c$ ) or the value indicated on the approved drawings has been achieved. After removal from the form, all exposed concrete surfaces shall continue to be cured in conformance with the *Final Curing Methods* sections until completion.

### **Handling and Storage of Precast Concrete Bridge Elements.**

Precast Concrete Bridge Elements may be exposed to temperatures below freezing (32°F) when the chosen curing cycle has been completed, provided that the following conditions are met:

- (c) Precast Concrete Bridge Elements are protected from precipitation with polyethylene curing covers until 100%  $f'_c$  is attained
- (d) Precast Concrete Bridge Elements maintain a minimum concrete temperature of 40°F until 100%  $f'_c$  is attained

Precast Concrete Bridge Elements damaged during handling and storage will be repaired or replaced at MassDOT's direction at no cost to MassDOT. Precast Concrete Bridge Elements shall be lifted at the designated points by approved lifting devices embedded in the concrete and in accordance with proper lifting and handling procedures. Storage areas shall be smooth and well compacted to prevent damage due to differential settlement. Precast Concrete Bridge Elements shall be supported on the ground by means of continuous blocking, in accordance with the approved dunnage plan.

Precast Concrete Bridge Elements shall be loaded on a trailer with blocking as described above, in accordance with the approved dunnage plan. Shock-absorbing cushioning material shall be used at all bearing points during transportation of the Precast Concrete Bridge Elements. Blocking shall be provided at all locations of tie-down straps. Precast Concrete Bridge Elements stored prior to shipment shall be inspected by the Contractor prior to being delivered to the site to identify damage that would be cause for repair or rejection.

### **Repairs and Replacement.**

In the event defects are identified, they shall be classified in the following categories and a non-conformance report (NCR) shall be filed if required. The NCR shall be submitted to MassDOT for review. Defects in all categories shall be documented by plant Quality Control personnel and made available to MassDOT upon request. Any required repairs shall utilize materials listed on the MassDOT QCML.

Where noted, defects shall be repaired according to the PCI Northeast Region Guidelines for Resolution of Non-Conformances in Precast Concrete Bridge Elements, Report Number PCINE-18-RNPCBE. Please note that reference to PCINE-18-RNPCBE is made for repair details only. In the case of conflicts with this Special Provision, this Special Provision shall govern.

#### **1. Category 1, Surface Defects.**

Category 1 defects do not need to be repaired, and an NCR does not need to be filed. Surface defects are defined as the following:

- (d) Surface voids or bug holes that are less than 5/8-inch in diameter and less than 1/4-inch deep, except when classified as Category 4
- (e) Cracks less than or equal to 0.006 inches wide
- (f) Cracks less than or equal to 0.125 inches wide on surfaces that will receive a field-cast concrete overlay

## **2. Category 2, Minor Defects.**

Category 2 defects shall be repaired, but an NCR does not need to be filed. Minor defects are defined as the following:

- (d) Spalls, honeycombing, surface voids that are less than 2 inches deep and have no dimension greater than 12 inches
- (e) Cracks less than or equal to 0.016 inches that will not receive a concrete overlay
- (f) Broken or spalled corners that will be covered by field-cast concrete

Minor defects shall be repaired according to PCINE-18-RNPCBE. Cracks shall be sealed according to the PCI Repair Procedure #14 in PCINE-18-RNPCBE.

## **3. Category 3, Major Defects.**

For Category 3 defects, the Fabricator shall prepare an NCR that documents the defect and describes the proposed repair procedure. The NCR shall be submitted to MassDOT for approval prior to performing the repair. Major defects are defined as the following:

- (g) Spalls, honeycombing and surface voids that are deeper than 2 inches or have any dimension greater than 12 inches, when measured along a straight line
- (h) Concentrated area of defects consisting of four or more Category 2 Defects within a 4-square foot area.
- (i) Exposed reinforcing steel
- (j) Cracks greater than 0.016 inches and less than or equal to 0.060 inches in width that will not receive a concrete overlay
- (k) Bearing area spalls with dimensions not exceeding 3 inches
- (l) Cracks, spalls and honeycombing that will be encased in cast in place concrete need not be repaired, but the limits and location of the defects shall be documented with an NCR

Upon MassDOT approval, defects and cracks shall be repaired according to PCINE-18-RNPCBE and this specification. All repairs shall be completed at the expense of the Contractor.

## **4. Category 4, Rejectable Defects.**

Rejectable defects as determined by the MassDOT Inspector, RMS, and Engineer may be cause for rejection. Fabricator may submit an NCR with a proposed repair procedure, requesting approval. Some rejectable defects are defined as the following:

- (f) Surface defects on more than 5% of the surface area which will be exposed to view after installation
- (g) Minor defects that in total make up more than 5% of the surface area of the unit
- (h) Cracks greater than 0.060 inches in width except as noted in Category 1
- (i) Elements fabricated outside of the specified tolerances

- (j) MassDOT compressive strength testing that does not meet the specified Design Strength,  $f'_c$

**Loading.**

Prior to the Fabricator loading the Precast Bridge Element on to the truck for shipping, the Fabricator shall provide the MassDOT Plant Inspector and RMS a minimum seven (7) days' notice of the Fabricator's intent to load the Precast Bridge Element. Inspection by the MassDOT Plant Inspector shall take place while the element is still on dunnage in the yard. The element shall not be loaded onto the truck until the MassDOT Plant Inspector has performed the inspection.

**Shipping.**

Prior to shipment, the Fabricator shall perform the following actions and provide the required documentation to the MassDOT Plant Inspector:

- (g) Precast Concrete Bridge Elements shall remain at the Fabricator's plant for a minimum of 7 days after cast date.
- (h) QC Inspection Reports shall be signed by the Quality Control Manager and provided to the MassDOT Plant Inspector.
- (i) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'_c$  for the Precast Concrete Bridge Element's representative Sublot shall be generated by the Fabricator and provided to the MassDOT Plant Inspector.
- (j) Certificate of Compliance shall be generated by the Fabricator as described under the Fabricator Quality Control section and provided to the MassDOT Plant Inspector.
- (k) All MassDOT RMS approved Corrective Actions submitted on the Non-Conformance Reports (NCR), shall be verified to have been completed by the MassDOT Plant Inspector and Quality Control Manager.
- (l) All NCRs shall be signed off by the Quality Control Manager, MassDOT Inspector and MassDOT RMS.

**Delivery.**

Upon Delivery, the following documentation shall be provided to the MassDOT Resident Engineer or designee:

- (d) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'_c$  for the Precast Concrete Bridge Element's representative sublot.
- (e) Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
- (f) QC Inspection Reports signed by the Quality Control Manager.

The Contractor shall inspect Precast Concrete Bridge Elements upon receipt at the site. Precast Concrete Bridge Elements damaged during delivery shall be repaired or replaced at MassDOT's direction at no cost to MassDOT.

**CONSTRUCTION METHODS – FIELD CONSTRUCTION**

**General.**

All of the Contractor's field personnel involved in the erection and assembly of the Precast Concrete Bridge Elements shall have knowledge of and follow the approved Erection Procedure.

Prior to installation, the following documentation shall be reviewed and confirmed by the MassDOT Resident Engineer or designee:

- (d) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'c$  for the Precast Concrete Bridge Element's representative subplot.
- (e) Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
- (f) QC Inspection Reports signed by the Quality Control Manager.

Field construction staff shall verify that the Resident Engineer has accepted all Precast Concrete Bridge Elements prior to installation.

### **Erection Procedure.**

Prior to the erection, the Contractor shall submit an Erection Procedure for approval by the Engineer. This submittal shall include computations and drawings for the transport, hoisting, erection and handling of the Precast Concrete Bridge Elements. The Erection Procedure shall be prepared and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts with working knowledge of the Contractor's equipment, approved shop drawings, and materials to build the bridge. The Erection Procedure shall, at a minimum, include the following:

#### **1. Erection Procedure**

The Erection Procedure shall be prepared to conform to the requirements of 960.61, Erection and the applicable sections in Chapter 8 of the PCI Design Handbook (seventh edition) for handling, erection, and bracing requirements. At a minimum, the Erection Procedure shall provide:

- (i) Minimum concrete compressive strength for handling the Precast Concrete Bridge Elements.
- (j) Concrete stresses during handling, transport, and erection.
- (k) Crane capacities, pick radii, sling geometry, and lifting hardware.
- (l) Verification that the equipment can handle all pick loads and weights with the required factor of safety.
- (m) Evaluation of construction sequence and evaluation of any geometric conflicts in the lifting of the Precast Concrete Bridge Elements and setting them as shown on the plans.
- (n) Design of crane supports including verification of subgrade for support.
- (o) Location and design of all temporary bracing that will be required during erection.

Non-shrink grout and concrete materials, approved by the Engineer, shall be placed as shown on the plans. Fill joints, keyways, and voids, in strict accordance with the specifications and manufacturer's recommendations and instructions.

For footings, approach slabs and highway guardrail transitions, once these Precast Concrete Bridge Elements have been set to the correct horizontal and vertical alignment, the void between them and the supporting soil shall be filled with Controlled Density Fill – Non-Excavatable to the limits as shown on the plans. Add additional grout ports in the footings to facilitate the bedding process if required.

Joints shall be filled flush to the top with non-shrink grout, and any vertical misalignment between adjacent elements shall be feathered out on a slope of 1 to 12.

Curing of grout or concrete shall be performed in strict accordance with the specifications and manufacturer's recommendations. Filling shall not be completed in cold weather when either the ambient temperature or the precast member's temperature is below the manufacturer's recommendation.

No localized heating of either the precast members or of the air surrounding the element will be permitted in an attempt to reach application temperatures.

If the joints or voids are not filled within five days after the Precast Bridge Elements are erected, the Contractor shall cover and protect the openings from weather and debris until they are filled.

### **Survey and Layout.**

Working points, working lines, and benchmark elevations shall be established prior to placement of all elements. The Contractor is responsible for field survey as necessary to complete the work. MassDOT reserves the right to perform additional independent survey. If discrepancies are found, the Contractor may be required to verify previous survey data.

### **Preparation of Closure Pour Keyways.**

Immediately prior to erecting the Precast Concrete Bridge Elements, the closure pour shear keys shall be cleaned at the job site of all dust, dirt, carbonation, laitance, and other potentially detrimental materials which may interfere with the bonding of the closure pour concrete and precast concrete using a high-pressure water blast. The exposed reinforcing steel in the precast concrete shall be protected from damage during the cleaning of the keyways. Damaged epoxy coating of steel reinforcement shall be repaired, and the reinforcing steel shall be cleaned as directed by the Engineer. The surfaces of the shear keys shall be wetted so that the surfaces shall have a Saturated Surface Dry (SSD) condition for at least 24 hours prior to the placement of the closure pour concrete.

### **Erection.**

The elements shall be placed in the sequence and according to the methods outlined in the Erection Procedure. As the erection proceeds, the Contractor shall constantly monitor the assembly to ensure that the precast concrete bridge element is within proper horizontal and vertical location and tolerances prior to releasing it from the crane and setting the next unit. The Contractor may use shims to maintain proper setting tolerances.

The concrete elements shall be lifted only by the lifting devices, and the utmost care shall be taken to prevent distortion of the elements during handling, transportation or storage.

Suitable spreaders shall be used during lifting so that only a vertical pull will be made on the lifting device. A non-vertical lifting force may be permitted if prior written approval is given by the Engineer. This approval will be contingent on the Contractor demonstrating by calculations, prepared by a Professional Engineer registered in Massachusetts, that the elements will not be damaged by the non-vertical lifting force and by documentation that the capacity of the lifting devices is adequate for the non-vertical lifting force.

Precast components shall be pre-bed with non-shrink grout thicker than shim stacks prior to placing other precast elements on top of them.

After all Precast Concrete Bridge Elements have been placed, the actual overall dimensions of the structure both horizontal and vertical, as laid out shall not deviate from the nominal dimensions shown on the plans beyond a tolerance of +0 inches and -1 inches. Once the layout of Precast Concrete Bridge Elements has been accepted by the Engineer, the Contractor shall cut all lifting devices off below the surfaces of the elements.

### **Filling of Blockouts for Lifting Devices and Threaded inserts.**

If the blockouts in the Precast Concrete Bridge Elements where the lifting devices were located will be exposed and visible after assembly is complete, the Contractor shall fill these blockouts with Cement Mortar (M4.02.15) or grout.

After the formwork has been removed, all threaded inserts that have been cast into the precast concrete bridge deck for support of the formwork shall be filled with a grout of the same color as that of the precast concrete.

## **HOT DIP GALVANIZED COATING FOR NEW STRUCTURAL STEEL**

### **A. GENERAL**

Fabricated steel shall be galvanized as indicated on the plans. All fabrication shall be completed prior to surface preparation and the application of any coating.

The faying surfaces of all field bolted connections shall be coated based on the design of the connection. Class B connections shall be masked prior to galvanizing to allow for application of an approved class B slip coefficient primer. After galvanizing the masked surface will be cleaned in accordance with SSPC-SP11 and coated with the approved zinc rich primer. A galvanized connection will result in a faying surface meeting a class C slip coefficient.

When grinding, drilling or any other operation produces steel turnings, filings, shavings, etc. the contractor shall completely clean all areas of all accumulation prior to the end of the work shift.

Locations of field applied studs shall require masking or removal of galvanizing and paint prior to welding.

The Engineer shall provisionally accept the shop coated items before shipment to the jobsite but final acceptance of the coating system will occur after erection of the coated items, and after all required repairs and coating application has been completed.

The contractor shall be responsible for failure and damage of all applied coating. Failures include but are not limited to, visible corrosion, blistering, checking, cracking, or delamination (peeling) and loss of gloss and color of the coating system. Damage includes but is not limited to damage from installation or from external agents, such as scraping, vandalism, debris impacts, and collisions. The extent and method of repair must be approved by the Engineer.

### **B. GALVANIZING**

The following shall be hot dipped galvanized in accordance with Section M7 of these Specifications:

1. Approach slab cover plates, their supports, and hardware.
2. Utility supports and hardware.

Galvanized members requiring shop fabrication and assembly shall be cut, welded, and/or drilled prior to galvanizing. Bearing members to be milled shall be galvanized prior to milling. A thin layer of a rust inhibitor shall be applied to the milled surface. Material to be painted shall not be quenched after galvanizing.

Damaged galvanized surfaces shall be repaired in accordance with ASTM A780 "Repair of Hot Dip Galvanizing" section 4.2.2 Paints Containing Zinc Dust "High Zinc Dust Content". The paint shall be applied to achieve a minimum dry film thickness of 3 mils and not more than 5 mils. Repair paint shall meet M7.04.11 and application shall be in accordance with the manufacturer's recommendations.

The contractor shall provide protection of the adjacent coating in areas that will be field welded. After welding, the weld areas shall be prepared in accordance with SSPC-SP-11.

**BASIS OF PAYMENT**

Bridge Structure shall be paid at the Contract Lump Sum bid, which said sum shall be full compensation for furnishing all equipment, transportation, materials, and labor necessary to furnish and install the precast NEXT F beams, including all shipping, handling, joining; cast-in-place reinforced concrete abutments, wingwalls, approach slabs, and bridge mounted barriers; damp-proofing; membrane waterproofing for bridge decks; utility supports; pavement sawcut joint; and appurtenances required to complete the system as specified herein and indicated on the Plans.

**SCHEDULE OF BASIS FOR PARTIAL PAYMENT**

Within ten (10) days after the notice to proceed, the Contractor shall submit, in duplicate, for the approval of the Engineer, a schedule of unit prices for the major components of each bridge superstructure as listed below. The bridge superstructure Lump Sum breakdown quantities provided below are estimated and not guaranteed. The total of all partial payments to the Contractor shall equal the Lump Sum contract price regardless of the accuracy of the quantities furnished by the Engineer for the individual bridge components. The cost of labor and materials for any Item not listed but required to complete the work shall be considered incidental to Item 995.01 and no further compensation will be allowed.

<u>SUB-ITEM</u>	<u>DESCRIPTION</u>	<u>QTY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>TOTAL</u>
153.1	Controlled Density Fill – Non Excavatable	3	CY		
482.31	Sawing & Sealing Joints in Asphalt Pavement at Bridges	61	FT		
904.4	4000 PSI, 3/4 IN., 585 HP Cement Concrete	305	CY		
905.2	5000 PSI, 3/8 IN., 710 HP Cement Concrete	13	CY		
910.	Steel Reinforcement for Structure	9,300	LB		
910.1	Steel Reinforcement for Structures – Epoxy Coated	33,900	LB		
922.	Laminated Elastomeric Bearing Without Anchor Bolts	16	EA		
930.601	Prestressed Concrete NEXT 24 F Beams	4	EA		
930.64	Precast Concrete Highway Guardrail Transitions	4	EA		

960.1	Structural Steel – Coated	6,900	LB
965.	Membrane Waterproofing for Bridge Decks	1203	SF
970.	Damp-Proofing	2253	SY

Total Lump Sum Price for Item 995.01 =

The above schedule applies only to Bridge No. H-12-024 (CFF). Payment for similar materials and construction at locations other than at this bridge structure shall not be included under this Item. Sub-Item numbering is presented for information only in coordination with MassDOT Standard Nomenclature.

**ITEM 999.1**

**POLICE**

**ALLOWANCE**

Work under this Item shall consist of furnishing traffic control services required to regulate, control and protect vehicular and pedestrian traffic on existing roadways and pathways which will be affected by the Contractor's operations. Where vehicular and pedestrian traffic is maintained, the work shall be conducted and guarded so that there will be at all times a safe passageway.

The Contractor shall provide such police officers, as may be deemed necessary by the Engineer, for the direction and control of vehicular and pedestrian traffic. Such officers shall wear regulation policemen's uniforms. Only City of Haverhill Police shall be employed on roadways under control of the Town of Haverhill.

With respect to orders, control, and direction, City of Haverhill Police shall be under the jurisdiction of the City of Haverhill Chief of Police.

**METHOD OF MEASUREMENT**

The Contractor shall include in his bid a lump sum allowance of \$20,000 for furnishing of Police. The Contractor must submit certified copies of itemized Bills of Services rendered for review and approval by the Engineer. This lump sum allowance will be adjusted to the actual paid for, authorized, and approved services.

**BASIS OF PAYMENT**

The service to be paid for under Police shall be the actual amount paid by the Contractor to provide satisfactory services as stipulated above. Any allowance for overhead shall be considered to have been included for payment in the prices stipulated in the numbered items of the Proposal.

**END OF SECTION**

Appendix A  
Order of Conditions





**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:  
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**A. General Information (cont.)**

6. Property recorded at the Registry of Deeds for (attach additional information if more than one parcel):  
 Southern Essex District  
 a. County \_\_\_\_\_ b. Certificate Number (if registered land) \_\_\_\_\_  
 n/a right-of-way \_\_\_\_\_  
 c. Book \_\_\_\_\_ d. Page \_\_\_\_\_
7. Dates: 2/21/2024 5/9/2024 5/20/2024  
 a. Date Notice of Intent Filed b. Date Public Hearing Closed c. Date of Issuance
8. Final Approved Plans and Other Documents (attach additional plan or document references as needed):  
 See Attachment "A", "Special Conditions", incorporated herein and made part of this Order of Conditions.
- \_\_\_\_\_ b. Prepared By \_\_\_\_\_ c. Signed and Stamped by \_\_\_\_\_  
 \_\_\_\_\_ d. Final Revision Date \_\_\_\_\_ e. Scale \_\_\_\_\_  
 \_\_\_\_\_ f. Additional Plan or Document Title \_\_\_\_\_ g. Date \_\_\_\_\_

**B. Findings**

1. Findings pursuant to the Massachusetts Wetlands Protection Act:  
 Following the review of 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 (the Act). Check all that apply:
- a.  Public Water Supply b.  Land Containing Shellfish c.  Prevention of Pollution  
 d.  Private Water Supply e.  Fisheries f.  Protection of Wildlife Habitat  
 g.  Groundwater Supply h.  Storm Damage Prevention i.  Flood Control
2. This Commission hereby finds the project, as proposed, is: (check one of the following boxes)

**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.



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**B. Findings (cont.)**

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 the 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 Act's interests, 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 310 CMR 10.02(1)(a) 0  
a. linear feet

**Inland Resource Area Impacts:** Check all that apply below. (For Approvals Only)

Resource Area	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
4. <input checked="" type="checkbox"/> Bank	129 (perm), 41 (temp)	129 (perm), 41 (temp)	119	119
	a. linear feet	b. linear feet	c. linear feet	d. linear feet
5. <input checked="" type="checkbox"/> Bordering Vegetated Wetland	347 (temp)	281 (temp)	347	281
	a. square feet	b. square feet	c. square feet	d. square feet
6. <input checked="" type="checkbox"/> Land Under Waterbodies and Waterways	309 (temp)	309 (temp)	593	593
	a. square feet	b. square feet	c. square feet	d. square feet
	88	88		
	e. c/y dredged	f. c/y dredged		
7. <input checked="" type="checkbox"/> Bordering Land Subject to Flooding	6631 (temp)	6046 (temp)	6046	6046
	a. square feet	b. square feet	c. square feet	d. square feet
Cubic Feet Flood Storage	262.18	522.72	262.18	17,822.7
	e. cubic feet	f. cubic feet	g. cubic feet	h. cubic feet
8. <input type="checkbox"/> Isolated Land Subject to Flooding				
	a. square feet	b. square feet		
Cubic Feet Flood Storage				
	c. cubic feet	d. cubic feet	e. cubic feet	f. cubic feet
9. <input checked="" type="checkbox"/> Riverfront Area	11,716	11,758		
	a. total sq. feet	b. total sq. feet		
Sq ft within 100 ft	5223(temp) 6493(redev)	5147(temp) 6611(redev)	11,716	11,758
	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft				
	g. square feet	h. square feet	i. square feet	j. square feet



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**B. Findings (cont.)**

**Coastal Resource Area Impacts:** Check all that apply below. (For Approvals Only)

	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	_____	_____		
	a. square feet	b. square feet		
	_____	_____		
	c. c/y dredged	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	_____	_____	_____ cu yd	_____ cu yd
	a. square feet	b. square feet	c. nourishment	d. nourishment
14. <input type="checkbox"/> Coastal Dunes	_____	_____	_____ cu yd	_____ cu yd
	a. square feet	b. square feet	c. nourishment	d. nourishment
15. <input type="checkbox"/> Coastal Banks	_____	_____		
	a. linear feet	b. linear feet		
16. <input type="checkbox"/> Rocky Intertidal Shores	_____	_____		
	a. square feet	b. square feet		
17. <input type="checkbox"/> Salt Marshes	_____	_____	_____	_____
	a. square feet	b. square feet	c. square feet	d. square feet
18. <input type="checkbox"/> Land Under Salt Ponds	_____	_____		
	a. square feet	b. square feet		
	_____	_____		
	c. c/y dredged	d. c/y dredged		
19. <input type="checkbox"/> Land Containing Shellfish	_____	_____	_____	_____
	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			
	_____	_____		
	a. c/y dredged	b. c/y dredged		
21. <input type="checkbox"/> Land Subject to Coastal Storm Flowage	_____	_____		
	a. square feet	b. square feet		
22. <input type="checkbox"/> Riverfront Area	_____	_____		
	a. total sq. feet	b. total sq. feet		
Sq ft within 100 ft	_____	_____	_____	_____
	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft	_____	_____	_____	_____
	g. square feet	h. square feet	i. square feet	j. square feet





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### **C. General Conditions Under Massachusetts Wetlands Protection Act**

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            33-1565            "
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 MassDEP.
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.



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**C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)**

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 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.
19. The work associated with this Order (the "Project")
- (1)  is subject to the Massachusetts Stormwater Standards
- (2)  is NOT subject to the Massachusetts Stormwater Standards

**If the work is subject to the 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 Pollution Discharge Elimination System Construction General Permit as required by Stormwater Condition 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;



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**C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)**

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 18(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 Pollution 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 18(f) through 18(k) with respect to that BMP. Any failure of the proposed responsible party to implement the requirements of Conditions 18(f) through 18(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.



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**C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)**

- 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 (if you need more space for additional conditions, please attach a text document):

**See Attachment "A", "Special Conditions", incorporated herein and made part of this Order of Conditions.**

20. For Test Projects subject to 310 CMR 10.05(11), the applicant shall also implement the monitoring plan and the restoration plan submitted with the Notice of Intent. If the conservation commission or Department determines that the Test Project threatens the public health, safety or the environment, the applicant shall implement the removal plan submitted with the Notice of Intent or modify the project as directed by the conservation commission or the Department.



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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 Haverhill Conservation Commission hereby finds (check one that applies):
  - a.  that the proposed work 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 of Conditions is issued.
  - b.  that the following additional conditions are necessary to comply with a municipal ordinance or bylaw:
 

An Ordinance to Protect the Wetlands, Related Water Resources and Adjoining Land Areas	Chapter 253 2. Citation
--	----------------------------
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 (if you need more space for additional conditions, attach a text document):

See Attachment "A", "Special Conditions", incorporated herein and made part of this Order of Conditions.



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### E. Signatures

This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.

05/20/2024

1. Date of Issuance

Please indicate the number of members who will sign this form.

5

This Order must be signed by a majority of the Conservation Commission.

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.

Pursuant to the vote taken by the Conservation Commission on May 7, 2020, the following signatures are made in accordance with M.G.L. c.110G and pursuant to said Commission's electronic signature authorization vote recorded on May 21, 2020, with the Southern Essex District Registry of Deeds in Book 38538, Page 455.

/Evan Barman/

Signature

Evan Barman

Printed Name

/Jennifer Rubera/

Signature

Jennifer Rubera

Printed Name

/Thomas Wylie/

Signature

Thomas Wylie

Printed Name

/Frederick Clark/

Signature

Frederick Clark

Printed Name

/Lisa DeMeo/

Signature

Lisa DeMeo

Printed Name

Signature

Printed Name

Signature

Printed Name

Signature

Printed Name

by hand delivery on

by certified mail, return receipt requested, on

05/20/2024

Date

Date



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## 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.



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### G. Recording Information

Prior to commencement of work, 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.

Haverhill  
 Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Haverhill  
 Conservation Commission

Please be advised that the Order of Conditions for the Project at:

Rosemont Street Bridge – right-of-way	33-1565
Project Location	MassDEP File Number

Has been recorded at the Registry of Deeds of:

Southern Essex District	Book	Page
County		

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



# Haverhill

Conservation Department  
Phone: 978-374-2334 Fax: 978-374-2366  
[conservation@cityofhaverhill.com](mailto:conservation@cityofhaverhill.com)

## ATTACHMENT A: SPECIAL CONDITIONS

**MassDEP FILE #33-1565**

**ISSUING AUTHORITY:** Haverhill Conservation Commission (“HCC”)

**APPLICANT:** City of Haverhill

**PROJECT LOCATION:** Rosemont Street Right-of-Way Bridge Over Little River

### PROJECT DESCRIPTION

The Applicant proposes the removal of a failing 16’-8” single span bridge and its replacement with a new 35’-11” single span bridge pursuant to the results of a hydraulic analysis and in compliance with the MA Stream Crossing Standards. Work includes temporary utility reconfigurations, roadway resurfacing, drainage improvements, and related resource area restoration activities. The project involves temporary and some permanent impacts to resource areas associated with Little River.

### RESOURCE AREA FINDINGS

The Haverhill Conservation Commission finds this site to contain, at a minimum, the following resource areas: inland Bank, Land Under Water, Bordering Vegetated Wetlands, Bordering Land Subject to Flooding, Riverfront Area, and associated Buffer Zones.

### EXPIRATION DATE

Unless extended, this Order of Conditions (“OOC”) will expire May 20, 2027.

### PLANS AND DOCUMENTS

Work on this project site shall be performed according to the following listed plans and documents on file with the HCC. Should any conflicts be found to exist between these plans and documents and the conditions of this OOC, the HCC shall be contacted for clarification.

- a) “Rosemont Street Bridge Over Little River – Bridge No. H-12-024 (CFF)” (8 Sheets), site plan prepared by BETA Group, Inc. (89 Shrewsbury Street, Suite 300, Worcester, MA 01604), dated April 2024;
- b) “Rosemont Street Bridge Replacement Notice of Intent Narrative” (14 Pages), prepared by BETA, dated February 2024;
- c) “Hydraulic and Scour Analysis Report”, document prepared by BETA, dated April 2024;
- d) “Wildlife Habitat Report” (3 Pages), document prepared by BETA, dated April 25, 2024;
- e) “Streambed Restoration” (2 Pages), specification prepared by BETA, dated received April 25, 2024; and
- f) NHESP Conditional Approval Letter (3 Pages), prepared by NHESP, dated March 22, 2024.

**Pursuant to the Massachusetts Wetlands Protection Act (M.G.L. Chapter 131, Section 40), its Regulations (310 CMR 10.00), and Haverhill City Code Chapter 253 (“An Ordinance to Protect the Wetlands, Related Water Resources and Adjoining Land Areas”), the Commission orders that all work shall be performed in accordance with the following additional, special conditions:**

#### **GENERAL CONSTRUCTION**

21. The HCC may designate one or more Conservation Department Officials as its agent (“HCC Official”), with full powers to act on its behalf in administering and enforcing this OOC.
22. Work on this project shall be performed in accordance with Haverhill Municipal Ordinances Chapter 253 – “An Ordinance to Protect the Wetlands, Related Water Resources, and Adjoining Land Areas”.
23. In accordance with Haverhill Municipal Ordinance Chapter 253, there shall be no activities allowed within 25’ of the delineated wetland resource areas and no building construction within 50’ of these same areas, except as shown on the approved plans referenced above.
24. All wetland resource areas shall be visibly flagged and/or staked every 25 feet along the resource area boundaries to assure that no intrusion into these areas occurs. Flagging and staking used to identify wetland resource areas shall be of a color different from any others used on the site and shall be maintained until the work is complete.
25. The rows of erosion control devices, as shown on the site plan, shall also act as a limit of site activity.
26. The MassDEP File Number sign shall not be attached to a live tree.
27. Any changes proposed under this OOC might require the Applicant to file a “Request for a Modification to the Order of Conditions” with the HCC.
28. While all activities regulated by this Order are being performed and during the construction phase of this project, an on-site foreman, directing engineer, or designated construction manager, shall have a copy of this permit and its associated plans and documents at the site, familiarize him or herself with the conditions of this permit, and adhere to such conditions. This OOC shall be made part of all construction-related documents for this project. All contractors working at the site shall be made aware of the provisions contained within this OOC and adhere to them.
29. The Applicant shall secure an Environmental Monitor (“EM”) for this project. The EM shall be, at a minimum, a professional with experience in Resource Area Protection; Erosion, Sedimentation, and Pollution Prevention; and Stormwater Management. The EM shall have, at a minimum, a working knowledge of botany, hydrology, and general construction practices. The Applicant may designate the EM as responsible for fulfilling the requirements of the Pollution Prevention and Erosion and Sedimentation Control (“PPESC”) Monitor under this OOC. Otherwise, the EM shall establish an appropriate working relationship with the PPESC Monitor to ensure the project’s complete compliance with this OOC. The Applicant shall give the EM authority to stop construction for PPESC purposes.
  - a) On the Monday of every week throughout the life of this project, the EM shall provide the HCC with a status report of the project. This report shall indicate the functions of the PPESC devices and any need for maintenance, replacement, augmentation, emergency placement, and any other corrective action of

PPESC devices; the activities completed the previous week; and the activities planned for the current week. The report shall also mention any deviations from the previous week's report and any environmental mitigation measures that have been undertaken. The report shall include representative photographs of deviations, needed repairs, and on-going work. The frequency of this reporting may be altered as site conditions warrant, upon concurrence between the HCC and the EM.

- b) In addition to this reporting, the EM shall be responsible for all inspections and reporting as outlined in this OOC and the referenced plans and documents pertaining to Resource Area Activities; Erosion, Sedimentation, and Pollution Prevention; and Stormwater Management. The EM shall be on site as necessary to ensure proper implementation of the conditions of this OOC and the work outlined in the referenced plans and documents.

### **CONSTRUCTION SEQUENCING**

30. Prior to the commencement of work, the Applicant shall provide the HCC with electronic copies of all other applicable federal, state, and local permits for this project. The Applicant shall adhere to any Time of Year restrictions recommended by federal and/or state agencies as part of their permitting.
31. To minimize sedimentation and turbidity in downstream areas, the Applicant shall deploy such measures as turbidity curtains and temporary coffer dams.
32. A minimum of two (2) business days in advance, the Applicant shall provide the HCC with written notification of the commencement of work on site. At this time, the Applicant shall also supply the HCC with a list of names, addresses, and emergency phone numbers (including evenings and weekends) for those parties responsible for compliance with this OOC on the site, including the Environmental Monitor and the Pollution Prevention and Erosion and Sedimentation Control Monitor.
33. Prior to the commencement of work on this site, the Applicant shall schedule a pre-construction meeting with the site contractor, the Applicant's engineers/consultants, the EM, the PPESC Monitor, and the HCC. The purpose of the meeting is to review this OOC and resolve any outstanding issues at that time.
34. The Applicant shall make every effort to ensure that no invasive plant species, as defined and listed by the Massachusetts Invasive Plant Advisory Group, are introduced to, or moved around the site by construction activities, including importation of infected materials such as borrow, compost, nursery stock, seed, or hay bales. Corrective measures, if necessary, shall be made by the Applicant as directed by the EM. Corrective measures shall be implemented for as long as necessary to eliminate the introduced invasive plant species and prevent re-establishment of same. The Applicant shall satisfactorily dispose of all cleared, invasive plant material (seeds, roots, woody vegetation, associated soils, etc.). The Applicant shall take measures to prevent viable, invasive plant materials from leading to further infestations 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.

Prior to the commencement of work on site, the EM shall survey this site for the presence of invasive plant species within the approved limits of work. If found, the EM shall provide the HCC with an updated, as necessary, written Invasive Species Control Plan ("ISCP") proposal and schedule of control. The ISCP is critical for identifying pre-construction conditions, as well as strategies for minimizing import or spread of invasive plants. All materials and methods proposed shall be consistent with the conditions of this OOC. The ISCP shall include, but not be limited to, the following:

- a) Description of treatment areas, including identification of targeted invasive plant species, locations, approximate size of areas, and digital photos with time/date stamp.
- b) Delineation of treatment areas with polygons outlining their perimeter or locations of individual plants. A free-hand sketch drawn on construction plans, or an aerial photo can be used to show locations.
- c) Proposed methods of treatment for each species or area, such as manual removal, cutting, or herbicides.
  - i. If herbicides are proposed, the IPMS shall include the product label, including application methods and rates for each. MSDS information shall also be provided for each herbicide.
- d) Proposed time of treatment based on target plant species and construction schedule.
- e) Method for disposing of invasive plant materials.
- f) General monitoring schedule.
- g) Preliminary re-treatment schedule. Re-treatment shall be based on assessment of initial results and time of year.
- h) Proposed performance metrics, or measure of treatment success, which shall be agreed upon with HCC.

Control of invasive plant species shall begin immediately with the initiation of construction and continue for a minimum of five (5) years, after which time a Complete Certificate of Compliance may be pursued for this project. The EM shall report on the success of the ISCP in the work area in the weekly, seasonal, and final EM reports required under this OOC. If necessary, the corrective measures shall be outlined in the reporting in a manner consistent with the ISCP requirements.

35. **Prior to the commencement of work, the Applicant shall provide the HCC with electronic copies of the contractor's "Water Control Plan" and "Dewatering Plan" for review by HCC staff.**
36. **Immediately upon completion of testing, the Applicant shall provide the HCC with an electronic copy of the testing results for the dredged material along with an explanation of the planned method for disposal.**
37. Immediately upon completion of this project, the Applicant shall provide the HCC with an as-built plan showing, at a minimum, the following information as it pertains to the subject property. This plan shall be stamped by a MA-registered Professional Engineer. This plan shall be subject to the review and approval of the HCC.
  - a) Wetland resource areas subject to protection under this OOC and their approved delineations;
  - b) Limits of all Buffer Zones, including No-Disturbance and No-Build Zones;
  - c) Planted trees and shrubs;
  - d) Structures, including abutments, walls, drainage features...;
  - e) Existing limits of lawn/landscaped, pavement, ... areas;
  - f) Date(s) of survey fieldwork; and
  - g) A statement by the Professional Engineer certifying compliance with the approved plans and conditions of this OOC and setting forth deviations from same, if any exist.

### **CONSTRUCTION PERIOD EROSION, SEDIMENTATION, AND POLLUTION PREVENTION**

38. The Applicant, site contractor, and their assigns shall implement Construction Period Pollution Prevention and Erosion and Sedimentation Control measures from the commencement of work until the site is fully and permanently stabilized and the temporary erosion and sedimentation controls are removed, upon HCC approval.

39. All vegetation cutting associated with the construction of this project shall be subject to the prior review and approval of the HCC. Prior to the commencement of work, the Applicant's surveyor shall stake out, flag, or mark by other appropriate means, the locations of the approved limits of cutting and the locations of the proposed PPESC devices for inspection by the site contractor, EM, PPESC Monitor, and the HCC. The commencement of vegetation cutting work shall be contingent upon the approval of the HCC at that time.
40. Prior to the commencement of work, the Applicant shall install the initial PPESC devices. The Applicant shall schedule an inspection of the installed devices by the site contractor, EM, PPESC Monitor, and the HCC. Should any of these devices be considered insufficient, the PPESC Monitor shall immediately propose augmentation or other corrective measures to address areas of concern. The continuation of on-site work shall be contingent upon HCC approval of the devices at that time.
41. The Applicant shall designate a PPESC Monitor for the site. This Monitor shall be a professional with experience in PPESC practices. This Monitor shall inspect PPESC devices daily for proper function and maintenance, including the proper disposal of waste products. This Monitor shall immediately arrange for the maintenance, replacement, augmentation, emergency placement, and any other corrective action of PPESC devices on site. Areas of construction shall remain in a stable condition at the end of each day. The Applicant shall give this Monitor authority to stop construction for PPESC purposes.
42. An adequate stockpile of PPESC materials shall be always on site for emergency or routine replacement and shall include materials to repair silt fences, straw bales, stone riprap, filter dikes or any other devices planned for use during construction.
43. PPESC devices may be modified based on experience at the site. Approval of the HCC must be obtained prior to any non-emergency modification of the approved PPESC measures.
44. The HCC reserves the right to impose additional conditions on portions of this project to mitigate any impacts which could result from site erosion or any noticeable degradation of surface water quality discharging from the site.
45. The locations of long term (greater than 30 days) stockpiles and the locations and construction methods of temporary construction entrances, if not addressed in the Construction Period PPESC Plan, shall receive the prior approval of the PPESC monitor and the HCC.
46. During all phases of construction, all disturbed or exposed soil surfaces shall be brought to final finished grade and either a) covered with loam and seeded in accordance with the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas (or equivalent document) for permanent stabilization or b) stabilized in another way approved by the HCC. Bare ground that cannot be permanently stabilized within 30 days shall be stabilized with mulch or any other protective covering and/or method approved by the USDA Soil Conservation Service.
47. Upon completion of the project all disturbed areas shall be permanently stabilized with rapidly growing vegetative cover with sufficient topsoil to assure long term stabilization of disturbed areas. After seeding, disturbed areas shall be covered with straw mulch, netting, or other protective covering to provide a suitable surface cover until seed germination.

48. All dewatering activities shall be controlled by implementing Best Management Practices. Dewatered fluids shall be prevented from flowing directly into resource areas. Discharge structures, such as temporary sediment basins or other Best Management Practices shall be configured to maximize sediment removal. If discharge towards resource areas cannot be avoided, it shall be via a maximized distance of overland upland sheet flow unless the HCC approves an alternative in advance. The PPESC Monitor shall review and approve all dewatering methods prior to implementation.
49. Soils, stumps, slash, timber, construction materials, debris, or other waste products shall not be deposited, stored, or otherwise accumulated within 100' of a wetland resource area or within land subject to flooding, unless approved in advance by the HCC.
50. Covered dumpsters shall be maintained on site for appropriate materials. The Applicant shall conduct routine litter pick-ups throughout construction to prevent trash and loose, synthetic debris from entering the resource areas and buffer zones.
51. All pumps, drilling machines, and their surrounding areas, whether used for dewatering or other purposes, shall be properly contained to limit the potential for environmental impacts due to fuel leakage, pump leakage, or other failures.
52. Refueling of equipment shall not be done within 100' of a wetland resource area. Fuel, oil, or other potential pollutants shall not be stored within 100' of a wetland resource area.
53. Equipment and vehicles staged overnight shall be stored on an impervious containment surface to prevent drippings and spills from leaching into the soil. The PPESC Monitor shall inspect this surface daily and take prompt action to address all pollution prevention concerns in accordance with this Order.
54. Any spills of hazardous materials, including but not limited to diesel fuel and hydraulic oil, shall be appropriately and promptly cleaned up. The Applicant shall notify Federal, Commonwealth, and/or Local agencies of such spills as may be applicable by law. The Applicant or PPESC Monitor shall notify the HCC, within one hour, of any spills within wetland resource areas or buffer zones. Onsite emergency spill kits shall always be available.
55. The Applicant shall ensure a hazardous materials spill containment kit is always maintained on site throughout construction. The kit shall be appropriately sized for the cumulative volumetric capacity of hazardous fluids contained by equipment on site at any one time.

## **STORMWATER**

56. **To ensure long term function and protection of Little River, the asphalt curbing proposed along the rear of the lift station entrance shall instead be vertical granite curbing.**
57. **As proposed by the Applicant, the existing catch basin that was unearthed near UP#19-84 will be inspected during construction of this project. Should the existing catch basin be found to contain a functional and appropriately sized deep sump with a gas trap, then the proposed gutter inlet will be installed with the appropriate connection. Should the catch basin not meet today's design standards, then a catch basin that does meet these standards will be installed in lieu of the gutter inlet, with the appropriate connection being made to the existing drainage system.**

**58. The Applicant shall install a new riprap apron below the existing 18"VC drainage system outlet located above Flag #B2-98 as part of this project.**

### **RESOURCE AREA ACTIVITIES**

59. All work proposed within the wetland resource areas and 100'-Buffer Zone shall be performed according to the plans and documents submitted as part of the Notice of Intent filing, unless specified otherwise in this Order. These areas shall meet or exceed the General Performance Standards outlined in 310 CMR 10.00 and Haverhill Municipal Ordinances Chapter 253. Should these areas fail to meet any of these standards, the HCC reserves the right to require those measures necessary to achieve compliance.
60. The Applicant shall ensure the EM is on site sufficiently throughout construction and restoration to provide supervision and inspect resource area activities for compliance with this Order.
61. The site contractor shall not disturb any area of protected or regulated Federal, State, and/or Local wetland resource area or buffer zone except for that which has been permitted by this Order.
62. The site contractor shall restore all temporarily disturbed resource areas and buffer zones to the satisfaction of the HCC and the EM. The EM shall ensure that 75 percent of the surface area of all temporarily disturbed and restoration areas is reestablished with indigenous plant species within two growing seasons of their planting or replanting. If at the end of one growing season it is evident, in the opinion of the EM or the HCC, that a disturbed area is not likely to be successfully reestablished within this time frame, the EM shall submit to the HCC a corrective plan of action detailing supplements to the planting, soils, and/or grading, as necessary, to achieve the required coverage. This plan shall be implemented upon HCC approval.
63. The contractor shall follow the directions of the EM, whether given prior to, or during, construction of any restoration area(s). If feasible, the contractor shall propose alternative mitigation and environmental protection techniques that provide cost or time savings, improved environmental protection, or enhanced mitigation, provided (1) they provide equivalent or greater wetland protection and mitigation than afforded by the methods contained in this Order and NOI and provided by the EM; (2) they receive prior approval by the HCC and the EM; and (3) they meet the Performance Standards of the MA Wetland Protection Regulations (310 CMR 10.00) and the requirements of Haverhill Municipal Ordinance Chapter 253.
64. The Applicant shall sequence all work below mean high water to maximize the use of low flow stream conditions. Turbidity barriers shall be deployed to reduce the potential for downstream sedimentation impacts.
65. Excavation equipment brought onto the site shall be cleaned at an off-site location prior to commencement of site work to remove any soil which may contain noxious plant remains.
- 66. The Applicant shall restore the streambed in a manner that replicates the function and appearance of the natural stream channel, as detailed in the provided specifications.**
- 67. The wood guardrail separating the limit of work from the parking area at #129-135 Rosemont Street shall be retained or, if necessary to remove as part of access, replaced at the end of construction to provide a structural barrier between the residential usage area and the restored riverfront area. In**

**addition to the proposed restoration plantings, the Applicant shall plant a row of evergreen shrubs parallel to and behind the wood guardrail.**

68. The Applicant is to contact the HCC immediately upon completion of the restoration work; an appointment for inspection by an HCC Official shall be arranged with the EM.
69. Immediately following the completion of work, the Applicant shall submit a status report, written by the EM, describing to the HCC the status of the resource areas and their immediate surroundings. This report shall be accompanied by the as-built plan required under Condition #37.
70. The EM, prior to and following each growing season for a minimum of three (3) years and until a Certificate of Compliance is issued, shall submit monitoring reports to the HCC. Monitoring reports shall describe, using narratives, plans, and color photographs, the physical characteristics of the areas within the limits of work with respect to soils, hydrology, habitat value, stability, survivorship of vegetation and plant mortality, aerial extent and distribution, species diversity and vertical stratification (i.e., the herb, shrub, and tree layers), the presence of invasive plant species, etc. These monitoring reports shall be submitted by May 31 and September 30 of each year. Applicable General Performance standards as outlined in 310 CMR are to be met within two years of completion. A Certificate of Compliance is to be issued ONLY AFTER the General Performance Standards and reporting requirements have been met.
71. A color photographic log of the site shall be kept with associated text by the EM. This log shall show pre-restoration through post-restoration views of the areas within the limits of work, undisturbed adjacent resource areas and buffer zones, and erosion/sedimentation control devices. A current log shall be submitted with the status and monitoring reports required above and with the Request for a Certificate of Compliance.

#### **WILDLIFE HABITAT PROTECTION**

72. **Turtle Protection Plan**: Prior to the start of work (including vegetation clearing or soil disturbance), the Applicant shall submit to the MA Division of Fisheries & Wildlife for review and written approval, a Wood Turtle Protection Plan. Said Plan shall detail procedures for protecting state-listed turtles during construction, and be prepared and implemented by a qualified, Division-approved wildlife biologist in possession of a valid Scientific Collection Permit issued by the Division. The Division is available for consultation on Plan development and can provide contact information for qualified biologists. The Division-approved Plan shall be implemented as written; any proposed changes to the Plan must be submitted to the Division for review and written approval prior to implementation of said changes. By December 31st of any year in which work occurs, the qualified biologist shall submit: a) a summary report to the Division detailing project status and compliance with the Plan; and b) any observations of state-listed turtles at <https://www.mass.gov/how-to/report-rare-species-vernal-pool-observations>.
73. **Following approval of the Turtle Protection Plan by the NHESP, the Applicant shall file the document with the HCC as a discussion item request for a scheduled meeting. The Applicant and/or its representative shall attend that meeting to detail the Plan to the Commissioners and to address any questions and/or comments.**

## **OTHER CONDITIONS**

74. If any unforeseen problem occurs during construction, which affects any of the eight statutory interests of the Wetlands Protection Act, M.G.L. Chapter 131, Section 40, upon discovery, the Applicant shall notify the HCC and an immediate meeting shall be held between the Commission, the Applicant, the engineer, contractor, and other concerned parties to determine the corrective measures to be employed. The Applicant shall then act to correct the problems using the corrective measures agreed upon.
75. Upon completion of the project, the Applicant shall request a Certificate of Compliance from the Commission and shall submit the following information with the request in both paper form and in an electronic form found acceptable to an HCC Official:
- a) A written statement by a professional engineer registered in the Commonwealth of Massachusetts certifying compliance with the approved plans referenced above and this OOC and setting forth deviations, if any exist.
  - b) A final monitoring report and current photo log prepared by the EM.
  - c) One set of as-built drawings prepared by the professional engineer showing resource areas, plantings, and detailed landscaping (i.e., all wetland resource areas, limits of work, etc.). These plans shall include the date(s) of fieldwork and shall be prepared in accordance with the "Plot Plan Standards" of the HCC Policy - P2000-02 "Occupancy Permit Checklist Endorsement".

## **ONGOING CONDITIONS**

Certain conditions are ongoing and do not expire upon the completion of the project or the issuance of a Certificate of Compliance. These conditions shall remain in effect after the issuance of a Certificate of Compliance for the project and shall be referenced in the chain of title for the property. These conditions are:

76. The HCC reserves the right to enforce all restrictions and/or requirements established for this property within this OOC under the enforcement powers of the City's wetlands protection ordinance, Municipal Ordinance Chapter 253.
77. The HCC reserves the right to schedule an annual inspection with the Applicant as part of a long-term management program to inspect the site for permanent stability and proper maintenance. The Applicant shall maintain the surrounding stormwater management system best management practices in accordance with the MA Stormwater Management Standards design manuals.

**--- END ---**



**Massachusetts Department of Environmental Protection**  
Bureau of Resource Protection - Wetlands

DEP File Number:

**Request for Departmental Action Fee**  
**Transmittal Form**

\_\_\_\_\_  
Provided by DEP

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

**A. Request Information**

1. Location of Project

_____	_____
a. Street Address	b. City/Town, Zip
_____	_____
c. Check number	d. Fee amount

2. Person or party making request (if appropriate, name the citizen group's representative):

\_\_\_\_\_

Name

\_\_\_\_\_

Mailing Address

_____	_____	_____
City/Town	State	Zip Code
_____	_____	
Phone Number	Fax Number (if applicable)	

3. Applicant (as shown on Determination of Applicability (Form 2), Order of Resource Area Delineation (Form 4B), Order of Conditions (Form 5), Restoration Order of Conditions (Form 5A), or Notice of Non-Significance (Form 6)):

\_\_\_\_\_

Name

\_\_\_\_\_

Mailing Address

_____	_____	_____
City/Town	State	Zip Code
_____	_____	
Phone Number	Fax Number (if applicable)	

4. DEP File Number:

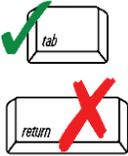
\_\_\_\_\_

**B. Instructions**

1. When the Departmental action request is for (check one):

- Superseding Order of Conditions – Fee: \$120.00 (single family house projects) or \$245 (all other projects)
- Superseding Determination of Applicability – Fee: \$120
- Superseding Order of Resource Area Delineation – Fee: \$120

**Important:**  
When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.





Massachusetts Department of Environmental Protection  
Bureau of Resource Protection - Wetlands

DEP File Number:

## Request for Departmental Action Fee Transmittal Form

\_\_\_\_\_  
Provided by DEP

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

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### B. Instructions (cont.)

Send this form and check or money order, payable to the *Commonwealth of Massachusetts*, to:

Department of Environmental Protection  
Box 4062  
Boston, MA 02211

2. On a separate sheet attached to this form, state clearly and concisely the objections to the Determination or Order which is being appealed. To the extent that the Determination or Order is based on a municipal bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.
3. Send a **copy** of this form and a **copy** of the check or money order with the Request for a Superseding Determination or Order by certified mail or hand delivery to the appropriate DEP Regional Office (see <https://www.mass.gov/service-details/massdep-regional-offices-by-community>).
4. 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.

# CITY OF HAVERHILL, MASSACHUSETTS

## ROSEMONT STREET OVER LITTLE RIVER

### BRIDGE NO. H-12-024 (CFF)



CITY COUNCIL

TIMOTHY J. JORDAN, PRESIDENT  
 JOHN A. MICHITSON, VICE PRESIDENT  
 MELINDA E. BARRETT, COUNCILLOR  
 JOSEPH J. BEVILACQUA, COUNCILLOR  
 THOMAS J. SULLIVAN, COUNCILLOR  
 MELISSA LEWANDOWSKI, COUNCILLOR  
 MICHAEL S. MCGONAGLE, COUNCILLOR  
 CATHERINE P. ROGERS, COUNCILLOR  
 SHAUN P. TOOHEY, COUNCILLOR

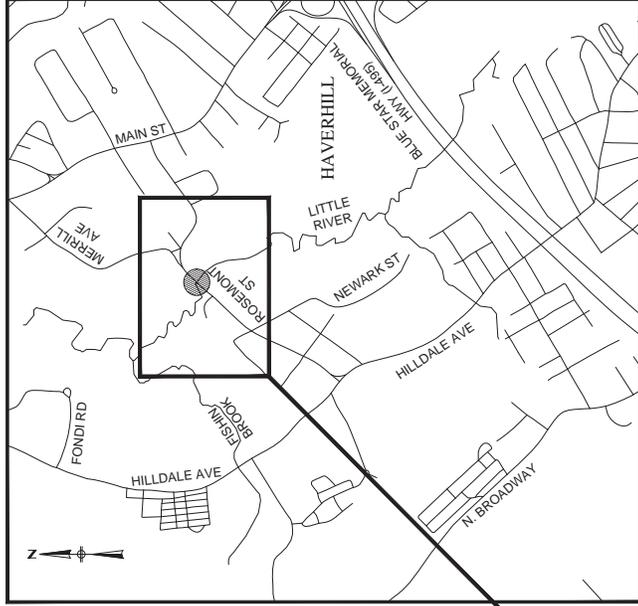
CITY MAYOR

JAMES J. FIORENTINI

DEPARTMENT OF PUBLIC WORKS

ROBERT E. WARD, DIRECTOR  
 JOHN H. PETTIS III, CITY ENGINEER

APRIL 2024



**Project  
Location**

PLAN INDEX

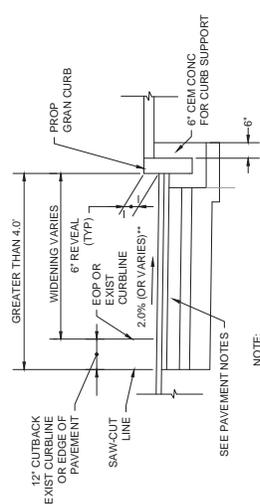
<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2	CONSTRUCTION DETAILS
3	SECTIONS
4	CONSTRUCTION PLAN & TYPICAL SECTION
5	BRIDGE GENERAL PLAN & ELEVATION
6	DREDGING LIMITS
7	JURISDICTIONAL BOUNDARIES PLAN
8	IMPACTS PLAN



PREPARED BY:

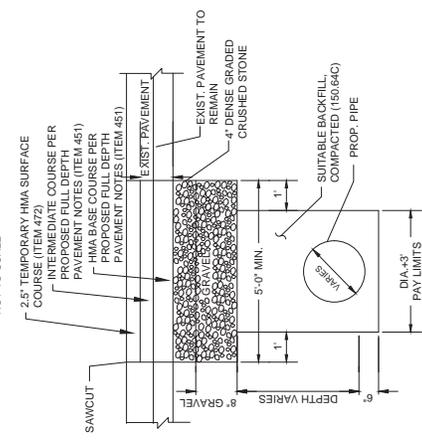


Christopher M. Jones  
 REGISTERED PROFESSIONAL ENGINEER  
 DATE 4/24/2024

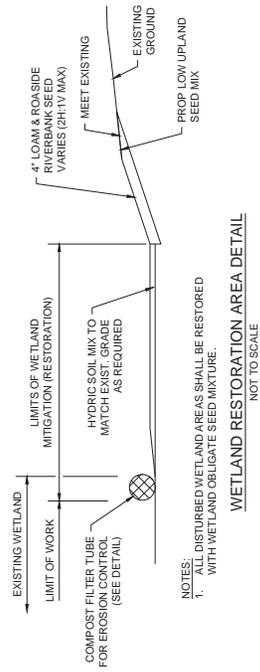


NOTE: SEE PAVEMENT NOTES SHEET 5

**DETAIL FOR BOX WIDENING GREATER THAN 4.0'**  
NOT TO SCALE

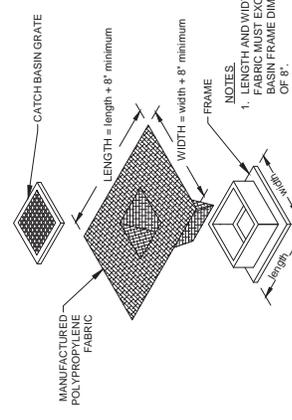


**PERMANENT TRENCH PATCH DETAIL  
IN MILLED AREAS**  
NOT TO SCALE



NOTE: 1. ALL DISTURBED WETLAND AREAS SHALL BE RESTORED WITH WETLAND OBLIGATE SEED MIXTURE.

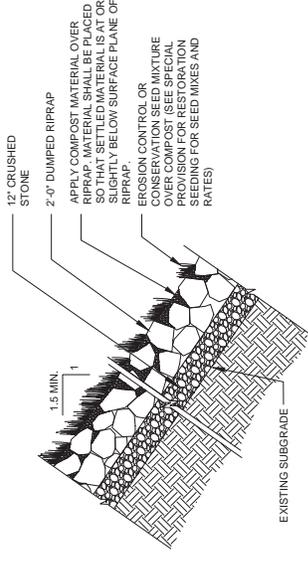
**WETLAND RESTORATION AREA DETAIL**  
NOT TO SCALE



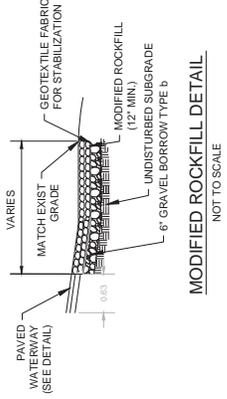
NOTES:

1. LENGTH AND WIDTH OF POLYPROPYLENE FABRIC MUST EXCEED EXISTING CATCH BASIN FRAME DIMENSIONS BY A MINIMUM OF 6\".
2. REMOVE CATCH BASIN GRATE AND INSTALL POLYPROPYLENE FABRIC OVER CATCH BASIN FRAME. REPLACE CATCH POLYPROPYLENE FABRIC IN PLACE.

**CATCH BASIN EROSION CONTROL PROTECTION (TYP)**  
NOT TO SCALE

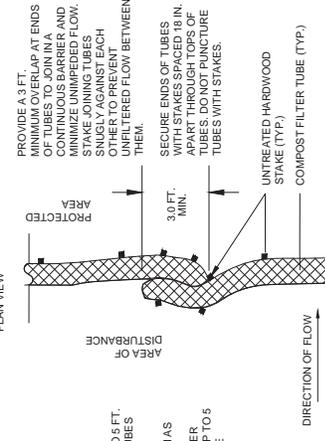
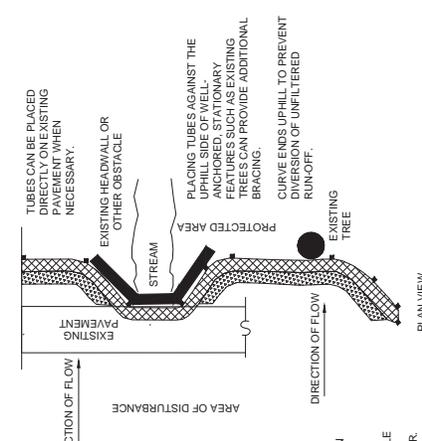


**RIPRAP DETAIL FOR SLOPE STABILIZATION**  
NOT TO SCALE

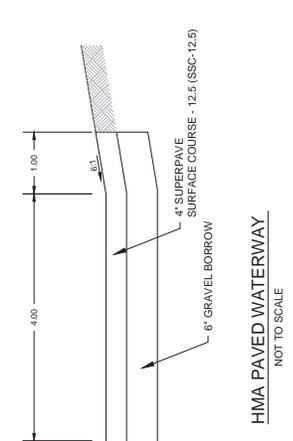


**MODIFIED ROCKFILL DETAIL**  
NOT TO SCALE

- GENERAL NOTES:**
1. PROVIDE A MINIMUM TUBE DIAMETER OF 12 INCHES (300mm) FOR SLOPES UP TO 50 FEET (15.24m) IN LENGTH WITH A SLOPE RATIO OF 3H:1V OR STEEPER. LONGER SLOPES OR ADDITIONAL COURSING OF FILTER TUBES DIAMETER OR ADDITIONAL COURSING OF FILTER TUBES MANUFACTURER'S RECOMMENDATIONS FOR SITUATIONS WITH LONGER OR STEEPER SLOPES. PERPENDICULAR TO SHEET OR CONCENTRATED FLOW, INTERMITTENT STREAMS, ANNUAL EPHEMERAL OR PERMANENT STREAMS.
  2. CONFIGURE TUBES AROUND EXISTING SITE FEATURES TO MINIMIZE SITE DISTURBANCE AND MAXIMIZE CAPTURE AREA OF STORMWATER RUN-OFF.



**SINGLE COMPOST FILTER TUBE DETAIL FOR EROSION CONTROL**  
NOT TO SCALE



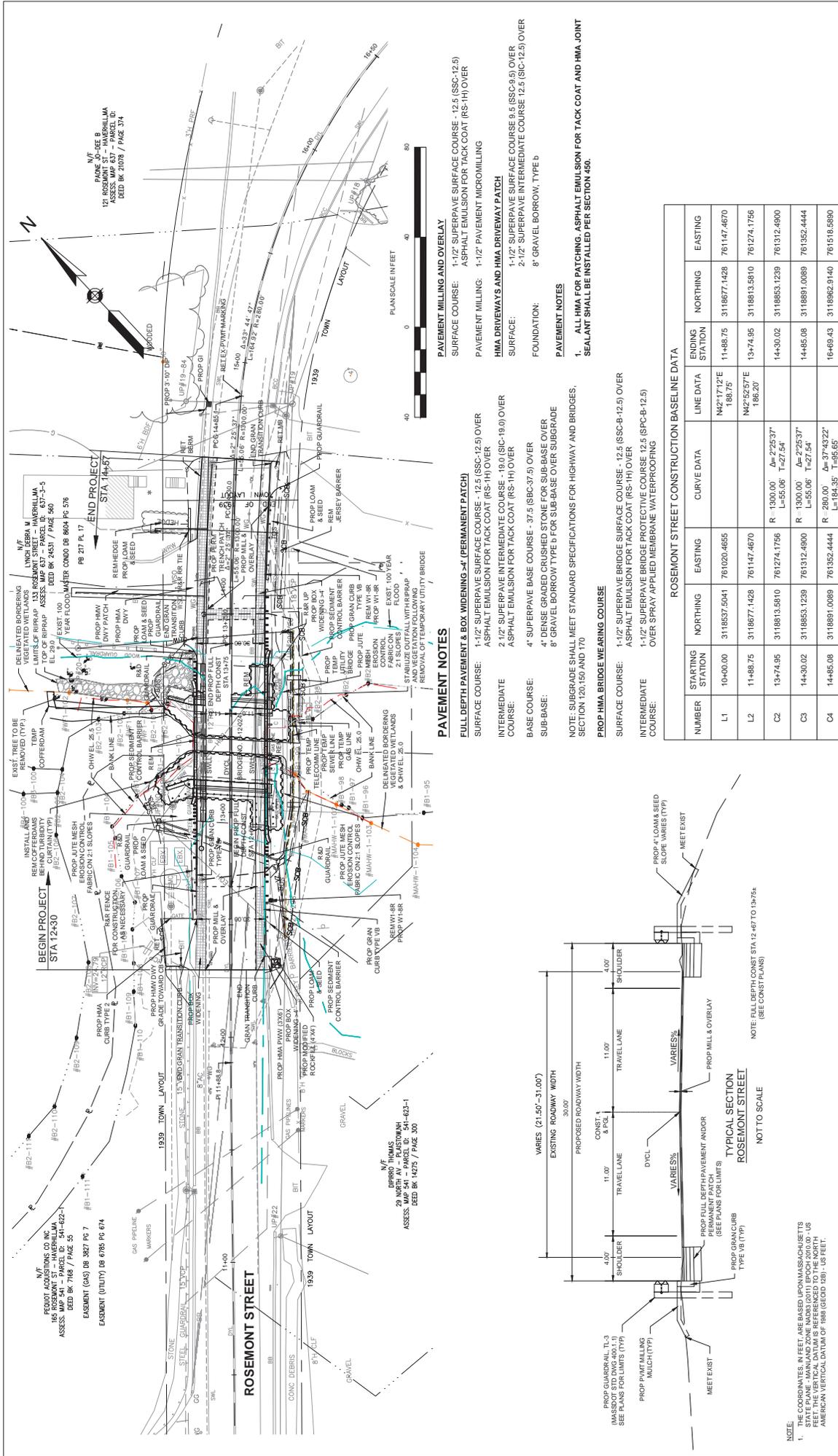
**ROSEMONT STREET BRIDGE**  
Haverhill, Massachusetts

Plot Date: 4/24/2024 4:07 PM

Figure No. 2  
Not to Scale

**CONSTRUCTION DETAILS**





N/E  
 FENOT ACQUISITIONS CO INC  
 121 ROSEMONT ST - HAVERHILL MA  
 ASSES. MAP 401 - PARCEL ID: 422-1  
 DEED BK 718 / PAGE 55  
 EASEMENT (043) DB 3827 PG 7  
 EASEMENT (UTILITY) DB 6786 PG 674

N/E  
 FENOT ACQUISITIONS CO INC  
 121 ROSEMONT ST - HAVERHILL MA  
 ASSES. MAP 401 - PARCEL ID: 422-1  
 DEED BK 718 / PAGE 55  
 EASEMENT (043) DB 3827 PG 7  
 EASEMENT (UTILITY) DB 6786 PG 674

N/E  
 FENOT ACQUISITIONS CO INC  
 121 ROSEMONT ST - HAVERHILL MA  
 ASSES. MAP 401 - PARCEL ID: 422-1  
 DEED BK 718 / PAGE 55  
 EASEMENT (043) DB 3827 PG 7  
 EASEMENT (UTILITY) DB 6786 PG 674

N/E  
 FENOT ACQUISITIONS CO INC  
 121 ROSEMONT ST - HAVERHILL MA  
 ASSES. MAP 401 - PARCEL ID: 422-1  
 DEED BK 718 / PAGE 55  
 EASEMENT (043) DB 3827 PG 7  
 EASEMENT (UTILITY) DB 6786 PG 674

N/E  
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 121 ROSEMONT ST - HAVERHILL MA  
 ASSES. MAP 401 - PARCEL ID: 422-1  
 DEED BK 718 / PAGE 55  
 EASEMENT (043) DB 3827 PG 7  
 EASEMENT (UTILITY) DB 6786 PG 674



**PAVEMENT MILLING AND OVERLAY**  
 SURFACE COURSE: 1-1/2' SUPERPAVE SURFACE COURSE - 2.5' (SSC-12.5) ASPHALT EMULSION FOR TACK COAT (RS-H) OVER  
 PAVEMENT MILLING: 1-1/2' SUPERPAVE INTERMEDIATE COURSE  
**HMA DRIVEWAYS AND HMA DRIVEWAY PATCH**  
 SURFACE: 1-1/2' SUPERPAVE SURFACE COURSE 9.5' (SSC-9.5) OVER  
 2-1/2' SUPERPAVE INTERMEDIATE COURSE 12.5' (SIC-12.5) OVER  
 FOUNDATION: 8" GRAVEL BORROW, TYPE B

**PAVEMENT NOTES**  
 1. ALL HMA FOR PATCHING, ASPHALT EMULSION FOR TACK COAT AND HMA JOINT SEALANT SHALL BE INSTALLED PER SECTION 456.

**PAVEMENT NOTES**  
 FULL DEPTH PAVEMENT & BOX WIDENING -4' (PERMANENT PATCH)  
 SURFACE COURSE: 1-1/2' SUPERPAVE SURFACE COURSE - 12.5' (SSC-12.5) OVER ASPHALT EMULSION FOR TACK COAT (RS-H) OVER  
 INTERMEDIATE COURSE: 2-1/2' SUPERPAVE INTERMEDIATE COURSE - 19.0' (SIC-19.0) OVER ASPHALT EMULSION FOR TACK COAT (RS-H) OVER  
 BASE COURSE: 4' SUPERPAVE BASE COURSE - 37.5' (SBC-37.5) OVER SUB-BASE:  
 4' DENSE GRADED CRUSHED STONE FOR SUB-BASE OVER  
 8' GRAVEL BORROW TYPE D FOR SUB-BASE OVER SUBGRADE  
 NOTE: SUBGRADE SHALL MEET STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGES, SECTION 120, 150 AND 170

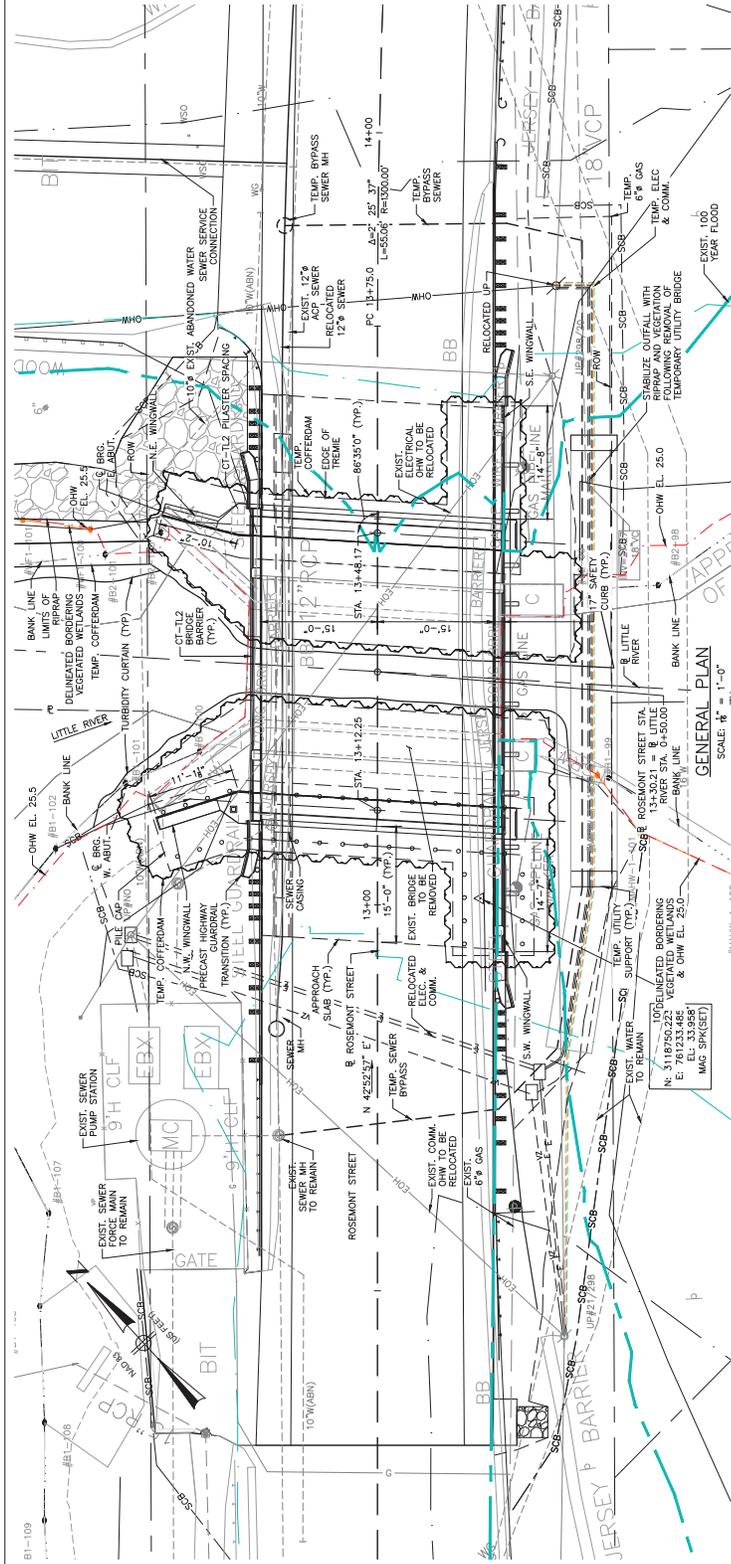
**PROP. HMA BRIDGE WEARING COURSE**  
 SURFACE COURSE: 1-1/2' SUPERPAVE SURFACE COURSE - 12.5' (SSC-12.5) OVER ASPHALT EMULSION FOR TACK COAT (RS-H) OVER  
 INTERMEDIATE COURSE: 1-1/2' SUPERPAVE INTERMEDIATE COURSE 12.5' (SIC-12.5) OVER SPRAY APPLIED MEMBRANE WATERPROOFING

**ROSEMONT STREET CONSTRUCTION BASELINE DATA**

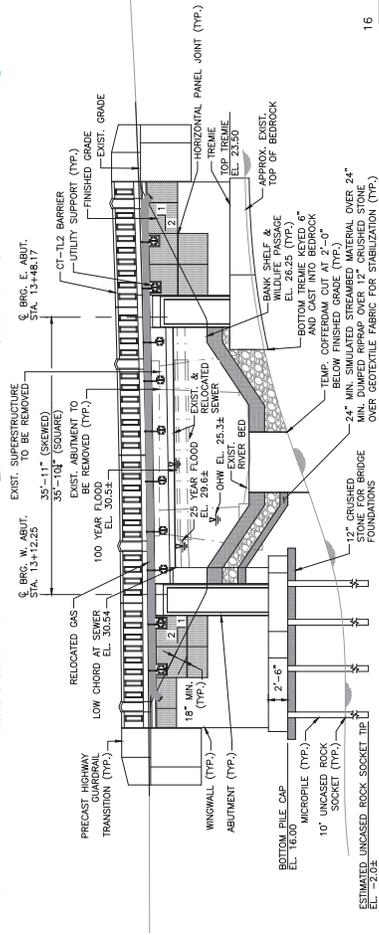
NUMBER	STARTING STATION	NORTHING	EASTING	CURVE DATA	LINE DATA	ENDING STATION	NORTHING	EASTING
L1	10+00.00	311857.5041	761020.4655		N42°17'12"E 188.75'	11+88.75	3118677.1428	761147.4670
L2	11+88.75	311857.5041	761020.4655	R = 1300.00' Δ = 2°25'37" L = 55.06' T = 57.54'	N42°52'57"E 186.20'	13+74.95	3118813.5910	761274.1756
C2	13+74.95	3118813.5910	761274.1756			14+30.02	3118853.1239	761312.4900
C3	14+30.02	3118853.1239	761312.4900			14+85.08	3118891.0089	761352.4444
C4	14+85.08	3118891.0089	761352.4444			16+69.43	3118662.9140	761518.6580

**ROSEMONT STREET BRIDGE**  
 Haverhill, Massachusetts  
 Figure No. 4  
 Scale: 1" = 40'

Plot Date: 4/22/2024 4:08 PM



GENERAL PLAN  
SCALE: 1" = 1'-0"



GENERAL ELEVATION  
SCALE: 1" = 1'-0"

NOTES:  
1. COORDINATES IN FEET ARE BASED UPON MASSACHUSETTS STATE PLANE, MAINLAND ZONE NAD83 (2011) EPOCH 2010.00 - US FEET. THE VERTICAL DATUM IS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (GEOID 12B) - US FEET.



**ROSEMONT STREET BRIDGE**  
Haverhill, Massachusetts

Plot Date: 4/24/2024 4:08 PM

Figure No. 5

Scale: 1/16" = 1'-0"

**BRIDGE GENERAL  
PLAN & ELEVATION**

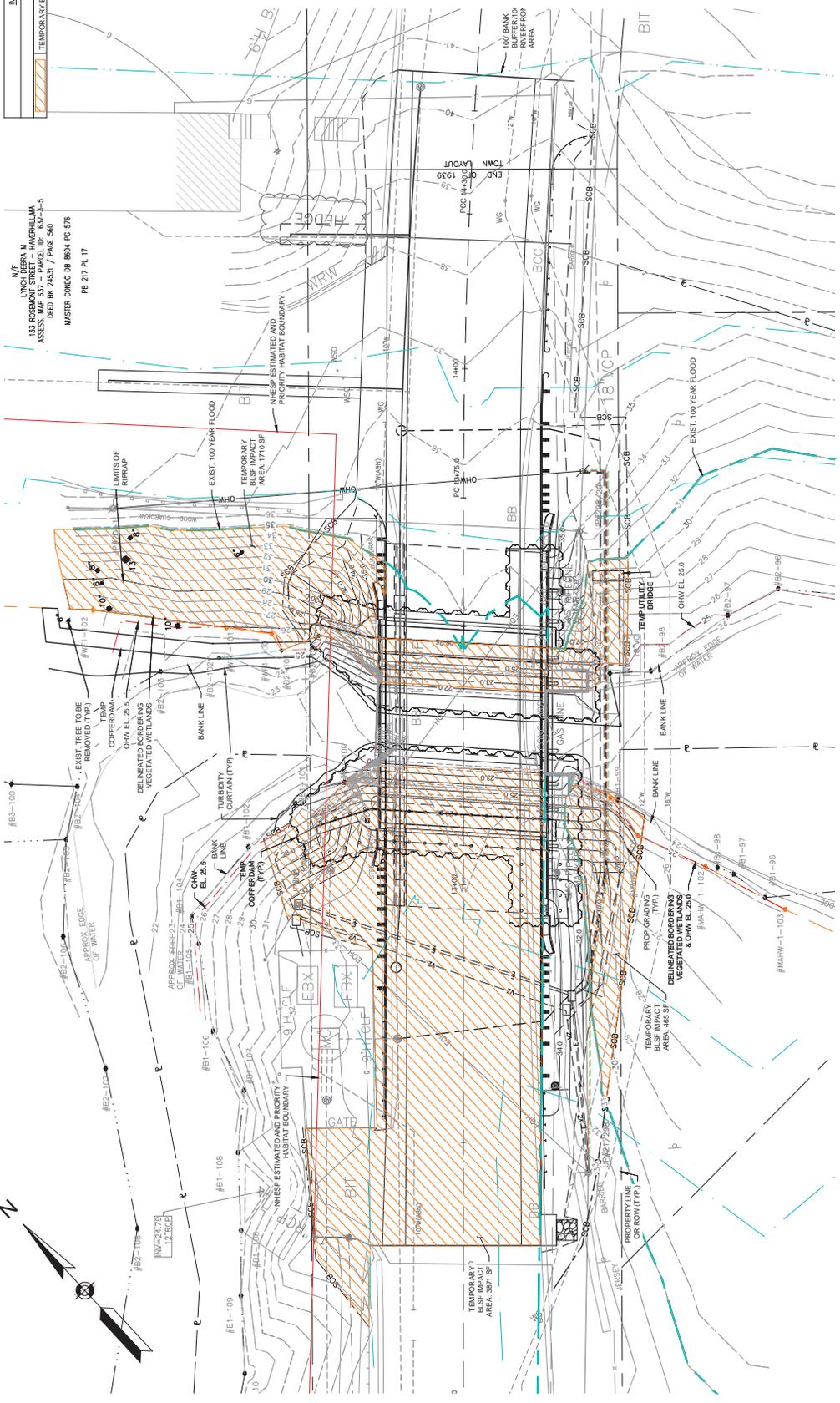
PLAN SCALE IN FEET





IMPACT LEGEND AND SUMMARY	
QUANTITY	UNITS
6046	SF
TEMPORARY BLF	

N/V  
 L'NOV DERRA M  
 135 BASS LANE  
 HAVERTILL MA  
 ASSESS MAP 637 - PARCEL ID: 637-3-5  
 DEED BK 24537 / PAGE 560  
 MASTER CONDO DR 8604 PG 576  
 PB 217 PL 17



NOTES:  
 1. THE COORDINATES IN FEET, ARE BASED UPON MASSACHUSETTS STATE PLANE COORDINATE SYSTEM 83 (NAD 83) IN US FEET. THE VERTICAL DATUM IS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (GEOID 128) - US FEET.  
 2. ALL WORK WITHIN THE RIVERFRONT AREA IS WITHIN THE INNER 100' RIPARIAN ZONE.



Figure No. 7  
 Scale: 1" = 20'  
**BORDERING LANDS SUBJECT  
 TO FLOODING PLAN**

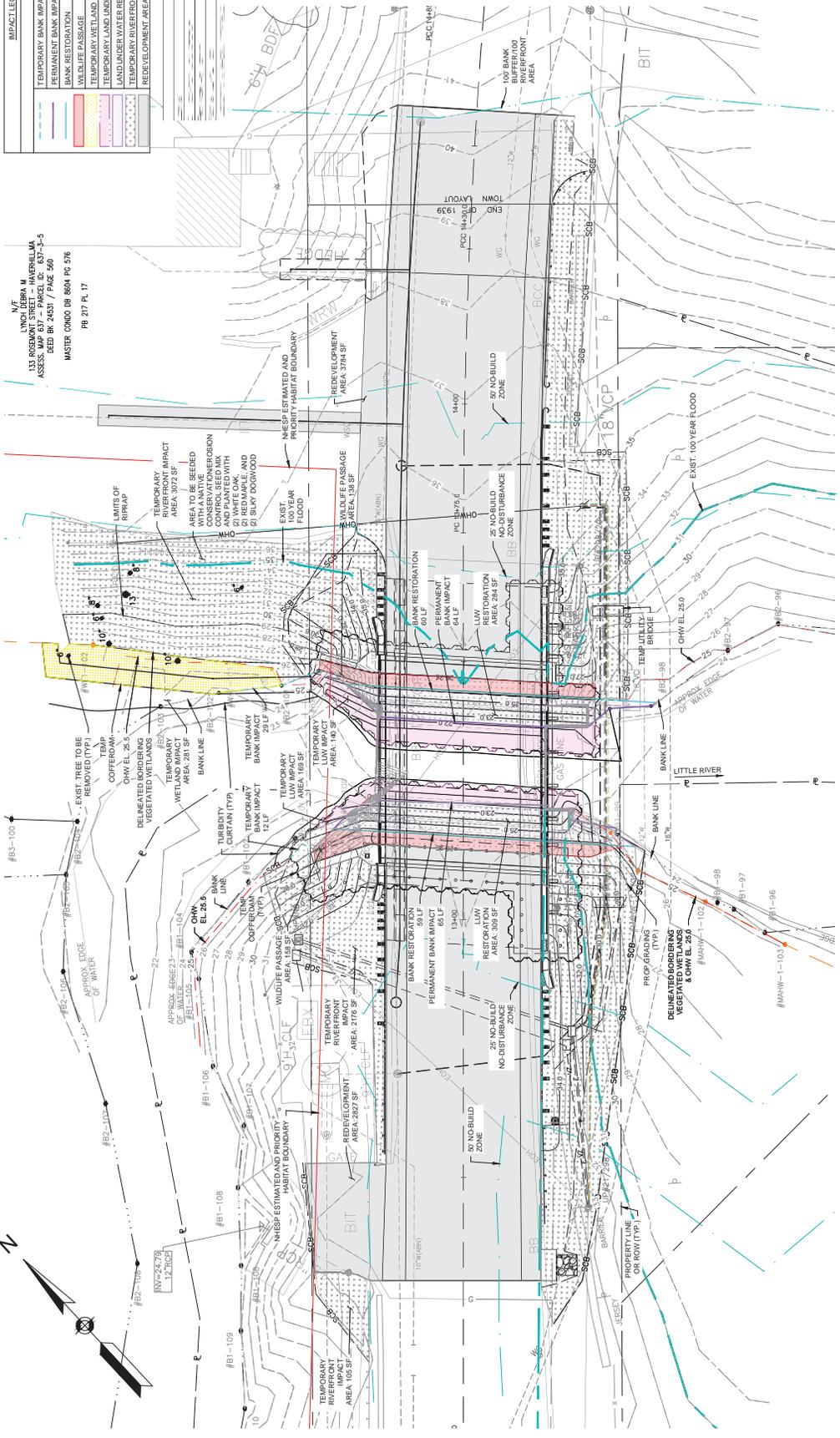
**ROSEMONT STREET BRIDGE**  
 Haverhill, Massachusetts  
 Plot Date: 4/24/2024 4:09 PM



IMPACT LEGEND AND SUMMARY

IMPACT TYPE	QUANTITY	UNITS
TEMPORARY BANK IMPACT	41	LF
PERMANENT BANK IMPACT	129	LF
BANK RESTORATION	119	LF
WILDLIFE PASSAGE	296	SF
TEMPORARY WETLAND IMPACT	281	SF
TEMPORARY LAND UNDER WATER IMPACT	309	SF
LAND UNDER WATER RESTORATION	583	SF
TEMPORARY RIVERFRONT IMPACT	5147	SF
REDEVELOPMENT AREA	6611	SF

N/V  
 LINDA DEBRA M  
 135 EAST LITTLE RIVER  
 ASSESS MAP #37 - PARCEL ID: 437-3-5  
 DEED BK 2457 / PAGE 560  
 MASTER CONDO DR #604 PG 576  
 PG 217 PL 17



- NOTES:
- THE COORDINATES IN FEET, ARE BASED UPON MASSACHUSETTS STATE PLANE COORDINATE SYSTEM (MPC) 1983 US FEET. THE VERTICAL DATUM IS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (GEOID 128 - 106 FEET).
  - ALL WORK WITHIN THE RIVERFRONT AREA IS WITHIN THE INNER 100' RIPARIAN ZONE.



# ROSEMONT STREET BRIDGE

Haverhill, Massachusetts

Plot Date: 4/24/2024 4:09 PM

Figure No. 8  
 Scale: 1" = 20'  
**IMPACTS PLAN**

Appendix B  
USACE General Permit



DEPARTMENT OF THE ARMY  
US ARMY CORPS OF ENGINEERS  
NEW ENGLAND DISTRICT  
696 VIRGINIA ROAD  
CONCORD MA 01742-2751

October XX, 2024

Regulatory Division  
File Number: **NAE-2024-0409**

City of Haverhill  
Attn: John Pettis III, City Engineer  
4 Summer Street, Room 300  
Haverhill, Massachusetts 01830  
Sent by email: [[jpettis@cityofhaverhill.com](mailto:jpettis@cityofhaverhill.com) ]

Dear Mr. Pettis:

The U.S. Army Corps of Engineers (USACE) has reviewed your application to discharge dredged and/or fill material into approximately **1,042** square feet of waters of the United States, associated with the Little River and adjacent wetlands, as part of the Rosemont Street Bridge Replacement Project . This crossing (Bridge No. H-12-024 (CFF)) is adjacent to 129 Rosemont Street in Haverhill, Massachusetts.

As part of this project the existing 16-foot 8-inch single span bridge will be replaced with a 35-foot 11-inch single span bridge and the existing sewer and line lines will be raised. Temporary cofferdams will be installed in a phased manner so that embankment work can be completed “in the dry”. Dumped riprap will be installed as scour protection to protect the new bridge embankments. A minimum of two feet of simulated streambed material will be installed over the dumped riprap to restore the river channel. The design for the new bridge includes a terrestrial wildlife passage bench.

This work is described on the enclosed plan drawings entitled “CITY OF HAVERHILL, MASSACHUSETTS, ROSEMONT STREET OVER LITTLE RIVER,” on a total of seven sheets, dated “MAY 2024”.

Based on the information that you have provided, we verify that the activity is authorized under General Permit **#23** (Linear Transportation Projects and Wetland/ Stream Crossings) of the June 2, 2023, federal permit known as the General Permits for the Commonwealth of Massachusetts (GP MA). The GP MA is available at <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit..>

Please review the GP MA carefully, in particular the general conditions beginning on page 35 and ensure that you and all personnel performing work authorized by the GP MA are fully aware of and comply with its terms and conditions. A copy of the GP MA and this verification letter shall be available at the work site as required by General Condition #17. You must perform this project in compliance with the terms and conditions of the GP MA and also with the following special conditions:

1. You must maintain the activity authorized herein in good condition and in conformance with the terms and conditions of this authorization. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition #39 on page 50 of the GP MA. Should you wish to cease to maintain the authorized activity, or should you desire to abandon it without a good faith transfer, you must obtain a modification of this authorization from this office, which may require restoration of the area.

2. The City of Haverhill (the permittee) must complete and return the enclosed Work Start Notification Form to this office at least two weeks prior to starting the authorized work.

3. All construction shall be completed in accordance with the limits of construction and the construction sequences detailed on the attached plan drawings, entitled "CITY OF HAVERHILL, MASSACHUSETTS, ROSEMONT STREET OVER LITTLE RIVER," on a total of seven sheets, dated "MAY 2024". If you propose to change the plans or construction methods for work within the Little River or in adjacent wetlands, please contact us immediately to discuss modification of this authorization. The Corps must approve any changes before you undertake them.

4. This Corps permit does not authorize you to "take" a federally listed endangered or threatened species, in particular the northern long-eared bat (*Myotis septentrionalis*). See 16 USC 1532(13) and 16 USC 1532(19) for definitions of take, which include harassment and harm. See 50 CFR 17.3 which further define harassment and harm.

5. No tree-clearing operations shall be conducted during the time-period between June 1<sup>st</sup> and July 31<sup>st</sup> of any year, in order to avoid impacts to northern long-eared bat pup roosting habitat areas. However, if an appropriate project-specific survey demonstrates that bats are absent from the action area, this special condition would not apply. Please contact us if you would like to conduct a survey in accordance with the "Range-Wide Indiana Bat & Northern Long-Eared Bat Survey Guidelines."

6. NOTE: General Condition **#14(d)** of the GP MA requires that you contact the Corps immediately if any previously unknown historic, cultural, or archaeological remains or artifacts are discovered during the construction phase of this project so that impacts to these potential historical properties can be minimized.

7. Appropriate measures must be taken to maintain normal downriver flows and to minimize flooding to the maximum extent practicable, when temporary structures, work, and discharges, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Temporary fills must be placed in a manner that will not be eroded by expected high flows. See General Condition **#22(f)** of the GP MA for more details.

8. All temporary construction fills and non-biodegradable sedimentation/erosion controls installed during the construction phase of this project shall be removed promptly after the completion of construction, in order to minimize the potential entrapment of wildlife. Any plastic construction debris shall be completely removed from this site. See General Condition **#25(e)** of the GP MA for more details.

9. The introduction, spread, or the increased risk of invasion of non-native invasive plant or animal species on the project site, into new or disturbed areas, or areas adjacent to the project site caused by the site work is prohibited and shall be managed appropriately. The Corps may require the City to develop a DRAFT invasive species control plan (ISCP) if this becomes an issue. The DRAFT ISCP would need to be coordinated with the Corps for our approval prior to implementing it. See General Condition **#29** of the GP MA for more details.

10. Prior to being onsite, the contractor shall thoroughly inspect and remove seeds, plant material, soil, mud, insects, and other invertebrates on all equipment, including construction mats, to be used on the project site to prohibit the introduction of invasive organisms. At a minimum, the following shall be inspected and cleaned on terrestrial vehicles where applicable:

**Rubber Tired Vehicles** - Crevices in upper surface and panels, tires, rims, and fender wells, spare tire mounting area, bumpers, front, and rear quarter panels, around and behind grills, bottom of radiator vent openings, brake mechanisms, transmission, stabilizer bar, shock absorbers, front and rear axles, beds, suspension units, exhaust systems, light casings, and mirrors.

**Tracked Land Vehicles** - Crevices in upper surface and panels, top of axles and tensioners, support rollers, between rubber or gridded areas, beneath fenders, hatches, under casings, and grills.

**Interiors of All Vehicles** - Beneath seats, beneath floor mats, upholstery, beneath foot pedals, inside folds of gear shift cover.

11. Sediment to be removed shall be dewatered in place or within an on-site dewatering facility. This will allow the suspended sediment to settle and the filtered water to evaporate, percolate into the ground, or flow downriver in the Little River. The scheduling of sediment removal and dewatering operations shall be such that the capacity of the dewatering area is not exceeded under any circumstances.

12. Prior to transporting any sediment off-site for permanent disposal, the City of Haverhill or their contractor will coordinate with the Corps the location(s) of the upland facilities where the excavated sediments will be permanently disposed.

13. Except where stated otherwise, reports, drawings, correspondence, and any other submittals required by this permit shall be marked with the words "Permit #**NAE-2024-0409**" and submitted via: a) MAIL: Massachusetts Section - Regulatory Division, Corps of Engineers, New England District, 696 Virginia Road, Concord, MA 01742-2751; b) EMAIL: [paul.j.sneeringer@usace.army.mil](mailto:paul.j.sneeringer@usace.army.mil) and [cenae-r@usace.army.mil](mailto:cenae-r@usace.army.mil); or c) FAX: (978) 318-8303. Documents which are not marked and addressed in this manner may not reach their intended destination and do not comply with the requirements of this permit. Requirements for immediate notification to the Corps shall be done by telephone to (978) 318-8338.

14. Within one month of completing the authorized construction associated with the Rosemont Street Bridge Replacement Project Project, the City of Haverhill shall fill out and return the enclosed Compliance Certification Form verifying that that this project was completed in compliance with all the terms and conditions of this GP MA authorization. As part of this submission, the City shall provide the Corps with post-construction photos of the bridge replacement and associated channel restoration areas.

15. Within six months of the completion of the Rosemont Street Bridge Replacement Project, the City of Haverhill shall forward a set of project plans and relevant technical documentation to the Risk Analysis Branch, Mitigation Division, Federal Emergency Management Agency ("FEMA"), Region 1, 99 High Street, Boston Massachusetts, 02110. This submission shall be made in a digital format, and provide a level of content detail, acceptable to FEMA Region 1 personnel. Such a submission is necessary so that upon confirmation of the recent physical changes affecting flooding conditions, risk premium rates and flood plain management requirements will be based upon current data.

16. If at any time, there is a project design change that may:

- a) result in any increase to the crossed waterway's National Flood Insurance Program ("NFIP") Base Flood Elevation ("BFE") profile;
- b) result in a greater than 0.5 foot decrease to the crossed waterway's NFIP BFE profile; or
- c) require an alteration to the waterway's existing NFIP Regulatory Floodway delineation.

The City of Haverhill shall coordinate with the FEMA Region 1 Risk Analysis Branch personnel to determine if initiation of an NFIP flood insurance study change review process is warranted. If FEMA personnel determine that a change to the flood insurance study pertinent to the project may be required, the City will submit all required information to FEMA and complete the applicable process. Once completed, the City will provide written notice to the Corps regarding the coordination process outcome.

This authorization presumes that the work as described above and as shown on your plans noted above is in waters of the U.S.

This authorization expires on June 1, 2028. You must commence or have under contract to commence the work authorized herein by June 1, 2028, and complete the work by June 1, 2029. If not, you must contact this office to determine the need for further authorization and we recommend you contact us *before* the work authorized herein expires. Please contact us immediately if you change the plans or construction methods for work within our jurisdiction as we must approve any changes before you undertake them. Performing work within our jurisdiction that is not specifically authorized by this determination or failing to comply with the special conditions provided above and all the terms and conditions of the GP MA may subject you to the enforcement provisions of our regulations.

This authorization does not obviate the need to obtain other federal, state, or local authorizations required by law. Applicants are responsible for applying for and obtaining any other approvals.

We continually strive to improve our customer service. To better serve you, we would appreciate your completing our Customer Service Survey located at <https://regulatory.ops.usace.army.mil/customer-service-survey>.

Please contact Mr. Paul Sneeringer of my staff at (978) 318-8491 or at [paul.j.sneeringer@usace.army.mil](mailto:paul.j.sneeringer@usace.army.mil) if you have any questions about this authorization letter.

Sincerely,

Paul M. Maniccia  
Chief, Massachusetts Branch  
Regulatory Division

Enclosures

Copies Furnished:

Ed Reiner, U.S. EPA, Region 1, Boston, Massachusetts, [reiner.ed@epa.gov](mailto:reiner.ed@epa.gov)  
Rachel Croy, U.S. EPA, Region 1, Boston, Massachusetts, [croy.rachel@epa.gov](mailto:croy.rachel@epa.gov)  
David Simmons, USFWS, New England Field Office, Concord, New Hampshire,  
[david\\_simmons@fws.gov](mailto:david_simmons@fws.gov)

**Sean Duffey, Massachusetts Office of Coastal Zone Management, Boston, MA,**  
[sean.duffey@mass.gov](mailto:sean.duffey@mass.gov)

**Patrice Bordonaro, Office of Coastal Zone Management, Boston, MA,**  
[patrice.bordonaro@mass.gov](mailto:patrice.bordonaro@mass.gov)

Jill Provencal, Massachusetts DEP Northeast Regional Office, Wetland and Waterways,  
Wilmington, MA, [jill.provencal@mass.gov](mailto:jill.provencal@mass.gov) [DEP File #XXX-XXXX]

Kristin Divris, Massachusetts DEP Northeast Regional Office, Wetland and Waterways,  
Wilmington, MA; [Kristin.Divris@mass.gov](mailto:Kristin.Divris@mass.gov) (DEP File No. XXXX)

Philip Di Pietro, Massachusetts DEP Northeast Regional Office, Wetland and  
Waterways, Wilmington, MA, [philip.dipietro@mass.gov](mailto:philip.dipietro@mass.gov) [DEP File #XXX-XXXX]

Tim McGuire, MassWildlife – Natural Heritage and Endangered Species Program,  
1 Rabbit Hill Road, Westborough, MA, [timothy.mcguire2@mass.gov](mailto:timothy.mcguire2@mass.gov) [RC-84126]

**MassDEP-WRP, Boston, MA; [dep.waterways@mass.gov](mailto:dep.waterways@mass.gov), (DEP File No. XXXX)**

Kerry Bogdan, Federal Emergency Management Agency, Region 1, 99 High Street,  
Sixth Floor, Boston, Massachusetts, [kerry.bogdan@fema.dhs.gov](mailto:kerry.bogdan@fema.dhs.gov)

David Robinson, MA Board of Underwater Archaeological Resources (BUAR), Boston,  
MA, [david.s.robinson@mass.gov](mailto:david.s.robinson@mass.gov)

Kevin DiRocco, CENAE-EDW

Frederick Clark IV, Haverhill Conservation Commission, 4 Summer Street, Haverhill,  
Massachusetts, 01830, [conservation@haverhillma.gov](mailto:conservation@haverhillma.gov)

Laura Krause, BETA Group, Inc., 89 Shrewsbury Street, suite 300, Worcester,  
Massachusetts, [lkrause@beta-inc.com](mailto:lkrause@beta-inc.com)

Permittee: [jpettis@cityofhaverhill.com](mailto:jpettis@cityofhaverhill.com)

DRAFT

# CITY OF HAVERHILL, MASSACHUSETTS

## ROSEMONT STREET OVER LITTLE RIVER

### BRIDGE NO. H-12-024 (CFF)



CITY COUNCIL

- TIMOTHY J. JORDAN, PRESIDENT
- JOHN A. MICHITSON, VICE PRESIDENT
- MELINDA E. BARRETT, COUNCILLOR
- JOSEPH J. BEVILACQUA, COUNCILLOR
- THOMAS J. SULLIVAN, COUNCILLOR
- MELISSA LEWANDOWSKI, COUNCILLOR
- MICHAEL S. MCGONAGLE, COUNCILLOR
- CATHERINE P. ROGERS, COUNCILLOR
- SHAUN P. TOOHEY, COUNCILLOR

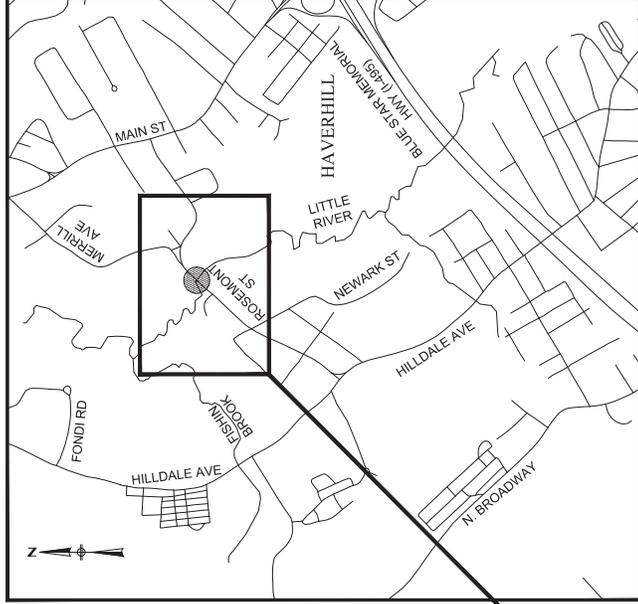
CITY MAYOR

JAMES J. FIORENTINI

DEPARTMENT OF PUBLIC WORKS

- ROBERT E. WARD, DIRECTOR
- JOHN H. PETTIS III, CITY ENGINEER

MAY 2024



**Project  
Location**

PROJECT LOCATION  
LOCATION MAP  
NOT TO SCALE

PLAN INDEX

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2	CONSTRUCTION DETAILS
3	SECTIONS (1 OF 2)
4	SECTIONS (2 OF 2)
5	CONSTRUCTION PLAN & TYPICAL SECTION
6	BRIDGE GENERAL PLAN & ELEVATION
7	DREDGING LIMITS
8	JURISDICTIONAL BOUNDARIES PLAN
9	IMPACTS PLAN

PREPARED BY:



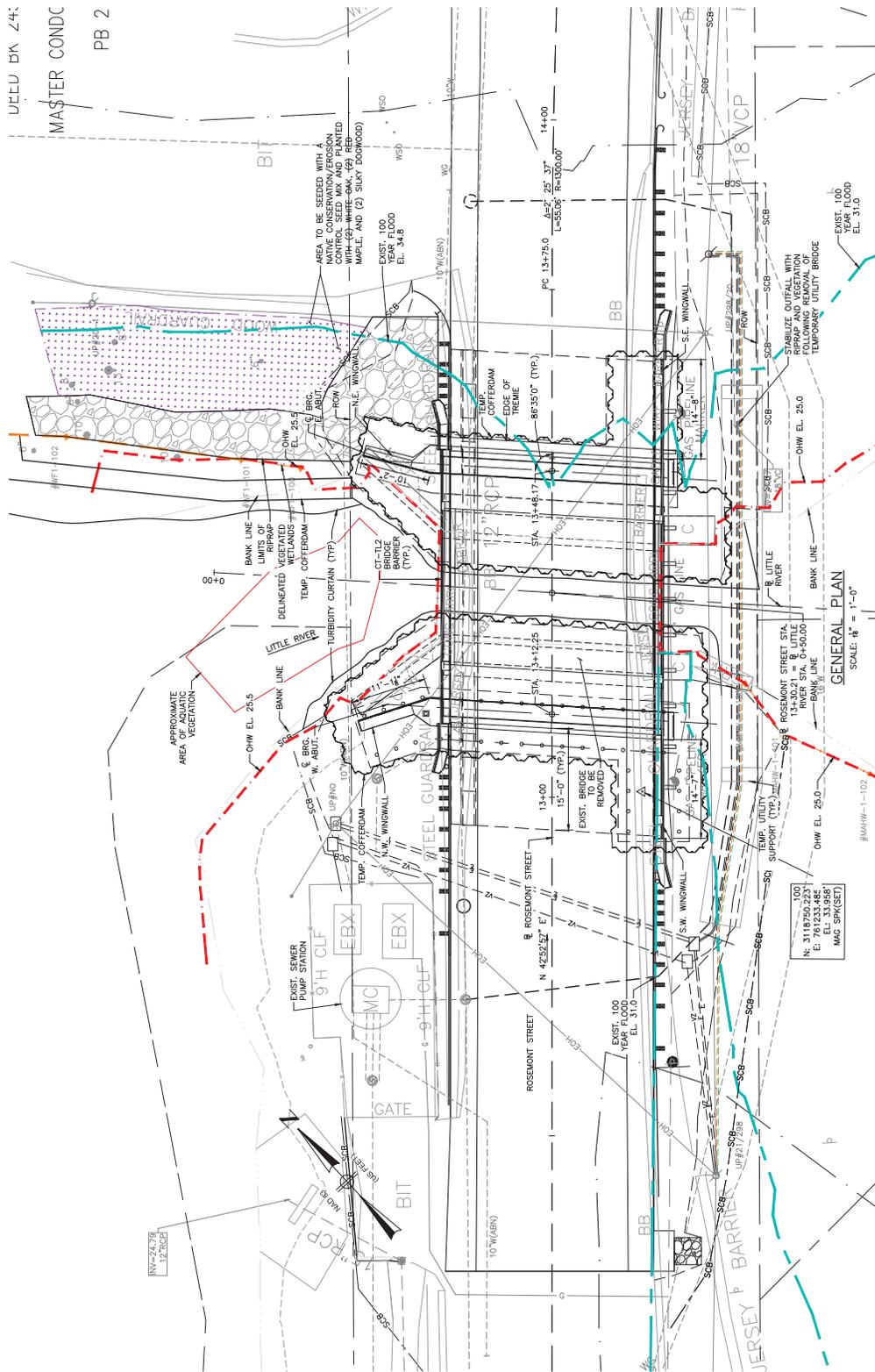








DELU BK 44;  
 MASTER CONDC  
 PB 2



NOTES:  
 1. THE COORDINATES, IN FEET, ARE BASED UPON MASSACHUSETTS STATE PLANE - MAINLAND ZONE NAD83 (2011) EPOCH 2010.00 - US DATUM 83. ALL VERTICAL ELEVATIONS REFERENCED TO THE NAD83 (2011) VERTICAL DATUM OF 1988 (GEOID 12B) - US FEET.



Figure No. 6  
 Scale: 1/16" = 1'-0"

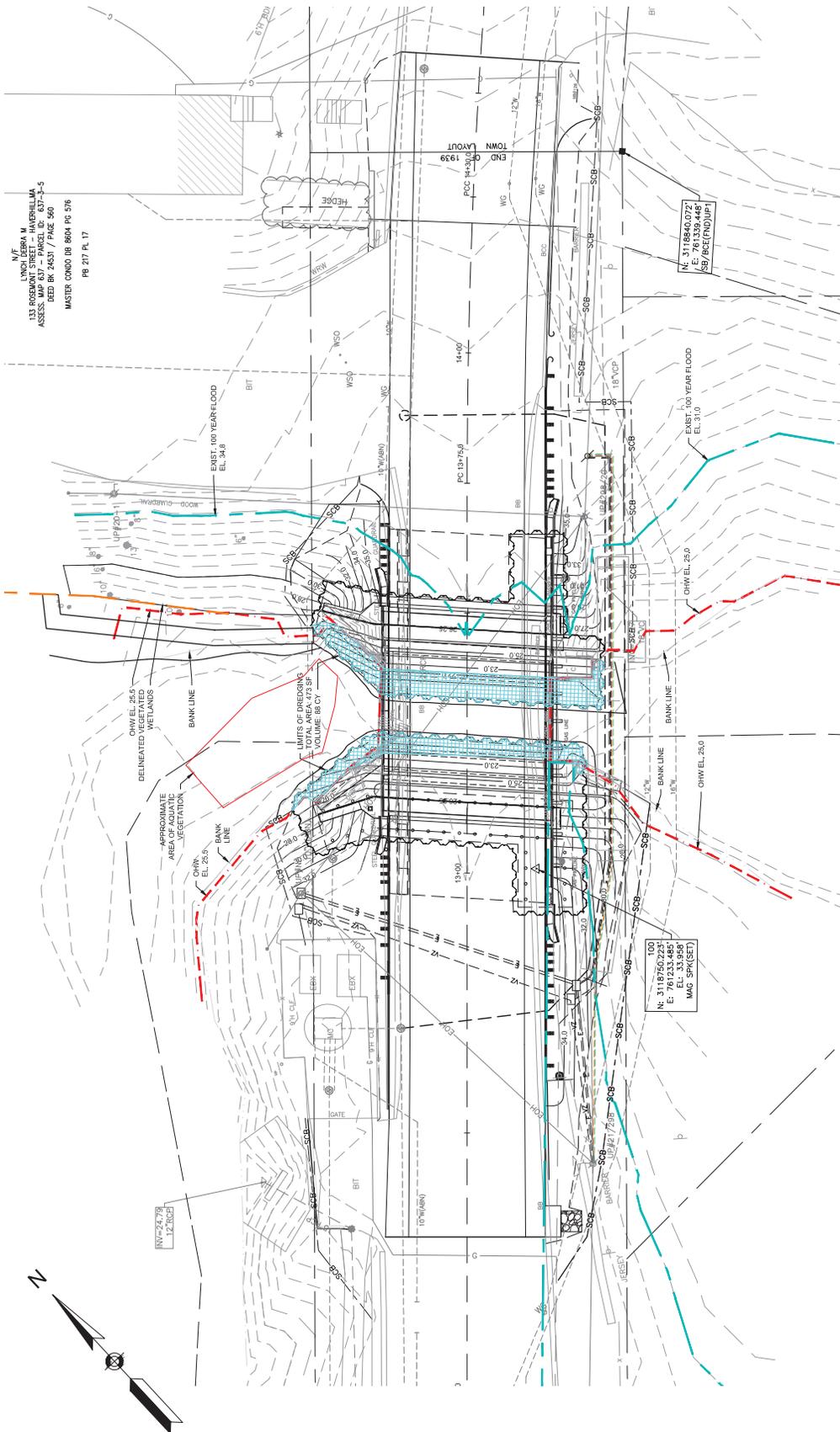
# ROSEMONT STREET BRIDGE

Haverhill, Massachusetts

# BRIDGE GENERAL PLAN & ELEVATION

Plot Date: 5/9/2024 1:54 PM





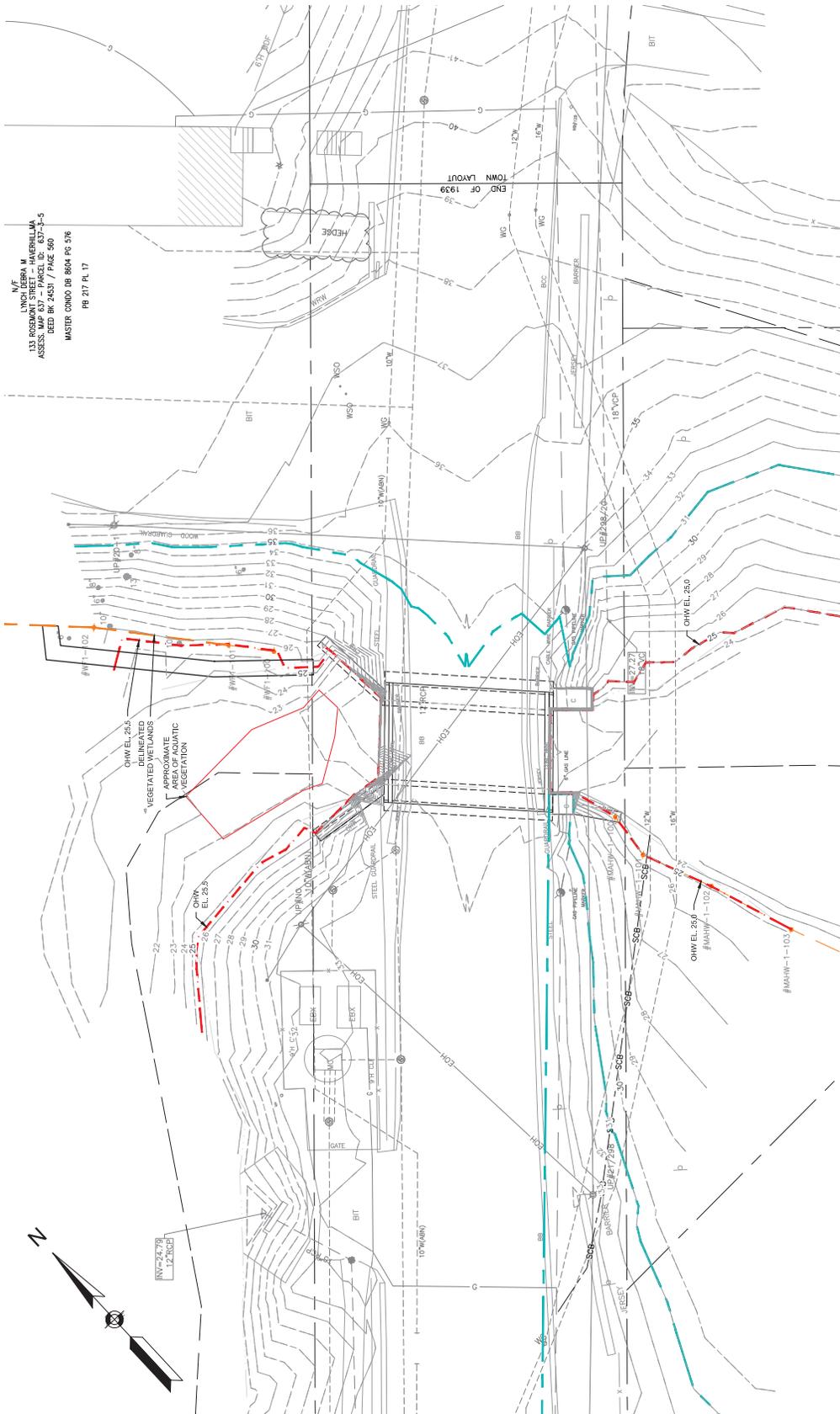
NOTE:  
 1. ALL DIMENSIONS IN FEET, ARE BASED UPON MASSACHUSETTS STATE PLANE (MAINLAND ZONE) AND ZONE MGRS (2011) EPOCH 2010.00 - US FEET. THE VERTICAL DATUM IS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (GEOID 120) - US FEET.



**ROSEMONT STREET BRIDGE**  
 Haverhill, Massachusetts

Plot Date: 5/9/2024 1:55 PM

Figure No. 7  
 Scale: 1" = 20'  
**DREDGING LIMITS**



**ROSEMONT STREET BRIDGE**  
 Haverhill, Massachusetts

Figure No. 8  
 Scale: 1" = 20'  
**JURISDICTIONAL BOUNDARIES PLAN**



Plot Date: 5/9/2024 1:56 PM



**Department of the Army**  
**General Permits for the Commonwealth of Massachusetts**

The New England District of the U.S. Army Corps of Engineers (USACE) hereby issues twenty-five (25) regional general permits (GPs) for activities subject to USACE jurisdiction in waters of the U.S., including wetlands, navigable waters within the Commonwealth of Massachusetts and adjacent ocean waters to the seaward limit of the outer continental shelf. The Massachusetts GPs (hereafter referred to as the MA GP or GP) are issued in accordance with USACE regulations at 33 CFR 320 – 332 [see 33 CFR 325.5(c)(1)]. These GPs establish criteria and contain permit conditions to ensure that the authorized activities have no more than minimal individual and cumulative adverse impacts to the environment.

This document contains the following sections:

Pages

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SECTION III	Massachusetts General Permits	8-34
SECTION IV	General Conditions	35-51
SECTION V	Mitigation Standards	52-54
SECTION VI	Federal & State Agency Contact Information & Websites	55-56
SECTION VII	Definitions & Acronyms	57-66
APPENDIX A	Guidance for Section 106 NHPA Compliance in Massachusetts	67-71
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In issuing these GPs, the Federal Government does not assume any liability for the following: (a) damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes; (b) damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the U.S. in the public interest; (c) damages to persons, property or to other permitted or unpermitted activities or structures caused by the activity authorized by any of the GPs; (d) design or construction deficiencies associated with the permitted work; or (e) damage claims associated with any future modification, suspension or revocation of these permits.

*Tammy R. Turley* 02 June 2023  
Date  
Tammy R. Turley  
Chief, Regulatory Division

## **SECTION I. STATUTORY AUTHORITIES & REGULATED ACTIVITIES**

### **1. Work Requiring USACE Authorization**

- a. Section 10: Work and structures that are located in, over, under or that affect navigable waters of the United States (U.S.) (see 33 CFR 329). The USACE regulates these activities under section 10 of the Rivers and Harbors Act of 1899 (see 33 CFR 322).
- b. Section 404: The discharge of dredged or fill material into waters of the U.S (see 33 CFR 328). The USACE regulates these activities under Section 404 of the Clean Water Act (CWA). The term “discharge of dredged or fill material” also includes certain discharges resulting from excavation. Applicants should contact USACE to determine if a particular excavation discharge occurring within waters of the U.S., is a regulated activity. See 33 CFR 323.4 of the CWA for exempted activities.

For additional information on the limits of USACE jurisdiction, please see:

[https://www.nae.usace.army.mil/Portals/74/docs/regulatory/JurisdictionalLimits/Jurisdictional\\_Limits\\_Brochure.pdf](https://www.nae.usace.army.mil/Portals/74/docs/regulatory/JurisdictionalLimits/Jurisdictional_Limits_Brochure.pdf)

### **2. Authority to Issue General Permits**

- a. In accordance with 33 CFR 322.2(f), 325.2(e)(2), and 325.5(c), USACE may issue regional general permits authorizing activities under Section 10 of the RHA.
- b. In accordance with Section 404(e) of the CWA, 33 USC 1344(e), and 33 CFR 323.2(h), 325.2(e)(2), and 325.5(c), after notice and opportunity for public hearing, USACE may issue regional general permits for any category of activities involving discharges of dredged or fill material if the activities in such category are similar in nature, will cause only minimal adverse environmental effects when performed separately, and will only have minimal cumulative adverse effect on the environment.

### **3. Related Laws**

33 CFR 320.3 includes a list of related laws including, but not limited to, Section 408 of the Rivers and Harbors Act of 1899, Section 401 of the Clean Water Act, Section 402 of the Clean Water Act, Section 307(c) of the Coastal Zone Management Act of 1972, Section 106 of the National Historic Preservation Act of 1966, Section 7 of the Endangered Species Act, the Fish and Wildlife Coordination Act of 1956, the Magnuson-Stevens Fishery Conservation and Management Act, the Fish and Wildlife Coordination Act, Section 302 of the Marine Protection, Research and Sanctuaries Act of 1972, Section 7(a) of the Wild and Scenic Rivers Act, the Golden Eagle Protection Act, and the Migratory Bird Treaty Act.

## **SECTION II. REVIEW CATEGORIES & APPLICATION PROCEDURES**

To qualify under these GPs, the design, construction, and maintenance associated with each proposed activity must meet the terms and eligibility criteria listed in Section III, all applicable general conditions (GCs) in Section IV, and any specific mitigation requirements in Section V. Applicants should first review the GPs to see if a project is eligible for authorization under one or more of the GPs within this document. Any activity not specifically listed may still be eligible for authorization under these GPs; applicants are advised to contact USACE for specific eligibility determination.

Please note that these GPs allow for Self-Verification (SV) contingent upon meeting all criteria and with full adherence to all GCs. Projects that do not qualify for SV, may meet criteria for Pre-Construction Notification (PCN). Tables are provided under each activity, which outline criteria for SV and PCN. Activities that do not meet criteria for SV or PCN may require review as an Individual Permit (IP). Activities may require a PCN or IP as noted in Sections III and/or IV of this GP. Notwithstanding compliance with the terms of these GPs, USACE retains discretionary authority to require either PCN review or IP review on a case-by-case basis for any project based on concerns for the environment or for any of the other public interest factors found in 33 CFR 320.4(a). These GPs also do not replace or change those activities identified as exempt from USACE regulation (33 CFR 323.4).

### **1. Pre-Application Assistance**

Prospective applicants may request a pre-application meeting to address any questions they may have. USACE may also request a pre-application meeting or additional information to facilitate review of the request. Pre-application meetings and/or site visits help streamline the authorization process by alerting the prospective applicant to potentially time-consuming factors that may arise during the evaluation of their project (e.g., avoidance, minimization and compensatory mitigation requirements, historic properties, endangered species, essential fish habitat, impacts to federal projects, and/or dredging of contaminated sediments).

To schedule a pre-application meeting, present questions, or if you need further assistance, please contact USACE at:

Email: [cenae-r-ma@usace.army.mil](mailto:cenae-r-ma@usace.army.mil) (strongly preferred)

Phone: (978) 318-8338

Mail: U.S. Army Corps of Engineers  
New England District  
Regulatory Division, Massachusetts Section  
696 Virginia Road  
Concord, MA 01742

### **2. Submitting a Request**

Please follow the procedures outlined in Sections II.2-5 when requesting an SV or applying for PCN authorization for activities covered by these GPs. The GPs are provided in Section III below. For SV-eligible projects, the Self-Verification Notification (SVN) must be submitted within 30 days of commencing work. Otherwise, a Pre-Construction Notification (PCN) must be submitted for work that is not SV-eligible. Please include appropriate drawings and attachments and submit your request using the mailbox identified in Section II.4 or II.5 below. USACE will promptly confirm receipt of your request and notify you in the event additional information is required. Guidance on

how to submit electronic correspondence is located on the NAE Regulatory website here: <https://www.nae.usace.army.mil/Missions/Regulatory/Submitting-Electronic-Correspondence>.

### 3. Local, State & Federal Approvals

Applicants are responsible for applying for and obtaining any required local, state, and federal permits or approvals. These must be obtained prior to the commencement of work in waters. Such authorizations may include a Water Quality Certification, a Coastal Zone Management Act consistency determination, and other approvals as noted below. Authorization under these GPs does not obviate the need for the permittee to obtain other Federal, State, or local permits, approvals, or authorizations required by law.

#### **I. Water Quality Certification under Section 401 of the Federal Clean Water Act (33 USC 1341).**

Applicants are responsible for determining the appropriate 401 Water quality Certification (WQC) requirements and submitting this information to the USACE at the time of their PCN application or when completing their SVN. Applicants that are unsure of whether their activity has been certified should contact MassDEP, or EPA Region 1 when the activity is located on tribal lands, for a determination. The 401 WQC requirement must be satisfied by acquiring one of the following WQCs from MassDEP (see GC 8):

**General 401 WQC:** The MassDEP issued a WQC on April 21, 2023 conditionally certifies all activities in GPs 1 – 24 eligible for SV and PCN so long as the activity is described in 314 CMR 9.03, and is not an activity described in 314 CMR 9.04, and so long as the activity meets all other requirements, terms and conditions of this WQC. The MassDEP WQC also conditionally certifies activities described in GP 25 so long as the activity meets all other conditions of the WQC. Emergency projects described in GP 25 must obtain an emergency certification or otherwise be authorized pursuant to 310 CMR 10.06, qualify under a Severe Weather Emergency Declaration pursuant to 310 CMR 10.06(8) issued by the MassDEP, or meet the requirements of 9.12(2) or (3) in order to be certified under the WQC

Applicants should refer to the following link to determine if their activity is eligible:

<https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>. If eligible, you must comply with all applicable WQC conditions. Activities listed in 314 CMR 9.03 that are not exempt from the Wetland Protection Act must have a valid Final Order of Conditions (OOC) or Final Restoration Order of Conditions pursuant to 310 CMR 10.00 to be eligible under the General 401 WQC.

**Individual 401 WQC:** In the event the proposed activity is not covered by the general WQC, applicants shall contact MassDEP and apply for an individual 401 WQC if their activity does not qualify for a General 401 WQC as outlined above. MassDEP may issue, waive, or deny the individual 401 WQC on a case-by-case basis. All activities listed in 314 CMR 9.04 must obtain an individual 401 WQC from MassDEP to be eligible under these GPs. When an Individual 401 WQC is required for *PCN activities*, the applicant shall submit their Individual 401 WQC application concurrently to MassDEP and the USACE to comply with 40 CFR 121.

**Activities Proposed on Tribal Lands:** When an activity is proposed on Tribal lands, the applicant shall refer to the general 401 WQCs granted by the Environmental Protection Agency (EPA), Region 1 on May 15, 2023. These 401 WQCs are located on the USACE Regulatory website: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>.

**II. Coastal Zone Management Act Federal Consistency Concurrence pursuant to Section 307 of the CZMA of 1972, as amended.**

Federal consistency concurrence is required for all activities located within the coastal zone, unless determined otherwise by the Massachusetts Office of Coastal Zone Management (MA CZM) (see GC 9). As applicable, this requirement must be satisfied by acquiring one of the following from the MA CZM:

**General CZM Federal Consistency Concurrence (General Concurrence):** MA CZM has granted General Concurrence for all SV and PCN activities for GPs 1-25 and this can be found at: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>. The applicant must obtain all applicable permits and approvals prior to the commencement of work in USACE jurisdiction (i.e., construction begins on site). For SVs, General Concurrence is automatically granted and no further action is required from the applicant. For PCNs, the USACE will coordinate with MA CZM to acquire General Concurrence as part of the PCN application review. During review of the PCN application, USACE may request additional information from the applicant to support CZM's evaluation of the activity.

**Individual CZM Federal Consistency Concurrence (Individual Concurrence):** In certain cases, MA CZM may elevate any GP activity 1-25 to require Individual Concurrence. The applicant must contact MA CZM and follow the procedures to obtain Individual Concurrence as determined appropriate by MA CZM.

The MA CZM program includes five regional offices that serve 78 coastal municipalities. The following map provides more information about these offices: <https://www.mass.gov/service-details/czm-regions-coastal-communities-and-coastal-zone-boundary>

**III. Other Approvals:** Approvals typically required in Massachusetts include, but are not limited to, a Chapter 91 Permit/License, Massachusetts Environmental Protection Act (MEPA) review, Wetlands Protection Act Order of Conditions, and/or Aquaculture Certification. *Applicants should also be aware that USACE may not be able to render a permit decision in the event the proposed activity is denied by another local, state and/or federal agency.*

**4. Procedures for Self-Verification (SV) Eligible Projects**

If the activity is eligible for an SV, the Self-Verification Notification (SVN) must be completed prior to the start of project construction and submitted to USACE within 30 days of commencing work. The purpose of the SVN is to provide applicants with a tool to assist them when determining if the activity as proposed is SV-eligible. The following GPs do not require submission of the SVN: GP 1 (SV #1), GP 3 (SV #2-3), GP 4 (SV #2), GP 11, GP 12 (note #2), GP 14 (see note), GP 15 (see note), and GP 24 (SV #3). **For the activities not listed above, the SVN must be completed prior to the start of work and be kept on site at all times during project construction.** The applicant shall not begin work for SV-eligible activities until they have completely verified the bulleted items below.

Digital submittals by email are **strongly encouraged** to facilitate the most efficient processing of the SVN submittal. Please communicate with USACE staff if you are unable to provide a digital copy. Addresses are [cenae-r-ma-sv@usace.army.mil](mailto:cenae-r-ma-sv@usace.army.mil) (email) or Regulatory Division, U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, MA 01742-2751 (mail).

**Eligible SV Activities:**

- Are subject to USACE jurisdiction (see GC 2); and
- Qualify for one or more of the GPs within this document (Section III); and
- Meet the GCs within this document (Section IV); and

- When required, are supported by a complete SVN (Appendix C); and
- Receive all other required local, State, and/or Federal approvals.

## 5. Procedures for Pre-Construction Notification (PCN) Eligible Projects

For activities that require a PCN, an application to and written authorization from USACE is required. *No work requiring a PCN may proceed until the applicant receives written authorization from USACE verifying that the activity is authorized.* The verification letter may include special conditions that the applicant must comply with. When possible, it is *highly* recommended that PCN application materials are submitted at least 90 days before the target start date to allow for USACE evaluation and any necessary agency consultations. PCN applications shall demonstrate in writing how the proposed activity complies with all GCs, as applicable to their activity.

Digital submittals by email are **strongly encouraged** to facilitate the most efficient processing of the PCN application. Please communicate with USACE staff if you are unable to provide a digital copy. Addresses are [cenae-r-ma@usace.army.mil](mailto:cenae-r-ma@usace.army.mil) or Regulatory Division, U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, MA 01742-2751 (mail).

### Eligible PCN Activities:

- Are subject to USACE jurisdiction (see GC 2); and
- Qualify for one or more of the GPs within this document (Section III); and
- Meet the GCs within this document (Section IV); and
- Comply with the Mitigation Standards within this document (Section V); and
- Are supported by a complete PCN document (Appendix B); and
- When required, are supported by the submittal of project information to the appropriate parties identified in Appendix A; and
- Receive all other required local, State, and/or Federal approvals.

## 6. Interagency Review Procedures

The USACE reserves the opportunity to coordinate PCN activities with Federal and State agencies to ensure that the proposed activity results in no more than a minimal impact to the aquatic environment. In some cases, USACE may require project modifications involving avoidance, minimization, and/or compensatory mitigation for unavoidable impacts to ensure the net effects of a project are minimal. The USACE determines, after review and coordination with the agencies and/or the applicant, if PCN applications:

- Meet the terms and conditions of the GP as proposed;
- Require additional information;
- Require avoidance, minimization, compensatory mitigation, construction sequencing, project modification, or other special conditions to avoid or minimize adverse impacts to the aquatic environment;
- Require individual permit review regardless of whether the terms and GCs of these GPs are met, based on concerns for the aquatic environment or any other factor of the public interest (see Section 9 below).

For activities requiring a PCN, the applicant must wait for written authorization from USACE before commencing activities in waters of the U.S. Beginning work for PCN required activities without a USACE written authorization is a violation of these GPs, and the terms and conditions of this document. The applicant may be subjected to an enforcement action by USACE and/or the Environmental Protection Agency (EPA).

## **7. Construction of Solid Fill Structures and Fills Along the Coastline or Baseline from Which the Territorial Sea is Measured.**

Projects involving the construction of solid fill structures or discharge of fill that may extend beyond the coastline or the baseline from which the territorial sea is measured (i.e., mean low water) will require a PCN. The USACE will submit a description of the proposed work and a copy of the plans to the Solicitor, Department of the Interior, Washington, DC 20240, and request comments concerning the effects of the proposed work on the outer continental rights of the United States. These comments will be included in the administrative record of the application. After completion of permit review, the record will be forwarded to the Chief of Engineers. The decision on the application will be made by the Secretary of the Army after coordination with the Attorney General.

## **8. Emergency Activities**

Per 33 CFR 325.2(e)(4), an emergency is limited to a situation that would result in an unacceptable hazard to life, a significant loss of property, or an immediate, unforeseen, and significant economic hardship if corrective action requiring a permit is not undertaken within a time period less than the normal time needed to process an application under standard procedures. Emergency work shall be limited to that which is necessary to stabilize and secure the situation. Additional work needed for final repairs shall not be completed until approval is obtained through the appropriate, non-emergency process. Emergency work is subject to the same terms and conditions of these GPs as non-emergency work, and similarly, must qualify for authorization under these GPs; otherwise, an IP is required. *See GP 25 Emergency Situations for additional information.*

## **9. Individual Permit**

Projects that do not meet the terms and conditions of this GP may require review as an IP (33 CFR 325.5 (b)). Proposed work in this category will require a separate Federal application for an individual permit from USACE (33 CFR 325.1). In addition, USACE retains discretionary authority on a case-by-case basis to elevate GP-eligible activities to an IP based on concerns for the environment or any other factor of the public interest (33 CFR 320.4 (a)). Applicants are required to submit the appropriate application materials directly to USACE as early as possible to expedite the permit review process. General information and application forms can be obtained at our website or by contacting our office at [cenae-r-ma@usace.army.mil](mailto:cenae-r-ma@usace.army.mil) or (978) 318-8338. Individual 401 WQC and/or CZMA Federal consistency concurrence from the appropriate MA agencies are required before USACE can issue an individual permit. Applying for an IP does not relieve the applicant from their obligation to obtain all required Federal, State and/or local approvals.

## **10. Compliance**

Applicants shall ensure compliance with all applicable GPs in Section III, GCs in Section IV, and any special conditions included in USACE verification letters. Noncompliance with these GPs, GCs, and special conditions may subject the applicant to criminal, civil, or administrative penalties, and/or an ordered restoration, and/or the permit may be modified, suspended or revoked by USACE. The USACE will consider any activity requiring USACE authorization to be noncompliant if that activity does not comply with all GP terms and conditions at all times, including while the project is under construction and when work is completed.

## **SECTION III. MASSACHUSETTS GENERAL PERMITS**

Applicants are encouraged to review Sections I & II prior to submitting an application to confirm that the activity as proposed complies with all terms and conditions of the 2023 MA GPs.

Applicants are also encouraged to review the definitions in Section VII, Definitions & Acronyms, of this document. Several terms are frequently used throughout the GPs, and it is important for the reader to understand these terms. If seeking verification for an activity previously verified under the 2018 MA GPs, please contact the USACE to discuss permitting needs in advance of submitting an application.

### **General Permits**

1. Aids to Navigation and Temporary Recreational Structures
2. Maintenance
3. Moorings
4. Structures in Navigable Waters of the U.S.
5. Boat Ramps and Marine Railways
6. Utility Lines, Oil or Natural Gas Pipelines, Outfall Or Intake Structures, and Appurtenant Features
7. Dredging, Disposal of Dredged Material, Beach Nourishment, Rock Removal and Rock Relocation
8. U.S. Coast Guard Approved Bridges
9. Bank and Shoreline Stabilization
10. Aquatic Habitat Restoration, Enhancement, and Establishment Activities
11. Fish and Wildlife Harvesting and Attraction Devices and Activities
12. Response Operations, Oil and Hazardous Substances
13. Cleanup of Hazardous and Toxic Waste
14. Scientific Measurement Devices
15. Survey Activities
16. Land and Water-Based Renewable Energy Generation Facilities and Hydropower Projects
17. Residential, Commercial and Institutional Developments, and Recreational Facilities
18. Aquaculture
19. Mining Activities
20. Living Shorelines
21. Agricultural Activities
22. Reshaping Existing Drainage Ditches, Construction of New Ditches, and Mosquito Management
23. Linear Transportation Projects and Wetland/Stream Crossings
24. Temporary Construction, Access, and Dewatering
25. Emergency Situations

**GP 1. AIDS TO NAVIGATION AND TEMPORARY RECREATIONAL STRUCTURES (Authority: §10)**

(a) The placement of aids to navigation and regulatory markers that are approved by and installed in accordance with the requirements of the U.S. Coast Guard (USCG). See 33 CFR, Part 66; and (b) Temporary buoys, markers, and similar structures placed for recreational use during specific events such as water skiing competitions and boat races or seasonal use. See GC 16.

**Self-Verification Eligible**

1. Aids to navigation and regulatory markers approved by and installed in accordance with the requirements of the USCG.
2. Temporary buoys, markers and similar structures that are: (a) placed for recreational use during specific events and removed within 30 days after event; or (b) placed during winter events on ice and removed before spring thaw. These structures must be authorized by the local harbormaster, not located within an FNP or its buffer zone, and not located in saltmarsh or tidal vegetated shallows.

**Pre-Construction Notification Required**

1. Impacts in saltmarsh or tidal vegetated shallows.
2. Activities that are not SV eligible.

Note: An SVN submittal to USACE is not required for work authorized under SV #1 above.

## **GP 2. MAINTENANCE (Authorities: §10 and §404)**

Repair, rehabilitation, or replacement of any previously authorized<sup>1</sup>, currently serviceable structure, or fill, or of any currently serviceable structure or fill authorized by 33 CFR 330.3 (activities occurring before certain dates), provided that the structure or fill is not to be put to uses differing from those uses specified or contemplated for it in the original permit or the most recently authorized modification. Minor deviations in the structure's configuration or filled area, including those due to changes in materials, construction technique requirements of other regulatory agencies, or current construction codes or safety standards that are necessary to make the repair, rehabilitation, or replacement are authorized. This GP also authorizes temporary structures, fills, and work, including the use of temporary mats, necessary to conduct the activities above. Maintenance dredging and beach nourishment are not eligible under GP 2 (see GP 7). Stream crossing modifications (including sliplining), replacements or extensions are not eligible under GP 2 (see GPs 6, 17, 23). See GP 25 Emergency Situations for expedited review of emergency activities.

**Not authorized under GP 2 (IP required):** (a) Permanent impacts in >1 acre in non-tidal waters and/or wetlands; or (b) Permanent impacts >1/2 acre in tidal waters; >1000 SF in saltmarsh, mud flats, riffle and pool complexes, or non-tidal vegetated shallows; or >100 SF in tidal vegetated shallows; or (c) Temporary impacts >1 acre in tidal waters; >5000 SF in saltmarsh, mud flats, riffle and pool complexes, or non-tidal vegetated shallows; or >1000 SF in vegetated shallows; (d) New stream channelization or stream relocation projects (e.g., those in response to storm or flood events).

### **Self-Verification Eligible**

Maintenance activities that meet all of the following terms:

1. In non-tidal waters, the combined permanent and temporary impacts extending beyond the original footprint are  $\leq 5,000$  SF<sup>2</sup> and not located in vegetated shallows or riffle and pool complexes.
2. In tidal waters, the combined permanent and temporary impacts extending beyond the original footprint are  $\leq 5,000$  SF,  $\leq 1,000$  SF in mudflats and/or natural rocky habitat, and not located in saltmarsh and tidal vegetated shallows.
3. Minor deviations in the repair, rehabilitation, or replacement of previously authorized, currently serviceable structures or fills.
4. Bulkhead replacement in tidal and non-tidal waters via installation of new bulkhead within 18 inches of the existing bulkhead and associated backfill.
5. Drawdown of an impoundment for dam/levee repair provided it does not exceed 18 months and one growing season (April through September).

### **Pre-Construction Notification Required**

1. Discharges associated with removal of accumulated sediments and debris in the vicinity of existing structures, including intake and outfall structures and associated canals.
2. The removal of sediment outside the immediate vicinity of existing structures (e.g., bridges, culverted road crossings, water intake structures, etc.) that is  $\geq 200$  linear feet. This activity is limited to the minimum necessary to restore the waterway in the vicinity of the structure to the approximate dimensions existing when the structure was built.
3. Dam and flood control or levee repair, rehabilitation, or replacement involves:
  - a. A change in the flood elevation or permanent water surface elevation of the impoundment; or
  - b. Drawdown of impoundment for construction exceeding one growing season (see SV eligible #5);
  - c. Any modification that changes the character, scope, or size of the original fill design; or
  - d. Does not meet SV eligible 1-7.
4. Installation of steel piles, including steel sheet piles, that cannot be done in the dry and where NOAA-ESA listed species are mapped as present.

<sup>1</sup> Some maintenance activities may not be subject to regulation under Section 404 of the CWA in accordance with 33 CFR 323.4(a)(2). Per 33 CFR 330.3, Vested dates are: a) Work performed and structures installed before December 18, 1968 (Section 10); and b) Fill placed before July 25, 1975 (Section 404).

<sup>2</sup> This excludes dam projects that may require a temporary drawdown with impacts >5,000 SF in non-tidal waters. Instead, the drawdown shall comply with SV #5 to be eligible under Self-Verification.

6. Any stream channel modification is limited to the minimum necessary for the repair, rehabilitation, or replacement of the structure or fill; such modifications, including the removal of material from the stream channel, must be immediately adjacent to the project or within the boundaries of the structure or fill.

7. Work to previously approved tide gates not affecting upstream tidal resource areas.

5. Activities located in the Connecticut River or Merrimack River, unless they are completed in the dry or when the tide is waterward of the work area.

6. Activities on USACE properties & USACE-controlled easements.

7. Activities that do not require an IP. Activities that do not require a PCN or an IP may be SV eligible.

Notes:

1. This authorizes the repair, rehabilitation, or replacement of any previously authorized structure or fill that does not qualify for the CWA §404(f) exemption for maintenance. See 33 CFR 323.4(a)(2). Prior USACE permits may have included authorization to maintain the activity, in which case authorization under this GP is not necessary.

2. See GC 22 for information on temporary construction mats.

### **GP 3. MOORINGS (Authority: §10)**

New moorings and mooring fields; the relocation of previously authorized moorings; expansions, boundary reconfigurations or modifications of previously authorized mooring fields; and maintenance and replacement of moorings.

**Not authorized under GP 3 (IP required):** (a) Moorings or mooring fields converted to or associated with a new boating facility<sup>1</sup>; or (b) Moorings in a USACE Federal Navigation Anchorage or USACE Federal Navigation Channel, except municipal-operated mooring fields.

#### **Self-Verification Eligible**

1. New or relocated moorings that meet all the following terms:
  - a. Authorized by a local harbormaster/municipality under MGL Chapter 91 §10A; and
  - b. No interference with navigation; and
  - c. Single boat, single-point and non-commercial; and
  - d. Not associated with a boating facility, and
  - e. Neither placed within nor impact tidal vegetated shallows (e.g., eelgrass); and
  - f. Not located within a USACE Federal navigation project (FNP) or the FNP buffer zone.
2. Existing, authorized moorings are converted from traditional moorings to low impact mooring technology (see note below) and/or helical anchors.
3. Maintenance and replacement of moorings authorized by the USACE.

#### **Pre-Construction Notification Required**

1. New mooring fields; or expansions, boundary reconfigurations or modifications of existing, authorized mooring fields.
2. Moorings located such that they, and/or vessels docked or moored at them, are within the buffer zone of the horizontal limits of a Federal Anchorage. The buffer zone is equal to 3 times the authorized depth of that channel (see GC 15).
3. New individual moorings located in saltmarsh, mudflats, natural rocky habitat, and tidal vegetated shallows. Locating moorings these areas should be avoided to the maximum extent practicable. If these areas cannot be avoided, plans should show conservation mooring or low-impact mooring systems that prevent mooring chains from resting or dragging on the bottom substrate at all tides, where practicable. USACE may require a survey in areas previously mapped as containing eelgrass or within 100 ft. of existing eelgrass beds to document presence or absence of eelgrass and to determine the appropriate type and amount of compensatory mitigation for impacts to eelgrass.
4. Replacement moorings located in tidal vegetated shallows.
5. Moorings that are not SV eligible and do not require an IP.

#### **Notes:**

1. Low impact mooring systems, including conservation moorings, are encouraged to minimize impacts of chain scouring from conventional moorings during the tidal cycle.
2. An SVN submittal to USACE is not required for work authorized under SV #2-3 above.

<sup>1</sup> Boating facilities are marinas, yacht clubs, boat clubs, boat yards, dockominiums, town facilities, land/homeowner's associations, etc. that provide for a fee, rent or sell mooring or docking space. Not classified as boating facilities are municipal moorings or municipal mooring fields that charge an equitable user fee based only on the actual costs incurred.

**GP 4. STRUCTURES IN NAVIGABLE WATERS OF THE U.S. (Authority: §10 & §404)**

New, expansions, reconfigurations or modifications of structures for navigational access in waters of the U.S. including but not limited to temporary/seasonal or permanent pile and pole-supported piers, floats, stairs, shore out hauls, and boat and float lifts.

**Not authorized under GP 4 (IP required):** (a) Structures associated with a new boating facility; (b) Structures in a USACE Federal anchorage or channel; or (c) Artificial reefs.

**Self-Verification Eligible**

1. Private, non-commercial piers, floats and lifts that meet all the following terms:
  - a. Piers and floats in: (i) Tidal waters total  $\leq 600$  SF combined; and (ii) Non-tidal navigable waters of the U.S. total  $\leq 600$  SF combined; and
  - b. Piers are  $\leq 4$  feet wide and  $\geq 6$  feet above the marsh substrate (the height is measured from the marsh substrate to the bottom of the lowest longitudinal support); and
  - c. Floats and lifts in tidal waters and non-tidal navigable waters of the U.S. are  $\geq 24$  inches above the substrate during all tidal cycles. Float stops are preferred when site conditions warrant them (i.e., low tide exposes substrate), and skids can only be used in areas where piles are not feasible and on sandy or hard bottom substrates; and
  - d. Piers, floats and lifts: (i) Are  $\geq 25$  feet from previously mapped or existing vegetated shallows, or riparian property line extensions; (ii) Extend  $\leq 25\%$  of the waterway width in non-tidal navigable waters of the U.S. or MHW in tidal navigable waters of the U.S.
  - e. Installation of  $\leq 12$ -inch diameter timber piles. Installation of  $\geq 12$ -inch diameter piles of any material type when installed in the dry.
2. Fenders and similar structures.

**Pre-Construction Notification Required**

1. Shore out hauls.
2. Expansions, modifications, or new reconfiguration zones at any authorized boating facility.
3. New, expansions, reconfigurations, reconfiguration zones, or modifications of structures that provide public, community or government recreational uses such as boating, fishing, swimming, access, etc.
4. Installation of steel piles, including steel sheet piles, that cannot be done in the dry and where NOAA-ESA listed species are mapped as present.
5. Located within the buffer zone of the horizontal limits of an FNP (GC 15).
6. Miscellaneous structures.
7. Impacts in tidal vegetated shallows.
8. Structures that are not SV eligible and do not require an IP.

**Notes:**

1. See GC 19 regarding pile driving and pile removal in navigable waters and
2. See GC 20 regarding time of year restrictions in tidal waters.
3. Boating facilities are facilities that provide for a fee, rent, or sell mooring space, such as marinas, yacht clubs, boat clubs, boat yards, town facilities, dockominiums, etc. Pile supported structures with no discharges of dredged or fill material are not regulated by USACE in non-navigable waters.
4. A SVN submittal to USACE is not required for SV #2 above.

**GP 5. BOAT RAMPS AND MARINE RAILWAYS (Authorities: §10 and §404)**

Activities required for the construction of boat ramps and marine railways, including excavation and fill.

**Not authorized under GP 5 (IP required):** (a) Permanent impacts that are >1 acre in non-tidal waters of the U.S., >½ acre in tidal waters; >1000 SF in saltmarsh, mud flats, riffle and pool complexes, or non-tidal vegetated shallows; or >100 SF in tidal vegetated shallows; (b) Temporary impacts in tidal waters that are >1 acre; >5000 SF in saltmarsh, mud flats, or riffle and pool complexes; or >1000 SF in vegetated shallows<sup>1</sup>; or (c) dredging in navigable waters of the U.S. (see GP 7).

**Self-Verification Eligible**

1. In non-tidal waters, the combined permanent and temporary impacts are (a) ≤5,000 SF, and (b) not located in riffle and pool complexes and non-tidal vegetated shallows.
2. In tidal waters, the combined permanent and temporary impacts are (a) ≤5,000 SF, (b) ≤1,000 SF in mudflats and/or natural rocky habitat, and (c), not located in saltmarsh and tidal vegetated shallows.

**Pre-Construction Notification Required**

1. Boat ramps are located within 25 feet of property line extensions unless the properties are owned by the same owner. The USACE may require a letter of no objection from the abutter(s).
2. Activities that are not eligible for SV and do not require an IP.

**GP 6. UTILITY LINES, OIL OR NATURAL GAS PIPELINES, OUTFALL OR INTAKE STRUCTURES, AND APPURTENANT FEATURES (Authorities: §10 & §404)**

Activities required for: (a) The construction, maintenance, repair or removal of utility lines, oil or natural gas pipelines<sup>1</sup>, outfall or intake structures<sup>2</sup>, and appurtenant features including the associated excavation, backfill, or bedding for these structures. (b) The construction, maintenance, or expansion of substations and other appurtenant facilities associated with a utility line, oil or natural gas pipeline, and outfall or intake structure in non-tidal waters of the U.S.; and (c) The construction and maintenance of foundations for overhead utility line towers, poles, and anchors in tidal and non-tidal waters of the U.S., provided the foundations are the minimum size necessary and separate footings for each tower leg (rather than a larger single pad) are used where feasible. This GP authorizes the construction of access roads to facilitate construction of the above activities provided the activity, in combination with all other activities included in one single and complete project, does not exceed the thresholds identified below (IP required). Access roads used solely for construction of the utility line must be removed upon completion of the work. This GP also authorizes temporary structures, fills, and work, including the use of temporary mats, necessary to conduct the activities above.<sup>3</sup>

**Not authorized under GP 6 (IP required):** (a) Permanent impacts for any single and complete project that are >1 acre in non-tidal waters of the U.S.; >½ acre in tidal waters; >1000 SF in saltmarsh, mud flats, riffle and pool complexes, or non-tidal vegetated shallows; or >100 SF in tidal vegetated shallows; (b) Temporary impacts in tidal waters that are >1 acre; >5000 SF in saltmarsh, mud flats, or riffle and pool complexes; or >1000 SF in vegetated shallows; (c) Stormwater treatment or detention systems, or subsurface sewage disposal systems in waters of the U.S.; or (d) New tide gates that do not meet SV criteria below.

**Self-Verification Eligible**

1. In non-tidal waters, the combined permanent and temporary impacts are (a) ≤5,000 SF, and (b) not located in riffle and pool complexes and non-tidal vegetated shallows.
2. In tidal waters, the combined permanent and temporary impacts are (a) ≤5,000 SF, (b) ≤1,000 SF in mudflats and/or natural rocky habitat, and (c), not located in saltmarsh and tidal vegetated shallows.
3. Intake structures that are dry hydrants used exclusively for firefighting activities with no stream impoundments.
4. New tide gates on outfall structures for pipes conveying stormwater and/or industrial NPDES-permitted discharges from waters that are not waters of the U.S.

**Pre-Construction Notification Required**

1. New outfall and/or intake structures.
2. Unconfined work or silt producing activities in streams with diadromous fish.
3. Submarine cables, conduits, or pipelines that occur in, over or under navigable waters of the U.S.
4. Stream channelization, relocation, impoundment, or loss of streambed occurs.
5. The activity is placed within and runs parallel to or along a streambed within waters of the U.S.
6. There is a permanent change in preconstruction contours in waters of the U.S.
7. Installation of utility lines or gas/oil pipelines using trench excavation where material is temporarily sidecast into waters of the U.S. for >3 months. Applicants must demonstrate how the material would not be dispersed by currents or other forces.
8. Activities that are not SV eligible and do not require an IP.

<sup>1</sup> See the definitions of a “utility line” and “oil or natural gas pipeline” in Section VII.

<sup>2</sup> Outfall structures must be in compliance with regulations issued under the National Pollutant Discharge Elimination System Program (Section 402 of the Clean Water Act).

<sup>3</sup> Temporary impacts shall comply with all GCs, including GC 32 Utility Line Installation and Removal.

**GP 7. DREDGING (Authority: §10), DISPOSAL OF DREDGED MATERIAL (Authorities: §10, §404), BEACH NOURISHMENT (Authorities: §10 & §404), ROCK REMOVAL (Authority: §10) AND ROCK RELOCATION (Authorities: §10 & §404)**

New, improvement and maintenance dredging (see notes below) including: (a) Disposal of dredged material at a confined aquatic disposal cell, beach nourishment location, near shore site, or ocean disposal site selected under Section 404 of the Clean Water Act pursuant to the 404(b)(1) Guidelines, provided the dredged material meets the requirements for such disposal; (b) Beach nourishment not associated with dredging; and (c) Rock removal and relocation for navigation.

**Not authorized under GP 7 (IP required):** (a) Dredging where ocean disposal is required for the disposal of dredged material (Section 103); New dredging >½ acre; ≥10,000 CY; >1000 SF permanent impacts to intertidal areas, saltmarsh, mud flats, riffle and pool complexes, or non-tidal vegetated shallows; or >100 SF permanent impacts to tidal vegetated shallows; (b) Maintenance or improvement dredging and/or disposal with >1 acre of impacts to intertidal areas, saltmarsh, mudflats, riffle and pool complexes, or non-tidal vegetated shallows; (c) New dredging where the primary purpose is sand mining for beach nourishment; (d) Beach scraping; (e) Boulder removal and relocation for navigation >½ acre; or (f) Blasting.

**Self-Verification Eligible**

1. Maintenance dredging of previously dredged areas, with upland disposal, that meet all of the following terms:
  - a. Dredged area ≤1/2 acre; and
  - b. Activities comply with GC 20, TOY Restrictions. The time-of-year restriction(s) stated in Appendix B of the MA Division of Marine Fisheries (DMF) Technical Report TR-47<sup>1</sup> can apply instead if the general TOY restriction if a TOY is provided for a specific waterbody and is less restrictive. This is to protect endangered species, EFH, and other species; and
  - c. The dredge footprint is located >25' from salt marsh or >100' from vegetated shallows; and
  - d. Combined permanent and temporary impacts that are (i) ≤1,000 SF in mudflats or natural rocky habitat, or (ii) ≤5,000 SF within intertidal habitat and areas containing shellfish (an area contains shellfish unless: it is verified that minimal shellfish are present per the local shellfish constable or a shellfish survey; or it is not mapped as a MassGIS shellfish suitability area).
  - e. No return water from upland disposal areas.
2. Boulder relocation with ≤1,000 SF of impacts, relocated to a similar depth and substrate.

**Pre-Construction Notification Required**

1. Maintenance dredging where the primary purpose is sand mining for beach nourishment.
2. New dredging and associated disposal ≤1/2 acre or <10,000 cubic yards.
3. Improvement dredging.
4. Beach nourishment in waters of the U.S. not associated with dredging.
5. Activities that are located in saltmarsh and tidal vegetated shallows.
6. Dredging in a Federal Navigation Project or within the buffer zone (see GC 15).
7. Activities that are not eligible for SV and do not require an IP.

**Notes:**

1. See Section VII for definitions of improvement and maintenance dredging.
2. For PCN activities, the USACE may waive or adjust the time of year requirement on a case-by-case basis after consultation with resource agencies.
3. Disposal site of any dredged material must be identified prior to obtaining USACE authorization.
4. Contact the USACE if a ten-year authorization to maintain an area is desired.

<sup>1</sup> The MA DMF Technical Report TR-47: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>

**GP 8. U.S. COAST GUARD APPROVED BRIDGES (Authorities: §404)**

Discharges of dredged or fill material incidental to the construction and modification of bridges across navigable waters of the U.S., including cofferdams, abutments, foundation seals, piers, and temporary construction and access fills provided that the USCG authorizes the construction of the bridge structure under Section 9 of the Rivers and Harbors Act of 1899 or other applicable laws. A USCG Authorization Act Exemption or a Surface Transportation and Uniform Relocation Assistance Act (STURRA) (144h) exemption do not constitute USCG authorization.

**Not authorized under GP 8 (IP Required):** Causeways and approach fills (see GP 23).

**Self-Verification Eligible**

1. Discharges of dredged or fill material that are incidental to the construction of bridges across navigable waters and meet all of the following:
  - a. Combined permanent and temporary impacts that are  $\leq 5,000$  SF.
  - b. Combined permanent and temporary impacts that are  $\leq 1,000$  SF in mudflats and natural rocky habitat.
  - c. Not located in saltmarsh and tidal vegetated shallows.

**Pre-Construction Notification Required**

1. Activities on USACE properties & USACE controlled easements.
2. Installation of steel piles, including steel sheet piles, that cannot be done in the dry and where NOAA-ESA listed species are mapped as present.
3. Activities that are not eligible for SV and do not require an IP.

**Notes:**

1. GP 8 is not applicable to bridges over inland waters or wetlands that are not tidally influenced or regulated as navigable under Section 10.
2. See eligibility criteria for GPs 2 & 23 for projects that are not subject to USCG regulations.

**GP 9. BANK AND SHORELINE STABILIZATION (Authorities: §10 & §404)**

Bank stabilization activities necessary for erosion protection along the banks of lakes, ponds, streams, estuarine and ocean waters, and any other open waters. Includes bulkheads, seawalls, riprap, revetments, living seawalls, or slope protection & similar structures, specifically for the purpose of shoreline protection. This GP also authorizes temporary structures, fills, and work, including the use of temporary mats, necessary to conduct the activities above.

Activities must meet the following criteria: (a) No material is placed in excess of the minimum needed for erosion protection; (b) No material is of a type, or is placed in any location, or in any manner, that will impair surface water flow into or out of any waters of the U.S.; (c) No material is placed in a manner that will be eroded by normal or expected high flows (properly anchored native trees and treetops may be used in low energy areas); (d) Native plants appropriate for current site conditions, including salinity, must be used for bioengineering or vegetative bank stabilization; (e) The activity is not a stream channelization activity; and (f) The activity must be properly maintained, which may require repairing it after severe storms or erosion events. This GP authorizes those maintenance and repair activities if they require authorization. This GP also authorizes temporary structures, fills, and work, including the use of temporary mats, necessary to construct the bank stabilization activity. See GP 20 for living shoreline stabilization structures or fills.

**Not authorized under GP 9 (IP required):** (a) New bank stabilization >500 feet in total length (>1,000 linear feet in total length when necessary to protect transportation infrastructure) or permanent loss of saltmarsh >1,000 SF, unless the District Engineer waives this criterion by making a written determination concluding that the discharge of dredged or fill material will result in no more than minimal adverse environmental effects (an exception is for bulkheads – the district engineer cannot issue a waiver for a new bulkhead that is >1,000 feet in length along the bank); (b) Stream channelization or relocation activities; or (c) Breakwaters, groins or jetties.

**Self-Verification Eligible**

1. Activities in tidal and non-tidal waters that are:
  - a. <200 feet in length.
  - b. <400 feet in length when necessary to protect transportation infrastructure.
  - c. ≤1 cubic yard of fill per linear foot average along the bank waterward of the plane of OHW or HTL.
  - d. Not located in non-tidal wetlands, saltmarsh, vegetated shallows.

**Pre-Construction Notification Required**

1. Activities in tidal and non-tidal waters that are:
  - a. ≥200 feet to ≤500 feet in total length. Activities >500 feet in total length must have a written waiver from USACE.
  - b. ≥400 feet to ≤1,000 feet in total length when necessary to protect transportation infrastructure. Activities >1,000 feet in total length must have a written waiver from USACE.
  - c. >1 cubic yard of fill per linear foot average along the bank waterward of the plane of OHW or HTL.
  - d. Located in non-tidal wetlands, saltmarsh, vegetated shallows.
2. Activities with permanent loss of tidal or non-tidal waters that is (a) ≥5,000 SF or (b) ≥1,000 SF in mudflats and natural rocky habitat.
3. Activities that are (a) located in the Connecticut River or Merrimack River and/or (b) require installation of steel piles/steel sheet piles that cannot be done in the dry where NOAA ESA-listed species are mapped as present.
4. Activities on USACE properties & USACE-controlled easements.
5. Activities that require grouted riprap and/or poured/unformed concrete.
6. Activities that are not eligible for SV and do not require an IP.

Note: The applicant shall comply with GC 24. This includes utilization of bioengineering techniques in lieu of hard armoring to the maximum extent practicable as site conditions allow.

**GP 10. AQUATIC HABITAT RESTORATION, ENHANCEMENT, AND ESTABLISHMENT ACTIVITIES  
(Authorities: §10 and §404)**

Activities for the restoration, enhancement and establishment of non-tidal and tidal wetlands and riparian areas, including invasive, non-native or nuisance species control; the restoration and enhancement of non-tidal streams and other non-tidal open waters; the relocation of non-tidal waters, including non-tidal streams & associated wetlands for reestablishment of a natural stream morphology and reconnection of the floodplain; the restoration and enhancement of shellfish, finfish and wildlife; and the rehabilitation or enhancement of tidal streams, tidal wetlands and tidal open waters; provided those activities result in net increases in aquatic resource functions and services. See GP 9 for bank and shoreline stabilization. See GP 20 for living shorelines.

**Not authorized under GP 10 (IP required):** Stream channelization activities and artificial reefs.

**Self-Verification Eligible**

1. In tidal and non-tidal waters excluding tidal vegetated shallows, the combined permanent and temporary impacts are  $\leq 5,000$  SF.
2. Eelgrass (vegetated shallows) planting and transplanting  $\leq 100$  SF in tidal waters.

**Pre-Construction Notification Required**

1. In tidal and non-tidal waters excluding tidal vegetated shallows, the combined permanent and temporary impacts are  $> 5,000$  SF.
2. Eelgrass (vegetated shallows) planting and transplanting  $> 100$  SF in tidal waters.
3. Permanent water impoundments, dam removal, fish ladders, or tide gates.
4. Stream relocation, impoundment, or loss of streambed occurs.
5. Runneling projects with the purpose of restoring saltmarsh by removing excess water that ponds on the saltmarsh surface.
6. The conversion of: (a) a stream or natural wetlands to another aquatic habitat type (e.g., stream to wetland or vice versa, wetland to pond, etc.) or uplands, (b) one wetland type to another (e.g., forested wetland to an emergent wetland).
7. Activities in the Connecticut River from the Turners Falls Dam to the MA/CT border, or Merrimack River from the Essex Dam to the mouth, involving permanent or temporary impacts unless they are performed  $< 5$  feet waterward from OHW or HTL and in the dry. This is to protect endangered species.
8. Activities on USACE properties & USACE-controlled easements.
9. Activities that are not eligible for SV and do not require an IP.

**Notes:**

1. Changes in wetland plant communities that occur when wetland hydrology is more fully restored during wetland rehabilitation activities are not considered a conversion to another aquatic habitat type.
2. See RGL 18-01 for guidance on removal of obsolete dams and other structures from rivers and streams. <https://www.usace.army.mil/missions/civil-works/regulatory-program-and-permits/guidance-letters/>
3. An ecological reference site may be used for a design basis of the restoration activity. The reference site should possess characteristics of an intact aquatic habitat or riparian area that exists in the region. The reference site shall represent the target habitat type of the proposed activity. A reference site may be required at the discretion of USACE.

**GP 11. FISH AND WILDLIFE HARVESTING AND ATTRACTION DEVICES AND ACTIVITIES**  
**(Authorities: §10 and §404)**

Fish and wildlife harvesting and attraction devices and activities in waters of the U.S. such as pound nets, crab traps, crab and shellfish dredging, eel pots, lobster traps, duck blinds, clam and oyster digging, fish aggregating devices, and small fish attraction devices such as open-water fish concentrators (sea kites, etc.).

**Not authorized under GP 11 (IP required):** Artificial reefs; or new, or expansions of, impoundments and semi-impoundments of waters of the U.S. for the culture or holding of motile species such as lobster with an impounded area  $> \frac{1}{2}$  acre.

**Self-Verification Eligible**

1. In non-tidal waters, the combined permanent and temporary impacts are (a)  $\leq \frac{1}{2}$  acre, and (b) not located in riffle and pool complexes and non-tidal vegetated shallows.
2. Fish and wildlife harvesting and attraction devices and activities that do not require a PCN or IP.

**Pre-Construction Notification Required**

1. Pound nets, impoundments or semi-impoundments of waters of the U.S. for the culture or holding of motile species such as lobster with an impounded area  $\leq \frac{1}{2}$  acre, fish aggregating devices, or small fish attraction devices.
2. Devices and activities that are located in tidal vegetated shallows, mud flats, or saltmarsh.
3. Devices and activities that do not require an IP.

Note: An SVN submittal to USACE is not required for work authorized under GP 11.

**GP 12. RESPONSE OPERATIONS, OIL AND HAZARDOUS SUBSTANCES (Authorities: §10 & §404)**

(a) Activities conducted in response to a discharge or release of oil and hazardous substances that are subject to the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300) including containment, cleanup, and mitigation efforts, provided that the activities are done under either: (i) The Spill Prevention, Control and Countermeasure Plan required by 40 CFR 112.3; (ii) The direction or oversight of the Federal on-scene coordinator designated by 40 CFR 300; or (iii) Any approved existing State, regional or local contingency plan provided that the Regional Response Team concurs with the proposed response efforts or does not object to the response effort; (b) Activities required for the cleanup of oil releases in waters of the U.S. from electrical equipment that are governed by EPA's polychlorinated biphenyl (PCB) spill response regulations at 40 CFR 761; (c) Booms placed in navigable waters of the U.S. for oil and hazardous substance containment, absorption and prevention; and (d) The use of structures and fills for spill response training exercises. Wetlands, vegetated shallows, mudflats, and riffle and pool complexes should be restored in place at the same elevation.

**Self-Verification Eligible**

1. Activities are conducted in accordance with (a) or (b) above that are not planned or scheduled, but an emergency response (see Note 1).
2. Booms placed in navigable waters of the U.S. for oil and hazardous substance containment, absorption and prevention.
3. Temporary impacts for spill response training exercises ≤5000 SF in non-tidal waters and ≤1000 SF in tidal waters with no impacts to wetlands, saltmarsh, mudflats, or vegetated shallows.
4. Temporary structures in tidal waters with no impacts to wetlands, saltmarsh, mudflats, vegetated shallows, or riffle and pool complexes and in place ≤30 days.

**Pre-Construction Notification Required**

1. Activities (a) or (b) above are planned or scheduled, not an emergency response; or
2. Activities that are not eligible for SV and do not require an IP.

**Notes:**

1. For emergency response activities in the Connecticut River from the Turners Falls Dam to the MA/CT border, Merrimack River from the Essex Dam to the mouth, and remaining tidal waters that are not rivers, the permittee must contact the USACE at (978) 318-8338 before or as soon as possible after the work authorized under GP 12(a) - (c) commences for the USACE to address effects under the Endangered Species Act.
2. An SVN submittal to USACE is not required for booms used for spill prevention, or properly contained and cleaned de minimus oil or hazardous substance discharges into navigable waters of the U.S.

**GP 13. CLEANUP OF HAZARDOUS AND TOXIC WASTE (Authorities: §10 and §404)**

Specific activities required to affect the containment, stabilization, or removal of hazardous or toxic waste materials, including court ordered remedial action plans or related settlements, which are performed, ordered or sponsored by a government agency with established legal or regulatory authority.

**Not authorized under GP 13:** (a) Establishment of new disposal sites; or (b) Expansion of existing sites used for the disposal of hazardous or toxic waste.

**Self-Verification Eligible**

1. In non-tidal waters, the combined permanent and temporary impacts are (a)  $\leq 5,000$  SF, and (b) not located in vegetated shallows and riffle and pool complexes.

**Pre-Construction Notification Required**

1. In non-tidal waters, the combined permanent and temporary impacts are (a)  $> 5,000$  SF, and (b) located in vegetated shallows and riffle and pool complexes.  
2. Permanent and temporary impacts in tidal waters or navigable waters of the U.S.  
3. Stream channelization, relocation, impoundment, or loss of streambed occurs.  
4. Activities that are not eligible for SV and do not require an IP.

**Notes:**

1. Wetlands, vegetated shallows, mudflats, and riffle and pool complexes should be restored in place at the same elevation to the maximum extent practicable.  
2. Activities undertaken entirely on a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site by authority of CERCLA, are not required to obtain permits under Section 404 of the CWA or Section 10 of the Rivers and Harbors Act.

**GP 14. SCIENTIFIC MEASUREMENT DEVICES (Authorities: §10 and §404)**

Scientific measurement devices for measuring and recording scientific data, such as staff gauges, tide and current gauges, meteorological stations, water recording and biological observation devices, water quality testing and improvement devices, and similar structures. Also eligible are small weirs and flumes constructed primarily to record water elevation, flow and/or velocity. Upon completion of the use of the device to measure and record scientific data, the measuring device and any other structures or fills associated with that device (e.g., foundations, anchors, buoys, lines, etc.) must be removed to the maximum extent practicable and the site restored to preconstruction elevations.

**Not authorized under GP 14 (IP required):** (a) Permanent impacts that are >5,000 SF in tidal and non-tidal waters of the U.S.; >1000 SF in tidal saltmarsh, mud flats, riffle and pool complexes; or >100 SF in tidal vegetated shallows; or (b) Temporary impacts in tidal waters that are >1 acre, unless the District Engineer waives this criterion by making a written determination concluding that the discharge of dredged or fill material will result in no more than minimal adverse environmental effects; >5000 SF in saltmarsh, mud flats, or riffle and pool complexes; or >1000 SF in vegetated shallows.

**Self-Verification Eligible**

1. In non-tidal waters, the combined permanent and temporary impacts are (a)  $\leq 5,000$  SF, (b) not located in riffle and pool complexes and non-tidal vegetated shallows.
2. In tidal waters, the combined permanent and temporary impacts are (a)  $\leq 5,000$  SF, (b)  $\leq 1,000$  SF in mudflats and/or natural rocky habitat, (c) not located in saltmarsh and tidal vegetated shallows.
3. Temporary, non-biological sampling devices in waters that do not restrict or concentrate movement of aquatic organisms and will not adversely affect the course, condition, or capacity of a waterway for navigation.
4. Scientific measurement devices, and small weirs and flumes constructed primarily to record water quantity and velocity provided the discharge of fill is limited to 25 cubic yards. These cannot obstruct or restrict the waterway course, condition, capacity, and location.
5. Temporary measuring devices and associated structures (e.g., anchors, buoys, etc.) in tidal and non-tidal waters that do not require a PCN or IP.

**Pre-Construction Notification Required**

1. Biological sampling devices, weirs or flumes, or the activity restricts or concentrates movement of aquatic organisms.
2. Permanent towers located in navigable waters that record and measure scientific data.
3. Devices that are not eligible for SV and do not require an IP.

Note: An SVN submittal to USACE is not required for temporary measuring devices with a footprint of <10 SF, with a profile of <3 feet high measured from the substrate and located in water deeper than -10 feet MLW.

**GP 15. SURVEY ACTIVITIES (Authorities: §10 and §404)**

Survey activities such as soil borings, core sampling, seismic exploratory operations, plugging of seismic shot holes and other exploratory-type bore holes, exploratory trenching, soil surveys, sampling, sample plots or transects for wetland delineations, and historic resources surveys.

**Not authorized under GP 15 (IP required):** (a) Permanent impacts that are >1 acre in tidal and non-tidal waters; >1000 SF in tidal saltmarsh, mud flats, or riffle and pool complexes; or >100 SF in tidal vegetated shallows; or (b) Temporary impacts in tidal waters that are >1 acre, unless the District Engineer waives this criterion by making a written determination concluding that the discharge of dredged or fill material will result in no more than minimal adverse environmental effects; >5000 SF in saltmarsh, mud flats, or riffle and pool complexes; or >1000 SF in vegetated shallows.

**Self-Verification Eligible**

1. In non-tidal waters, the combined permanent and temporary impacts are (a) ≤5,000 SF, (b) not located in riffle and pool complexes and non-tidal vegetated shallows.
2. In tidal waters, the combined permanent and temporary impacts are (a) ≤5,000 SF, (b) ≤1,000 SF in mudflats and/or natural rocky habitat, (c) not located in saltmarsh and tidal vegetated shallows.

**Pre-Construction Notification Required**

1. Exploratory trenching (see Note 2) occurs in waterways (e.g., streams, tidal waters).
2. Activities associated with the recovery of historic resources, and the drilling and discharge of excavated material from test wells for oil and gas exploration.
3. Seismic exploratory operations occur in tidal waters, the Connecticut River from the Turners Falls Dam to the MA/CT border, or the Merrimack River from the Essex Dam to the mouth. This is to protect endangered species.
4. Activities that are not eligible for SV and do not require an IP.

**Notes:**

1. An SVN submittal is not required for wetland delineations, and core sampling conducted for preliminary evaluation of dredge project analysis.
2. For the purposes of GP 15, the term “exploratory trenching” means mechanical land or underwater clearing of the upper soil profile to expose bedrock or substrate for the purpose of mapping or sampling the exposed material.
3. The discharge of drilling mud and cuttings may require a permit under §402 of the CWA.

**GP 16. LAND AND WATER-BASED RENEWABLE ENERGY GENERATION FACILITIES (Authorities: §10 and §404), AND HYDROPOWER PROJECTS (Authority: §10 and §404)**

Structures and work in tidal waters and discharges of dredged or fill material into tidal and non-tidal waters for the construction, expansion, modification or removal of: (a) Land-based renewable energy production facilities (e.g., solar, wind, biomass, geothermal) and their attendant features; (b) Water-based wind or hydrokinetic renewable energy generation projects and their attendant features; and (c) Discharges of dredged or fill material associated with hydropower projects. Attendant features may include, but are not limited to, land-based collection and distribution facilities, control facilities, and parking lots. For each single and complete project in (b) above, no more than 10 generation units (e.g., wind turbines or hydrokinetic devices) are authorized in navigable waters of the U.S. Upon completion of the pilot project (see note 2), the generation units, transmission lines, and other structures or fills associated with the pilot project must be removed to the maximum extent practicable.

**Not authorized under GP 16 (IP required):** (a) Permanent impacts that are >1 acre in non-tidal waters, >½ acre in tidal waters; >1000 SF in saltmarsh, mud flats, riffle and pool complexes, or non-tidal vegetated shallows; or >100 SF in vegetated shallows; or (b) Temporary impacts in tidal waters that are >1 acre; >5000 SF in saltmarsh, mud flats, or riffle and pool complexes; or >1000 SF in vegetated shallows.

**Self-Verification Eligible**

In non-tidal waters, the combined permanent and temporary impacts for land-based activities are (a) ≤5,000 SF, (b) not located in riffle and pool complexes and non-tidal vegetated shallows.

**Pre-Construction Notification Required**

1. In non-tidal waters, the combined permanent and temporary impacts for land-based activities are (a) >5000 SF, or (b) located in vegetated shallows or riffle and pool complexes.
2. Permanent and temporary impacts in tidal waters.
3. Water-based wind or hydrokinetic renewable energy generation projects, and hydropower projects.
4. For all activities eligible for authorization under GP 16:
  - a. The activity occurs in tidal waters or in, over or under navigable waters.
  - b. Stream channelization, relocation, impoundment, or loss of streambed occurs.
5. Activities that are not eligible for SV and do not require an IP.

**Notes:**

1. Utility lines constructed to transfer the energy from the land-based renewable generation or collection facility to a distribution system, regional grid, or other facility may be authorized by GP 6.
2. For the purposes of this GP, the term “pilot project” means an experimental project where the renewable energy generation units will be monitored to collect information on their performance and environmental effects at the project site.

**GP 17. RESIDENTIAL, COMMERCIAL AND INSTITUTIONAL DEVELOPMENTS AND RECREATIONAL FACILITIES (AUTHORITIES: §404)**

Discharges of dredged or fill material into non-tidal waters for the construction or expansion of: (a) Residences and residential subdivisions; (b) Residential, commercial and institutional building foundations and building pads; and (c) Recreational facilities such as playgrounds, playing fields, bikeways, trails, etc. This GP also authorizes attendant features that include, but are not limited to, roads, parking lots, garages, yards, and utility lines, and stormwater management facilities. This GP authorizes attendant features if they are necessary for the use of the project purpose.

**Not authorized under GP 17 (IP required):** (a) Permanent impacts that result in loss of non-tidal waters >1/2 acre; >1000 SF in riffle and pool complexes or vegetated shallows; or (b) Subsurface sewerage disposal systems in non-tidal waters.

**Self-Verification Eligible**

1. In non-tidal waters, the combined permanent and temporary impacts are (a) <5,000 SF, and (b) not located in riffle and pool complexes and non-tidal vegetated shallows.

2. Stream channelization or relocation resulting in loss of streambed that is <200 LF.

**Pre-Construction Notification Required**

1. In non-tidal waters, the combined permanent and temporary impacts are (a) ≥5,000 SF, or (b) located in riffle and pool complexes or non-tidal vegetated shallows.

2. Stream and wetland crossings that require a PCN per GCs 20 TOY Restrictions and GC 31 Stream Work and Crossings & Wetland Crossings.

3. Stream channelization or relocation resulting in loss of streambed that is ≥200 LF. Stream impoundment activities of any kind.

4. Activities on USACE properties & USACE-controlled easements.

5. Activities that are not SV eligible and do not require an IP.

**Notes:**

1. Stream and wetland crossings (permanent and temporary), including those built with construction mats; and modifications (including sliplining), replacements or extensions to existing crossings.

2. See GC 22 for information on temporary construction mats.

3. Subdivisions: For residential subdivisions, the aggregate total loss of waters of United States authorized by this GP cannot exceed 1/2-acre. This includes any loss of waters of the United States associated with development of individual subdivision lots.

**GP 18. AQUACULTURE (Authorities: §10 and §404)**

(a) The installation of buoys, floats, racks, trays, nets, lines, tubes, containers, and other structures into navigable waters of the U.S.; (b) Discharges of dredged or fill material into tidal and non-tidal waters necessary for shellfish seeding, rearing, cultivating, transplanting, and harvesting activities; and (c) Shellfish seeding or brushing the flats projects. Any fill material imported to the project from offsite (this is limited to mineral growth medium used in culture trays) shall be clean and of comparable grain size to the native substrate. Activities authorized under this GP must have (a) their MA DMF Aquaculture Certificate letter for licensed shellfish aquaculture sites, (b) documentation that the applicant has coordinated with the U.S. Coast Guard regarding USCG Private Aids to Navigation standards, (c) their MEPA Certificate (if required), and (d) documentation that the applicant has contacted their local authorities (ex. harbormaster, select board, shellfish constable) for authorization of their facility.

**Not authorized under GP 18 (IP required):** (a) New, or expansions of, impoundments and semi-impoundments of tidal and non-tidal waters for the culture or holding of motile species such as lobster with an impounded area >½ acre; (b) Cultivation of a nonindigenous species (see Note 1) unless that species has been previously cultivated in the waterbody; (c) Cultivation of an aquatic nuisance species (see Note 1); (d) Attendant features such as docks, piers, boat ramps (see GP 4); (e) stockpiles, staging areas, or the deposition of shell material back into tidal and non-tidal waters as waste.

**Self-Verification Eligible**

1. In tidal waters, a new lease site area is (a) ≤2-acre, (b) not located in salt marsh, natural rocky habitat, or tidal vegetated shallows.
2. In tidal waters, expansions of existing lease sites not to exceed 2 acres for the entire site (e.g. 1 acre lease site increasing to a 2 acre lease site may qualify as SV). A PCN is required for expansions in salt marsh, natural rocky habitat, and tidal vegetated shallows.
3. Cages, racks that are elevated ≥2 feet above the ocean floor with legs within a lease site with ≤4 buoys marking the corners.
4. Floating cage strings with a single connecting line, ≤2 anchors and ≤2 end marker buoys per string within a lease site with ≤4 buoys marking the corners.
5. No activities located within 25 feet of tidal vegetated shallows.
6. Culture only indigenous species.
7. Not located in FNP or within a distance of three times the authorized depth of an FNP (see GC 15).
8. Not located in or impinge upon the value of any National Lands or Federal Properties.
9. Floating upweller docks that total ≤600 SF in area.

**Pre-Construction Notification Required**

1. Discharges of fill material associated with aquaculture >5,000 SF.
2. Research, educational, commercial-viability or experimental aquaculture gear activities >1,000 SF.
3. Kelp or finfish aquaculture.
4. Land-based hatchery intakes >3 inches in diameter.
5. Activities in water depths >10 feet mean low lower water (MLLW).
6. Activities with in-water lines, ropes or chains that are not SV eligible (see #3-4).
7. Activities occur in the Connecticut River from the Turners Falls Dam to the MA/CT border or the Merrimack River from the Essex Dam to the mouth. This is to protect endangered species.
8. New, or expansions of, impoundments and semi-impoundments for the culture or holding of motile species such as lobster with an impounded area ≤1/2 acre.
9. Activities that do not require an IP. Activities that do not require a PCN or an IP may be SV eligible.

Note: The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 defines: (a) nonindigenous species as “any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country into another”; and (b) aquatic nuisance species as “a nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural, or recreational activities dependent on such waters.”

**GP 19. MINING ACTIVITIES (Authorities: §10 and §404)**

Discharges of dredged or fill material into non-tidal waters for mining activities, except for coal mining and metallic mineral mining activities.

**Not authorized under GP 19 (IP required):** (a) Permanent impacts >1 acre in non-tidal waters; or (b) Activities in tidal waters.

**Self-Verification Eligible**

In non-tidal waters, the combined permanent and temporary impacts are (a) ≤5,000 SF, and (b) not located in riffle and pool complexes, non-tidal vegetated shallows, and streams.

**Pre-Construction Notification Required**

1. In non-tidal waters, the combined permanent and temporary impacts are (a) >5,000 SF, or (b) located in riffle and pool complexes, non-tidal vegetated shallows, and streams.
2. The activity occurs in non-tidal navigable waters of the U.S.
3. Stream channelization, relocation, impoundment, loss of streambed, or discharge of tailings into streams occurs.
4. Work on USACE properties & USACE-controlled easements.
5. Activities that are not eligible for SV and do not require an IP.

**GP 20. LIVING SHORELINES<sup>1</sup> (Authorities: §10 and §404)**

Construction and maintenance of living shorelines to stabilize banks and shores in tidal waters. In non-tidal waters that are not subject to the ebb and flow of the tide, nature-based bank stabilization techniques such as bioengineering and vegetative stabilization may be authorized by GP 9. This GP authorizes those maintenance and repair activities in-kind that are necessary to address changing environmental conditions.

The following terms must be met for both SVs and PCNs as applicable: (a) Coir logs, coir mats, stone, native oyster shell, native wood debris, and other structural materials must be adequately anchored, of sufficient weight, or installed in a manner that prevents relocation in most wave action or water flow conditions, except for extremely severe storms; (b) For living shorelines consisting of tidal fringe wetlands, native plants appropriate for current site conditions, including salinity and elevation, must be used if the site is planted by the permittee; (c) Discharges of dredged or fill material into waters of the U.S., and oyster or mussel reef structures in navigable waters, must be the minimum necessary for the establishment and maintenance of the living shoreline; (d) If sills or other structural materials per PCN #4 must be constructed to protect fringe wetlands for the living shoreline, those structures must be the minimum size necessary to protect those fringe wetlands; (e) The activity must be designed, constructed, and maintained so that it has no more than minimal adverse effects on water and sediment movement between the waterbody and the shore and the movement of aquatic organisms between the waterbody and the shore; and (f) The living shoreline must be properly maintained and monitored, which may require periodic repair of sills, bioengineered components, or replacing sand fills after severe storms or erosion events. Vegetation may be replanted to maintain the living shoreline.

**Not authorized under GP 20 (IP required):** (a) The activity is ≥1000 feet in length along the bank (≥2000 LF both banks) unless waived by the District Engineer; or (b) The activity is >30 feet channel ward of mean low water in tidal waters; or (c) Upland reclamation activities; or (d) Stream channelization or relocation activities; or (e) Breakwaters, groins, jetties, or artificial reefs; or (f) Permanent impacts >1,000 SF in existing saltmarsh; >100 SF in existing tidal vegetated shallows.

**Self-Verification Eligible**

1. Tidal and non-tidal living shorelines ≤100 LF for each bank (≤200 LF for both banks).
2. Combined permanent and temporary impacts ≤5,000 SF in tidal waters, excluding existing salt marsh, tidal vegetated shallows, natural rocky habitat, and mudflats.

**Pre-Construction Notification Required**

1. Tidal and non-tidal living shorelines >100 LF to <1000 LF (>200 LF to <2000 LF for both banks).
2. Permanent and temporary impacts in existing salt marsh, tidal vegetated shallows, or mudflats.
3. Work on USACE properties & USACE-controlled easements.
4. Use of stone sills, native oyster shell, native wood debris, or other structural materials.

**Notes:**

1. PCNs require monitoring for a minimum of 5 years in accordance with an approved restoration plan, unless otherwise determined by the USACE. The first year of monitoring will be the first year that the site has been through a full growing period after completion of construction and planting.
2. Applicants are encouraged to obtain a MEPA certificate prior to submitting a USACE permit application.

<sup>1</sup> A living shoreline has a footprint that is made up mostly of native material. It incorporates vegetation or other living, natural “soft” elements alone or in combination with some type of harder shoreline structure (e.g., oyster or mussel reefs or rock sills) for added protection and stability. Living shorelines should maintain the natural continuity of the land-water interface and retain or enhance shoreline ecological processes. Living shorelines must have a substantial biological component, either tidal or lacustrine fringe wetlands or oyster or mussel reef structures.

**GP 21. AGRICULTURAL ACTIVITIES (Authority: §404)**

Discharges of dredged or fill material in non-tidal waters for agricultural activities, including the construction of building pads for farm buildings. Authorized activities include: (a) installation, placement, or construction of drainage tiles, ditches, or levees; mechanized land clearing; land leveling; the relocation of existing serviceable drainage ditches; and similar activities; (b) construction of farm ponds, excluding perennial streams, provided the farm pond is used solely for agricultural purposes; and (c) discharges of dredged or fill material to relocate existing serviceable drainage ditches constructed in non-tidal streams.

**Not authorized under GP 21 (IP required):** (a) Permanent impacts that are >1 acre in non-tidal waters; or >1000 SF in riffle and pool complexes, or non-tidal vegetated shallows; (b) Work in tidal waters; or (c) Construction of farm ponds in perennial streams.

**Self-Verification Eligible**

In non-tidal waters, the combined permanent and temporary impacts are (a) ≤5,000 SF, and (b) not located in riffle and pool complexes and non-tidal vegetated shallows.

**Pre-Construction Notification Required**

1. In non-tidal waters, the combined permanent and temporary impacts are (a) >5,000 SF, or (b) located in riffle and pool complexes and non-tidal vegetated shallows.
2. Activities occur in non-tidal navigable waters of the U.S.
3. Stream channelization, relocation, impoundment, loss of streambed, or farm ponds in non-perennial streams occurs.
4. Activities that are not eligible for SV and do not require an IP.

Note: Some discharges for agricultural activities may qualify for an exemption under Section 404(f) of the CWA (see 33 CFR 323.4). This GP authorizes the construction of farm ponds that do not qualify for the CWA §404(f)(1)(C) exemption because of the recapture provision at §404(f)(2).

**GP 22. RESHAPING EXISTING DRAINAGE DITCHES, CONSTRUCTION OF NEW DITCHES, AND MOSQUITO MANAGEMENT (Authorities: §10 and §404)**

Discharges to modify the cross-sectional configuration of currently serviceable drainage ditches constructed in tidal and non-tidal waters, for the purpose of improving water quality by regrading the drainage ditch with gentler slopes, which can reduce erosion, increase growth of vegetation, and increase uptake of nutrients and other substances by vegetation. Also authorized are mosquito reduction activities.

**Not authorized under GP 22 (IP required):** Stream channelization, relocation, impoundments, or loss of streambed.

**Self-Verification Eligible**

≤500 linear feet of drainage ditch will be reshaped provided excavated material is deposited in an upland area.

**Pre-Construction Notification Required**

1. >500 linear feet of drainage ditch will be reshaped, excavated material is deposited in a water of the U.S., or the reshaping of the ditch increases the drainage capacity beyond the original as-built capacity or expands the area drained by the ditch as originally constructed (i.e., the capacity of the ditch is not the same as originally constructed or drains additional wetlands or other waters of the U.S.).
2. Permanent and temporary impacts in tidal vegetated shallows.
3. New ditches or relocation of drainage ditches constructed in waters of the U.S. (i.e., the location of the centerline of the reshaped drainage ditch is not approximately the same as the location of the centerline of the original drainage ditch).
4. Activities that are not eligible for SV and do not require an IP.

Note: Some ditch activities are exempt under Section 404(f) of the CWA (see 33 CFR 323.4).

**GP 23. LINEAR TRANSPORTATION PROJECTS AND WETLAND/STREAM CROSSINGS (Authorities: §10 & §404)**

Activities<sup>1</sup> required for the construction, expansion, modification, or improvement of linear transportation projects (e.g., driveways, roads, highways, railways, trails, airport runways, and taxiways) and attendant features. This GP also authorizes temporary structures, fills, and work, including the use of temporary mats (see Note 1), necessary to construct the linear transportation project.

**Not authorized under GP 23 (IP required):** (a) Permanent impacts for any single and complete project that are >1 acre in non-tidal waters; >½ acre in tidal waters; >1000 SF in saltmarsh, mud flats, riffle and pool complexes, or non-tidal vegetated shallows; or >100 SF in tidal vegetated shallows; (b) Temporary impacts in tidal waters that are >1 acre; >5000 SF in saltmarsh, mud flats, or riffle and pool complexes; or >1000 SF in vegetated shallows; (c) Non-linear features commonly associated with transportation projects, such as vehicle maintenance or storage buildings, parking lots, train stations, or aircraft hangars (see GP 17); or (d) New tide gates.

**Self-Verification Eligible**

1. In non-tidal waters, the combined permanent and temporary impacts are a) ≤5,000 SF; b) not located in riffle and pool complexes and non-tidal vegetated shallows; and c) meet the Massachusetts River and Stream Crossing Standards
2. Existing crossings (e.g., culverts, elliptical or arch pipes, etc.) are not modified by (a) decreasing the diameter of the crossing or (b) changing the friction coefficient, such as through slip lining (retrofitting an existing culvert by inserting a smaller diameter pipe), culvert relining or invert lining.
3. Stream channelization or relocation resulting in loss of streambed that is <200 LF.

**Pre-Construction Notification Required**

1. In non-tidal waters, the combined permanent and temporary impacts are a) >5,000 SF; b) located in vegetated shallows or riffle and pool complexes; or c) do not meet the Massachusetts River and Stream Crossing Standards (see note 4).
2. The activity occurs in tidal waters, salt marsh, or in, over or under navigable waters of the U.S.
3. Stream and wetland crossings that require a PCN per GC 20 TOY Restrictions and GC 31 Stream Work and Crossings & Wetland Crossings.
4. Stream channelization or relocation resulting in loss of streambed that is ≥200 LF. Stream impoundment activities of any kind.
5. Work on USACE properties & USACE-controlled easements.
6. Activities that are not eligible for SV and do not require an IP.

**Notes:**

1. See GC 22 for information on temporary construction mats.
2. Discharges of dredged or fill material incidental to the construction of bridges across navigable waters of the U.S. may be authorized under GP 8.
3. Loss of streambed does not require a PCN when bridge piers or similar supports are used.
4. In their PCN application submission to the USACE, applicants must explain why they are unable to meet the Massachusetts River and Stream Crossing Standards.
5. For tidal crossings, modeling is encouraged as a method to verify the proposed crossing would not be undersized and resilient to the effects of sea level rise.

<sup>1</sup> Stream crossings must conform with the MA Stream Crossing Guidelines when practicable and comply with all applicable GCs of this document (Section IV).

**GP 24. TEMPORARY CONSTRUCTION, ACCESS, AND DEWATERING (Authorities: §10 and §404)**

Temporary structures, work, and discharges, including cofferdams, necessary for construction activities or access fills or dewatering of construction sites that are not authorized under another GP activity.

**Not authorized under GP 24 (IP required):** (a) Permanent structures or impacts; (b) Temporary impacts in tidal waters that are >1 acre; >5000 SF in saltmarsh, mud flats, or riffle and pool complexes; or >1000 SF in vegetated shallows; (c) Use of cofferdams to dewater wetlands or other aquatic areas to change their use; (d) Temporary stream crossings (see GPs 6, 17, 23); (e) Structures or fill left in place after construction is completed.

**Self-Verification Eligible**

1. In non-tidal waters, temporary impacts are a)  $\leq 5,000$  SF; b) not located in riffle and pool complexes and non-tidal vegetated shallows.
2. In tidal waters, temporary impacts are a)  $\leq 5,000$  SF, b)  $\leq 1,000$  SF in mudflats and/or natural rocky habitat, and c) not located in saltmarsh and tidal vegetated shallows.
3. Structures in navigable waters of the U.S. provided impacts do not require a PCN and they are left in place  $\leq 30$  days.

**Pre-Construction Notification Required**

1. In non-tidal waters, temporary impacts are a)  $> 5,000$  SF; b) located in riffle and pool complexes or non-tidal vegetated shallows.
2. In tidal waters, temporary impacts are a)  $> 5,000$  SF; b)  $> 1,000$  SF in mudflats and/or natural rocky habitat, or (c) located in saltmarsh and tidal vegetated shallows.
3. Activities in the Connecticut River from the Turners Falls Dam to the MA/CT border, or Merrimack River from the Essex Dam to the mouth, involving temporary impacts unless they are performed  $< 5$  feet waterward from OHW or HTL and in the dry. This is to protect endangered species; or
4. Activities not eligible for SV and do not require an IP.

Notes:

1. Turbidity or sediment resuspension is generally not considered to occur when properly using management techniques to work in dry conditions. See GC 25.
2. Total impact areas under SV Eligible 1-2 exclude use of temporary construction mats. See GC 22 for information on temporary construction mats.
3. An SVN submittal to USACE is not required for SV #3 above.

**GP 25. EMERGENCY SITUATIONS (Authorities: §10 and §404)**

Structures or work in or affecting navigable waters of the U.S. and the discharge of dredged or fill material into waters of the U.S., including wetlands, necessary for repair or protection measures associated with an emergency situation<sup>1</sup>, MassDEP Emergency Declaration/Certification, or FEMA Declared Disaster. The activity shall be the minimum necessary to alleviate the immediate emergency unless that additional work would result in no more than minimal effects to aquatic environment and is necessary to reduce the potential for future failure or loss of the structure or site. Typical activities authorized under this GP include, but are not limited to, restoration of damaged areas; bank stabilization; temporary fills for staging, access, and dewatering; and, repair, replacement, or rehabilitation of existing structures and/or fills (i.e., roads, bridges, utility pipelines and flood control structures, including attendant features, and other existing structures located in waters of the U.S.).

For the restoration of areas damaged by storms floods, or other discrete events: (a) The restored area must not extend waterward of the ordinary high-water mark or high tide line that existed prior to the damage. (b) The slope of the restored area below the ordinary high-water mark or high tide line must not exceed the slope that existed prior to the damage. (c) The bottom elevation of the restored area must not exceed the bottom elevation that existed prior to the damage (i.e., the restored area must not result in a reduction in the depth of the waterbody that existed prior to the damage). (d) Except in cases of FEMA reimbursement, the activity must be initiated, under contract to commence, or funds shall be allocated for the activity within 30 days of authorization under GP 25.

**Not authorized under GP 25 (IP required):** (a) Permanent impacts for a single and complete project >1/2 acre in tidal waters, unless the district engineer waives this criterion by making a written determination concluding that the activity will result in no more than minimal adverse environmental effects; >1,000 SF in saltmarsh, mud flats, riffle and pool complexes, or non-tidal vegetated shallows; or >100 SF in tidal vegetated shallows; (b) Temporary impacts in tidal waters that are >5,000 SF in saltmarsh, mud flats, or riffle and pool complexes; or >1,000 SF in vegetated shallows; (c) New structures or fills that did not previously exist before the storm event or other discrete event (see other GPs).

**Self-Verification Eligible**

1. Activities that qualify under a Severe Weather Emergency Declaration pursuant to 310 CMR 10.06(8) and/or receive an Emergency Certification pursuant to 310 CMR 10.06 and/or meet the requirements of 314 CMR 9.12(2) or (3); and
2. Activities eligible under a FEMA Declared Disaster that also comply with #1 above.

**Pre-Construction Notification Required**

1. Activities that are eligible under a FEMA Declared Disaster and do not qualify under SV #1.
2. Minor deviations in the structure or fill area, including those to existing structures or fills are authorized due to changes in materials, construction techniques, requirements of other regulatory agencies, or current construction codes or safety standards that are necessary to alleviate the emergency.
3. Activities that are not eligible for SV and do not require an IP.

Notes:

1. Review the GCs (Section IV) to confirm if a PCN is not required elsewhere in this document.
2. If the activity is not a MassDEP Emergency Declaration/Certification, does not meet the requirements of 314 CMR 9.12(2) or (3), or is not a FEMA Declared Disaster, applicants must explain in writing why their activity qualifies as an emergency (see footnote) to be eligible under GP 25.
3. SV eligible activities qualify under the general 401 WQC MassDEP issued for the 2023 MA GPs (GC 9).

<sup>1</sup> An emergency, as determined by this office and 33 CFR 325.2(e)(4), is one which would result in an unacceptable hazard to life, a significant loss of property, or an immediate, unforeseen, and significant economic hardship if corrective action requiring a Department of the Army permit is not undertaken within a time period less than the normal time to process the request under standard processing procedures.

## **SECTION IV. GENERAL CONDITIONS:**

To qualify for GP authorization, the applicant must comply with the following general conditions, as applicable, in addition to authorization-specific conditions imposed by the division or district engineer.

1. Other Permits
2. Federal Jurisdictional Boundaries
3. Single and Complete Projects
4. Use of Multiple General Permits
5. Suitable Material
6. Tribal Rights & Burial Sites
7. Avoidance, Minimization, and Compensatory Mitigation
8. Water Quality & Stormwater Management
9. Coastal Zone Management
10. Federal Threatened and Endangered Species
11. Essential Fish Habitat
12. National Lands
13. Wild and Scenic Rivers
14. Historic Properties
15. USACE Property and Federal Projects (§408)
16. Navigation
17. Permit/Authorization Letter On-Site
18. Storage of Seasonal Structures
19. Pile Driving and Pile Removal in Navigable Waters
20. Time of Year Restrictions
21. Heavy Equipment in Wetlands
22. Temporary Fill & Construction Mats
23. Restoration of Wetland Areas
24. Bank Stabilization
25. Soil Erosion and Sediment Controls
26. Aquatic Life Movements and Management of Water Flows
27. Spawning, Breeding, and Migratory Areas
28. Vernal Pools
29. Invasive Species
30. Fills Within 100-Year Floodplains
31. Stream Work and Crossings & Wetland Crossings
32. Utility Line Installation and Removal
33. Water Supply Intakes
34. Coral Reefs
35. Blasting
36. Inspections
37. Maintenance
38. Property Rights
39. Transfer of GP Verifications
40. Modification, Suspension, and Revocation
41. Special Conditions
42. False or Incomplete Information
43. Abandonment
44. Enforcement Cases
45. Previously Authorized Activities
46. Duration of Authorization

**1. Other Permits.** Authorization under these GPs does not obviate the need for the permittee to obtain other Federal, State, or local permits, approvals, or authorizations required by law. Permittees are responsible for obtaining all required permits, approvals, or authorizations. Activities that are not regulated by the State, but subject to USACE jurisdiction, may still be eligible for these GPs.

**2. Federal Jurisdictional Boundaries.**

a. Applicability of these GPs shall be evaluated with reference to Federal jurisdictional boundaries. Activities shall be evaluated with reference to “waters of the U.S.” under the CWA (33 CFR 328) and “navigable waters of the U.S.” under §10 of the Rivers and Harbors Act of 1899 (33 CFR 329).

Permittees are responsible for ensuring that the boundaries used satisfy the Federal criteria defined at 33 CFR 328-329. These sections prescribe the policy, practice, and procedures to be used in determining the extent of the USACE jurisdiction. Note: Waters of the U.S. includes all waters pursuant to 33 CFR 328.3(a), and adjacent wetlands as the term is defined in 33 CFR 328.3(c).

b. Wetlands shall be delineated in accordance with the USACE Wetlands Delineation Manual and the most recent Northcentral/Northeast Regional Supplement. Wetland delineation and jurisdiction information is located at: [www.nae.usace.army.mil/missions/regulatory/jurisdiction-and-wetlands](http://www.nae.usace.army.mil/missions/regulatory/jurisdiction-and-wetlands) and maps are located at [www.nae.usace.army.mil/missions/regulatory/state-general-permits/massachusetts-general-permit](http://www.nae.usace.army.mil/missions/regulatory/state-general-permits/massachusetts-general-permit).

c. Vegetated shallows shall be delineated when present on the project site. Vegetated shallow survey guidance and maps are located at: [www.nae.usace.army.mil/missions/regulatory/state-general-permits/massachusetts-general-permit](http://www.nae.usace.army.mil/missions/regulatory/state-general-permits/massachusetts-general-permit).

d. Natural rocky habitats shall be delineated when present on the project site. The definition of natural rocky habitats is in Section VII of the MA GP. Natural rocky habitat survey guidance and maps are located at: [www.nae.usace.army.mil/missions/regulatory/state-general-permits/massachusetts-general-permit](http://www.nae.usace.army.mil/missions/regulatory/state-general-permits/massachusetts-general-permit).

**3. Single and Complete Projects.** The MA GP shall not be used for piecemeal work and shall be applied to single and complete projects. The term “single and complete project” is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers.

a. For non-linear projects, a single and complete project must have independent utility. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed, even if the other phases were not built, can be considered as separate single and complete projects with independent utility.

b. Unless USACE determines the activity has independent utility, all components of a single project and/or all planned phases of a multi-phased project (e.g., subdivisions should include all work such as roads, utilities, and lot development) shall be evaluated as one single and complete project.

c. For linear projects such as power lines or pipelines with multiple crossings, a “single and complete project” is all crossings of a single water of the U.S. (i.e., single waterbody) at a specific location. For linear projects crossing a single waterbody several times at separate and distant locations, each crossing is considered a single and complete project. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately. If any crossing requires a PCN review or an individual permit review, then the entire linear project shall be reviewed as one project under PCN or the individual permit procedures.

**4. Use of Multiple General Permits.** The use of more than one GP for a single and complete project is prohibited, except when the acreage loss of waters of the U.S. authorized by the GPs does not exceed the acreage limit of the GPs with the highest specified acreage limit. For example, if a road crossing over waters is constructed under GP 23, with an associated utility line

crossing authorized by GP 6, if the maximum acreage loss of waters of the U.S. for the total project is  $\geq 1$  acre it shall be evaluated as an IP.

**5. Suitable Material & Discharge of Pollutants.** No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). All activities involving any discharge into waters of the U.S. authorized under these GPs shall be consistent with applicable water quality standards, effluent limitations, standards of performance, prohibitions, and pretreatment standards and management practices established pursuant to the CWA (33 U.S.C. 1251), and applicable state and local laws. If applicable water quality standards, limitations, etc., are revised or modified during the term of this GP, the authorized work shall be modified to conform with these standards within six months from the effective date of such revision or modification, or within a longer period of time deemed reasonable by the District Engineer in consultation with the Regional Administrator of the EPA. Unless monitoring data indicates otherwise, applicants may presume that their activity complies with state water quality standards provided they are in compliance with the Section 401 WQC (Applicable only to the Section 404 activity).

## **6. Tribal Rights & Burial Sites**

- a. For all SV and PCN applications, prospective permittees shall follow the guidance set forth in Appendix A, Guidance for NHPA Section 106 Compliance in Massachusetts.
- b. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.
- c. Many tribal resources are not listed on the National Register of Historic Places (NRHP) and may require identification and evaluation in collaboration with the identifying tribe and by qualified professionals. The Tribal Historic Preservation Officer (THPO) and State Historic Preservation Officer (SHPO) may be able to assist with locating information on:
  - i. Previously identified tribal resources; and
  - ii. Areas with potential for the presence of tribal resources.
- d. Discovery of Previously Unknown Remains and Artifacts: If any previously unidentified human remains, cultural deposits, or artifacts are discovered while accomplishing the activity authorized by this permit, you must immediately notify the USACE of what you have found, and to the maximum extent practicable, cease work and avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The USACE will initiate the appropriate the Federal, Tribal, and state coordination required to determine if the items or remains are eligible for listing in the NRHP and warrant a recovery effort or can be avoided.
- e. Burial Sites: Burial sites, marked or unmarked, are subject to state law (Massachusetts Unmarked Burial Law). Native American burial sites on federal or tribal land are subject to the provisions of Native American Graves Protection and Repatriation Act (NAGPRA). Regulated activities may not result in disturbance or removal of human remains until disposition of the remains has been determined by the appropriate authority under these laws, and the work is authorized by the USACE. Regulated activities which result in an inadvertent discovery of human remains must stop immediately, and the USACE, as well as the appropriate state and tribal authority, must be notified. Regulated work at inadvertent discovery sites requires compliance with state law or NAGPRA, as appropriate, prior to re-starting work.

**7. Avoidance, Minimization, and Compensatory Mitigation.** To qualify under the MA GP, activities must comply with Section V Mitigation Standards and the following as applicable:

- a. Avoid and Minimize: Activities must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the U.S. to the maximum extent practicable at the project site. Avoidance and minimization are required to the extent necessary to ensure that the adverse effects to the aquatic environment (both area and function) are no more than minimal.

- b. Compensatory mitigation for unavoidable impacts to waters of the U.S., including direct, indirect, secondary, and temporal loss, will generally be required for permanent impacts that exceed the thresholds identified in Section V, and may be required for temporary impacts, to offset unavoidable impacts which remain after all appropriate and practicable avoidance and minimization has been achieved and to ensure that the adverse effects to the aquatic environment are no more than minimal. Proactive restoration projects or temporary impact work with no secondary effects may generally be excluded from this requirement.
- c. Mitigation proposals shall follow the guidelines found in the Compensatory Mitigation for Losses of Aquatic Resources; Final Rule April 10, 2008; 33 CFR 332. Prospective permittees may purchase mitigation credits in-lieu of permittee-responsible mitigation as compensation for unavoidable impacts to waters of the U.S. in the Commonwealth of Massachusetts.

**8. Water Quality & Stormwater Management.** The 401 WQC requirement applies to all activities listed under GPs 1-25, unless determined otherwise by MassDEP. Permittees shall also satisfy stormwater management requirements in Massachusetts.

- a. General 401 WQC: MassDEP issued a WQC on April 21, 2023 which conditionally certifies all activities in GPs 1 – 24 eligible for SV and PCN so long as the activity is described in 314 CMR 9.03, and is not an activity described in 314 CMR 9.04, and so long as the activity meets all other requirements, terms and conditions of the WQC. The MassDEP WQC also conditionally certifies activities described in GP 25 so long as the activity meets all other conditions of the WQC. Emergency projects described in GP 25 must obtain an emergency certification or otherwise be authorized pursuant to 310 CMR 10.06, qualify under a Severe Weather Emergency Declaration pursuant to 310 CMR 10.06(8) issued by the MassDEP, or meet the requirements of 9.12(2) or (3) in order to be certified under the WQC. Prospective permittees may refer to the following link to determine if their activity is eligible: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>. The General 401 WQC is located here, and it provides detailed information regarding what activities are certified and the conditions for certification. Activities listed in 314 CMR 9.03 that are not exempt from the Wetland Protection Act must have a valid Final Order of Conditions (OOC) or Final Restoration Order of Conditions pursuant to 310 CMR 10.00 to be eligible under the General 401 WQC.
- b. Individual 401 WQC: Prospective permittees shall contact MassDEP and apply for an individual 401 WQC if their activity does not qualify for a General 401 WQC as outlined above. MassDEP may issue, waive, or deny the individual 401 WQC on a case-by-case basis. All activities listed in 314 CMR 9.04 must obtain an individual 401 WQC from MassDEP to be eligible under these GPs. When an Individual 401 WQC is required for *PCN activities*, the prospective permittee shall submit their Individual 401 WQC application concurrently to MassDEP and USACE to comply with 40 CFR 121.
- c. The prospective permittee is responsible for determining the appropriate 401 WQC requirement and submitting this information to the USACE at the time of their PCN application or when completing their SVN. Prospective permittees that are unsure of whether their activity has been certified should contact MassDEP for a determination.
- d. As applicable, all activities shall be compliant with the Massachusetts Stormwater Handbook. The Stormwater Handbook can be accessed on the NAE Regulatory website here: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>.
- e. No work requiring authorization under Section 404 of the CWA may be performed unless (1) the prospective permittee qualifies for coverage under the April 21, 2023 General 401 WQC, (2) the prospective permittee receives an individual Section 401 WQC from the MassDEP, or (3) the MassDEP waives individual Section 401 WQC.

**9. Coastal Zone Management.** The permittee must obtain CZM consistency concurrence when an activity is located in the coastal zone in order to be eligible under the MA GP. This requirement

shall be satisfied by acquiring one of the following from the Massachusetts Office of Coastal Zone Management (MA CZM):

- a. General CZM Federal Consistency Concurrence (General Concurrence): MA CZM has granted General Concurrence for all SV and PCN activities for GPs 1-25. The prospective permittee must obtain all applicable permits and approvals before construction of the authorized activity begins (e.g., before work begins on site). For SVs, General Concurrence is automatically granted and no further action is required from the prospective permittee. For PCNs, the USACE will coordinate with MA CZM to acquire General Concurrence as part of the PCN application review.
- b. Individual CZM Federal Consistency Concurrence (Individual Concurrence): In certain cases, MA CZM may elevate any GP activity 1-25 and require Individual Concurrence. The prospective permittee must contact MA CZM and follow the procedures to obtain Individual Concurrence as determined appropriate by MA CZM.
- c. Permittees must obtain CZM consistency concurrence as outlined above before commencing work authorized under these GPs.

## **10. Federal Threatened and Endangered Species**

- a. No activity is authorized under any GP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify designated critical habitat or critical habitat proposed for such designation. No activity is authorized under any GP which “may affect” a listed species or critical habitat, unless ESA section 7 consultation addressing the consequences of the proposed activity on listed species or critical habitat has been completed. See 50 CFR 402.02 for the definition of “effects of the action” for the purposes of ESA section 7 consultation, as well as 50 CFR 402.17, which provides further explanation under ESA section 7 regarding “activities that are reasonably certain to occur” and “consequences caused by the proposed action.”
- b. Other Federal agencies should follow their own procedures for complying with the requirements of the ESA (see 33 CFR 330.4(f)(1)). If a PCN is required for the proposed activity, the Federal permittee must provide USACE with the appropriate documentation to demonstrate compliance with those requirements. The USACE will verify that the appropriate documentation has been submitted. If the appropriate documentation has not been submitted, additional ESA section 7 consultation may be necessary for the activity and the respective federal agency would be responsible for fulfilling its obligation under section 7 of the ESA.
- c. USFWS ESA-Listed Species: Non-federal applicants shall use the USFWS website, Information for Planning and Consultation (IPAC), to determine if their activity is located within the ESA-listed species range. The IPAC website can be accessed on the NAE Regulatory website: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>. Applicants shall ensure they have an updated, valid species list before construction begins. This may require applicants to update their species list in IPAC before the start of construction. Note: Applicants should refer to the NAE Regulatory Website at the link above to determine if they have been designated as a non-federal representative. Applicants shall complete Section 7 consultation according to the guidance document located on the NAE Regulatory Website. After completing the Rangewide Determination Key and reaching the outcome “may affect, not likely to adversely affect”, you may be required to wait up to 15 days before that outcome is final and compliance under Section 7 of the ESA is fulfilled.
  - i. *Self-Verification Criteria*: The activity is SV-eligible if:
    - 1) The activity is not located within the ESA-listed species range;
    - 2) Another (lead) Federal agency has completed Section 7 consultation; or
    - 3) The activity is located within the ESA-listed species range *and* USACE has designated the applicant as a non-federal representative under 50 CFR 402.08 of the ESA for all

species within the project's action area. As the non-federal representative, the applicant shall complete consultation through IPAC and reach the outcome of "no effect" or "not likely to adversely affect".

ii. *Pre-Construction Notification Criteria*: The activity requires a PCN if:

- 1) The activity is located within the ESA-listed species range and USACE has NOT designated the applicant as a non-federal representative under 50 CFR 402.08 of the ESA for all species within the project's action area;
- 2) The activity is located in designated or proposed critical habitat; or
- 3) The activity is located within the ESA-listed species range and completion of the IPAC determination key has resulted in the outcome of "may affect" or "may affect, likely to adversely affect"; or
- 4) A PCN is required elsewhere in this document.

d. **NOAA-Listed Species**: Non-federal applicants shall refer to the Section 7 Mapper for federally listed species to determine if any species are mapped as present. When NOAA-listed species are present, the applicant shall generate a species report through the mapper and submit this document as part of their PCN or SVN submission. The NOAA Fisheries' Section 7 Mapper can be accessed here on the NAE Regulatory website here: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>.

e. Authorization of an activity by an GP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the FWS or the NMFS, the Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

## **11. Essential Fish Habitat (EFH).**

a. SV eligible activities have been determined to result in no more than minimal adverse effects, provided the permittee complies with all terms and conditions of the MA GP as applicable to the activity. NMFS has granted General Concurrence [50 CFR 600.920(g)] for all SV eligible activities. These activities do not require project specific EFH consultation.

b. For PCN required activities, the applicant is required to describe and identify potential adverse effects to EFH and should refer to NOAA Fisheries' EFH Mapper (<http://www.fisheries.noaa.gov/resource/map/essential-fish-habitat-mapper>) and Omnibus Essential Fish Habitat Amendment 2 Volume 2: EFH and HAPC Designation Alternatives and Environmental Impacts ([https://www.habitat.noaa.gov/application/efhmapper/oa2\\_efh\\_hapc.pdf](https://www.habitat.noaa.gov/application/efhmapper/oa2_efh_hapc.pdf)). If an activity is located within EFH, the PCN application must contain:

1. A description of the action located in EFH.
2. An analysis of the potential adverse effects of the action on EFH and the managed Species.
3. Conclusions regarding the effects of the action on EFH.
4. Proposed mitigation, if applicable (refer to the mitigation thresholds located in Section V).

c. Federal agencies shall follow their own procedures for complying with the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act. For activities requiring a PCN, the applicant is responsible for furnishing documentation that demonstrates consultation for EFH has been completed.

d. For PCN activities, no work may commence until EFH consultation as required by the Magnuson-Stevens Act has been completed.

**12. National Lands.** Activities that impinge upon the value of any National Wildlife Refuge, National Forest, National Marine Sanctuary, National Historic Landmarks or any other area administered by the National Park Service, U. S. Fish and Wildlife Service (USFWS) or U.S. Forest Service (USFS) require a PCN or Individual Permit. Federal land managers seeking authorization for activities located in the above listed National Lands may proceed under SV, unless a PCN is required elsewhere in this document.

**13. Wild and Scenic Rivers.** The following activities in designated river or study river segments in the National Wild and Scenic River (WSR) System require a PCN unless the Federal agency with direct management responsibility for such river, in Massachusetts this is generally the National Park Service, has determined in writing to the proponent that the proposed work will not adversely affect the WSR designation or study status:

- a. Activities that occur in WSR segments, in and 0.25 miles up or downstream of WSR segments, or in tributaries within 0.25 miles of WSR segments;
- b. Activities that occur in wetlands within 0.25 miles of WSR segments;
- c. Activities that have the potential to alter free-flowing characteristics in WSR segments.

No GP activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status.

As of May 10, 2023, affected rivers in Massachusetts include: the Taunton River (40 miles), Sudbury River (16.6 miles), Assabet River (4.4 miles), Concord River (8 miles), Nashua River (27 miles), Squannacook River (16.3 miles), Nissitissit River (4.7 miles), and the Westfield River, including West Branch, Middle Branch, Gendale Brook, East Branch, Drowned Land Brook, Center Brook, Windsor Jambs Brook, Shaker Mill Brook, Depot Brook, Savery Brook, Watson Brook, Center Pond Brook (78.1 miles). The most up to date list of designated and study rivers and their descriptions may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service). Information on these rivers is also available at: <http://www.rivers.gov/>.

#### **14. Historic Properties**

- a. For all SV and PCN applications, permittees shall follow the guidance set forth in Appendix A, Guidance for NHPA Section 106 Compliance in Massachusetts.
- b. No undertaking authorized by these GPs shall cause effects<sup>1</sup> (defined in 36 CFR Part 800 and 33 CFR Part 325, Appendix C, and its Interim Guidance) on properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places (NRHP)<sup>2</sup>, including previously unknown historic properties within the permit area, unless the USACE or another Federal action agency has satisfied the consultation requirements of Section 106 of the National Historic Preservation Act (Section 106). If another Federal agency is determined the lead federal agency for compliance with Section 106, applicant must obtain the appropriate documentation and provide this information to the USACE to demonstrate compliance with Section 106. The applicant shall not begin the activity until the USACE notifies them in writing that the documentation provided satisfies Section 106 requirements.

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<sup>1</sup> Effect means the alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the National Register of Historic Properties.

<sup>2</sup> See the NAE Regulatory website, National Register of Historic Places link here: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>.

- c. Many historic properties are not listed on the NRHP and may require identification and evaluation by qualified historic preservation and/or archaeological consultants. The State Historic Preservation Officer (SHPO), Massachusetts Board of Underwater Archaeological Resources (BUAR), local historical societies, certified local governments, general public, and NRHP may also be able to assist with locating information on:
- i. Previously identified historic properties; and
  - ii. Areas with potential for the presence of historic properties.
- d. Discovery of Previously Unknown Remains and Artifacts: If any previously unidentified human remains, cultural deposits, or artifacts are discovered while accomplishing the activity authorized by this permit, you must immediately notify the USACE of what you have found, and to the maximum extent practicable, cease work and avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The USACE will initiate the Federal, State and tribal coordination required to determine if the items or remains warrant a recovery effort and/or if the site is eligible for listing in the National Register of Historic Places.
- e. Section 110k: Prospective permittees should be aware that section 110k of the NHPA (54 U.S.C. § 306113) prevents the USACE from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106, has intentionally significantly adversely effected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the USACE, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the USACE is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties effected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or effects historic properties on tribal lands or effects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.
- f. Underwater Archaeological Resources: Under Massachusetts General Law Ch. 6, s.'s 179-180, and Ch. 91, s. 63, the BUAR has statutory jurisdiction within state waters and is the sole trustee of the Commonwealth's underwater heritage, charged with the responsibility of encouraging the discovery and reporting, as well as the preservation and protection, of underwater archaeological resources. Underwater archaeological resources located within the waters of the Commonwealth of Massachusetts are property of the Commonwealth, which holds title to these resources and retains regulatory authority over their use. Under Massachusetts General Law, no person, organization or corporation may "remove, displace, damage, or destroy" any underwater archaeological resources located within the Commonwealth's submerged lands except through consultation with the BUAR and in conformity with the permits it issues. <https://www.mass.gov/orgs/board-of-underwater-archaeological-resources>.

#### **15. USACE Property and Federal Projects. (33 USC §408)**

- a. USACE projects and property can be found at: <https://www.nae.usace.army.mil/Missions/Civil-Works/>.
- b. In addition to any authorization under these GPs, prospective permittee shall contact the USACE Real Estate Division (<https://www.nae.usace.army.mil/Missions/Real-Estate-Division/>) at (978) 318-8585 for work occurring on or potentially affecting USACE properties and/or USACE-controlled easements. Work may not commence on USACE properties and/or USACE-controlled easements until they have received any required USACE real estate documents evidencing site-specific permission to work.
- c. Any proposed temporary or permanent occupation or alteration of a Federal project (including, but not limited to, a levee, dike, floodwall, channel, anchorage, breakwater, seawall, bulkhead, jetty, wharf, pier, or other work built or maintained but not necessarily owned by the United States),

is not eligible for SV and requires a PCN. This includes all proposed structures and work in, over, or under a USACE federal navigation project (FNP) or in the FNP's buffer zone. The buffer zone is an area that extends from the horizontal limits of the FNP to a distance of three times the FNP's authorized depth. The activity also requires review and approval by the USACE pursuant to 33 USC 408 (Section 408 Permission). The prospective permittee may reach out to the POCs located here: <https://www.nae.usace.army.mil/Missions/Section-408/>.

d. Any structure or work constructed in a FNP or its buffer zone shall be subject to removal at the owner's expense prior to any future USACE dredging or the performance of periodic hydrographic surveys.

e. Where a Section 408 permission is required, written verification for the PCN will not be issued prior to the decision on the Section 408 permission request.

## **16. Navigation**

a. No activity may cause more than a minimal adverse effect on navigation.

b. Any safety lights and signals prescribed by the U.S. Coast Guard, must be installed, and maintained at the permittee's expense on authorized facilities in navigable waters of the U.S.

c. There shall be no unreasonable interference with navigation by the existence or use of the activity authorized herein, and no attempt shall be made by the permittee to prevent the full and free use by the public of all navigable waters at or adjacent to the activity authorized herein.

d. The permittee understands and agrees that if future U.S. operations require the removal, relocation, or other alteration of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from USACE, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the U.S. No claim shall be made against the U.S. on account of any such removal or alteration.

**17. Permit/Authorization Letter On-Site.** For PCNs, the permittee shall ensure that a copy of these GPs and the accompanying authorization letter are at the work site (and the project office) whenever work is being performed, and that all personnel with operational control of the site ensure that all appropriate personnel performing work are fully aware of its terms and conditions. The entire permit authorization shall be made a part of any and all contracts and sub-contracts for work that affects areas of USACE jurisdiction at the site of the work authorized by these GPs. This shall be achieved by including the entire permit authorization in the specifications for work. The term "entire permit authorization" means these GPs, including GCs and the authorization letter (including its drawings, plans, appendices, special conditions, and other attachments), and any permit modifications. If the authorization letter is issued after the construction specifications, but before receipt of bids or quotes, the entire permit authorization shall be included as an addendum to the specifications. If the authorization letter is issued after receipt of bids or quotes, the entire permit authorization shall be included in the contract or sub-contract as a change order. Although the permittee may assign various aspects of the work to different contractors or sub-contractors, all contractors and sub-contractors shall be obligated by contract to comply with all environmental protection provisions contained within the entire authorization letter, and no contract or sub-contract shall require or allow unauthorized work in areas of USACE jurisdiction. For SVs, the permittee shall ensure that a complete and signed copy of the SVN is present on site during construction and is made available for review at any time by USACE and other Federal, State, & Local regulatory agencies. A complete and signed copy of the SVN must be submitted to USACE Regulatory within 30 days of initiating construction of the authorized activity, unless stated otherwise in the applicable GP.

**18. Storage of Seasonal Structures.** Coastal structures such as pier sections, floats, etc., that

are removed from the waterway for a portion of the year (often referred to as seasonal structures) shall be stored in an upland location, located above MHW and not in tidal wetlands. These seasonal structures may be stored on the fixed, pile-supported portion of the structure that is seaward of MHW. This is intended to prevent structures from being stored on the marsh substrate and the substrate seaward of MHW.

#### **19. Pile Driving and Pile Removal in Navigable Waters.**

- a. Derelict, degraded or abandoned piles and sheet piles in navigable waters of the U.S., except for those inside existing work footprints for piers, must be completely removed, cut and/or driven to 3 feet below the substrate to prevent interference with navigation, and existing creosote piles that are affected by project activities shall be completely removed if practicable. In areas of fine-grained substrates, piles must be removed by the direct, vibratory or clamshell pull method<sup>1</sup> to minimize sedimentation and turbidity impacts and prevent interference with navigation from cut piles. Removed piles shall be disposed of in an upland location landward of MHW or OHW and not in wetlands, tidal wetlands or mudflats.
- b. A PCN is required for the installation or removal of structures with jetting techniques.
- c. A PCN is required for the installation of >12 inch-diameter piles of any material type or steel piles of any size in tidal waters, unless they are installed in the dry. If piles are not installed in the dry:
  - i. Impact pile driving shall commence with an initial set of three strikes by the hammer at 40% energy, followed by a one-minute wait period, then two subsequent 3-strike sets at 40% energy, with one minute waiting periods, before initiating continuous impact driving.
  - ii. Vibratory pile driving shall be initiated for 15 seconds at reduced energy followed by a one-minute waiting period. This sequence of 15 seconds of reduced energy driving, one-minute waiting period shall be repeated two more times, followed immediately by pile-driving at full rate and energy.
  - iii. In addition to using a soft start at the beginning of the workday for pile driving as described in 19c(i-ii), a soft start must also be used at any time following a cessation of pile driving for a period of 30 minutes or longer.
- d. Bubble curtains may be used to reduce sound pressure levels during vibratory or impact hammer pile driving.

**20. Time-of-Year (TOY) Restrictions.** Activities that include in-water work must comply with the TOY Restrictions below to be SV eligible, otherwise a PCN is required. PCN submittals shall contain written justification for deviation from the TOY Restrictions. The term “in-water work” does not include conditions where the work site is “in-the-dry” (e.g., intertidal areas exposed at low tide). The term “in-the-dry” includes work contained within a cofferdam so long as the cofferdam is installed and subsequently removed outside the TOY Restriction. The TOY restrictions stated in Appendix B of the MA DMF Technical Report TR-47<sup>2</sup> can apply instead for activities in tidal waters if (1) TOYs are provided for a specific waterbody where the activity is proposed and (2) the TOYs are less restrictive than below. The activity must also not require a PCN elsewhere in this document to be SV eligible.

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<sup>1</sup> Direct Pull: Each piling is wrapped with a choker cable or chain that is attached at the top to a crane. The crane then pulls the piling directly upward, removing the piling from the sediment. Vibratory Pull: The vibratory hammer is a large mechanical device (5-16 tons) that is suspended from a crane by a cable. The vibrating hammer loosens the piling while the crane pulls up. Clamshell Pull: This can remove intact, broken or damaged pilings. The clamshell bucket is a hinged steel apparatus that operates like a set of steel jaws. The bucket is lowered from a crane and the jaws grasp the piling stub as the crane pulls up. The size of the clamshell bucket is minimized to reduce turbidity during piling removal.

<sup>2</sup> The MA DMF Technical Report TR-47: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>

## TOY Restriction (No work)

### Non-tidal Waters

Defer to TR-47

### Tidal Waters

January 15 – November 15

Alternate work windows proposed under a PCN will generally be coordinated with the USFWS and NMFS. Resulting written verifications may include species-specific work allowed windows.

**21. Heavy Equipment in Wetlands.** Operating heavy equipment (drill rigs, fixed cranes, etc.) within wetlands shall be minimized, and such equipment shall not be stored, maintained, or repaired in wetlands, to the maximum extent practicable. Where construction requires heavy equipment operation in wetlands, the equipment shall:

- i. Have low ground pressure (typically  $\leq 3$  psi);
- ii. Be placed on swamp/construction/timber mats (herein referred to as “construction mats” or “mats”) that are adequate to support the equipment in such a way as to minimize disturbance of wetland soil and vegetation. See GC 22 for information on the placement of construction mats; or
- iii. Be operated on adequately dry or frozen wetlands such that shear pressure does not cause subsidence of the wetlands immediately beneath the equipment and upheaval of adjacent wetlands. Construction mats are to be placed in the wetland from the upland or from equipment positioned on mats if working within a wetland. Dragging construction mats into position is prohibited. Other support structures that are capable of safely supporting equipment may be used with written USACE authorization.

## 22. Temporary Fill, Work & Construction Mats.

a. Construction mats in non-tidal waters: Temporary construction mats shall be in place  $\leq 1$  year and for one growing season or less to be SV eligible. A PCN is required if construction mats are in place  $> 1$  year or for more than one growing season. Construction mats can be placed in an area of any size in non-tidal waters. The activity may occur in segments to ensure the requirements for SV above are met, otherwise a PCN is required.

b. Construction mats in tidal waters: Temporary construction mats placed in an area  $< 5,000$  SF in tidal waters are SV eligible, provided those mats are in place  $\leq 6$  months. Temporary construction mats placed in an area  $\geq 5,000$  SF or in place  $> 6$  months in tidal waters require a PCN.

c. Management of construction mats: At a minimum, construction mats shall be managed in accordance with the following construction mat best management practices (BMPs):

1. Mats shall be in good condition to ensure proper installation, use, and removal.
2. As feasible, mats shall be placed in a location that will minimize the amount of mats needed for the wetland crossing(s).
3. Inspect mats prior to their re-use and remove any plant debris. Mats are to be thoroughly cleaned before re-use to prevent the spread of invasive plant species.
4. Impacts to wetland areas shall be minimized during installation, use, and removal of the mats.
5. Adequate erosion & sediment controls shall be installed at approaches to mats to promote a smooth transition to, and minimize sediment tracking onto, the mats.
6. In most cases, mats should be placed along the travel area so that the individual boards are resting perpendicular to the direction of traffic. No gaps should exist between mats. Place mats far enough on either side of the resource area to rest on firm ground.

d. A PCN is required for temporary fills in place  $> 2$  years. All temporary fills and disturbed soils shall be stabilized to prevent the material from eroding into waters of the U.S. where it is not authorized. Work shall include phased or staged development to ensure only areas under active development are exposed and to allow for stabilization practices as soon as practicable. Temporary fill must be placed in a manner that will prevent it from being eroded by expected high flows.

- e. Activities that require unconfined temporary fill and are authorized for discharge into waters of the U.S. shall consist of material that minimizes effects to water quality.
- f. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable when temporary structures, work, and discharges of dredged or fill material, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Materials shall be placed in a location and manner that does not adversely impact surface or subsurface water flow into or out of the wetland. Temporary fill authorized for discharge into wetlands shall be placed on geotextile fabric or other appropriate material laid on the pre-construction wetland grade where practicable to minimize impacts and to facilitate restoration to the original grade. Construction mats are excluded from this requirement.
- g. Construction debris and deteriorated materials shall not be located in waters of the U.S.
- h. Temporary fills, construction mats, and corduroy roads shall be entirely removed as soon as they are no longer needed to construct the authorized activity and the disturbed areas be restored to pre-construction contours and conditions.
- i. Construction equipment, such as temporary barges in tidal waters, shall provide clearance above the substrate to avoid grounding onto the substrate during all tides.

### **23. Restoration of Wetland Areas.**

- a. Upon completion of construction, all disturbed wetland areas shall be stabilized with a wetland seed mix or plant plugs containing only plant species native to New England, and be appropriate for site conditions, including salinity and frequency of inundation, and shall not contain any species listed in the "Invasive and Other Unacceptable Plant Species" Appendix K of the New England District "Compensatory Mitigation Standard Operating Procedures" found at <https://www.nae.usace.army.mil/Missions/Regulatory/Mitigation.aspx>.
- b. The introduction or spread of invasive plant species in disturbed areas shall be prevented and controlled. Equipment shall be thoroughly cleaned before and after project construction to prevent the spread of invasive species. This includes, but is not limited to, tire treads and construction mats.
- c. In areas of authorized temporary disturbance, if trees are cut in USACE jurisdiction, they shall be cut at or above ground level and not uprooted in order to prevent disruption of any kind to the wetland soil structure and to allow stump sprouts to revegetate the work area, unless otherwise authorized.
- d. Wetland areas where permanent disturbance is not authorized shall be restored to their original condition and elevation, which under no circumstances shall be higher than the pre-construction elevation. Original condition means careful protection and/or removal of existing soil and vegetation, and replacement back to the original location such that the original soil layering and vegetation schemes are approximately the same, unless otherwise authorized.

### **24. Bank Stabilization.**

- a. Projects involving construction or reconstruction/maintenance of bank stabilization within USACE jurisdiction shall be designed to minimize environmental effects, effects to neighboring properties, scour, conversion of natural shoreline to hard armoring, etc. to the maximum extent practicable.
- b. Projects involving the construction of new bank stabilization within USACE jurisdiction shall use bioengineering techniques and natural materials in the project design to the maximum extent practicable. Use of hard structures shall be eliminated or minimized unless the prospective permittee can demonstrate that use of bioengineering techniques is not practicable due to site conditions.
- c. Where possible, bank stabilization projects shall optimize the natural function of the shoreline, including self-sustaining stability to attenuate flood flows, fishery, wildlife habitat and water quality protection, while protecting upland infrastructure from storm events that can cause erosion as well as impacts to public and private property.
- d. No material shall be placed in excess of the minimum needed for erosion protection.
- e. No material shall be placed in a manner that will be eroded by normal or expected high flows (properly anchored native trees and treetops may be used in low energy areas).

- f. Native plants appropriate for current site conditions, including salinity, must be used for bioengineering or vegetative bank stabilization.
- g. The activity must be properly maintained, which may require repairing it after severe storms or erosion events.

## **25. Soil Erosion and Sediment Controls.**

- a. Appropriate soil erosion and sediment controls<sup>1</sup> (hereinafter referred to as “controls”) must be installed prior to earth disturbance and maintained in effective operating condition during construction. Biodegradable wildlife friendly erosion controls should be used whenever practicable to minimize effects to water quality.
- b. Activities in streams (rivers, streams, brooks, etc.) and tidal waters that are capable of producing sedimentation or turbidity should be done during periods of low-flow or no-flow, when the stream or tide is waterward of the work area. Controls may also be used to obtain dry work conditions (e.g., coffer dam, turbidity curtain). The prospective permittee must demonstrate in the project plans where the controls are proposed and how these controls would avoid and/or minimize turbidity or sedimentation.
- c. A PCN is required for controls that encroach: i) >25% of the stream width measured from OHW in non-tidal diadromous streams from March 15 to June 30; or ii) >25% of the waterway width measured from MHW in tidal waters from Feb. 1 to June 30, or >50% of the waterway width measured from MHW in tidal waters from July 1 to Jan. 14. This is to protect upstream fish passage. Proponents must also maintain downstream fish passage throughout the project.
- d. No dewatering shall occur with direct discharge to waters or wetlands. Excess water in isolated work areas shall be pumped or directed to a sedimentation basin, tank or other dewatering structures in an upland area adequately separated from waters or wetlands. Suspended solids shall be removed prior to discharge back into waters or wetlands from these dewatering structures. All discharge points back into waters and wetlands shall use appropriate energy dissipaters and erosion and sedimentation control BMPs.
- e. Temporary controls shall be removed upon completion of work, but not until all exposed soil and other fills, as well as any work waterward of OHW or the HTL, are permanently stabilized at the earliest practicable date. Sediment and debris collected by these devices shall be removed and placed at an upland location in a manner that will prevent its later erosion into a waterway or wetland. Controls may be left in place if they are biodegradable and flows and aquatic life movements are not disrupted.

## **26. Aquatic Life Movements and Management of Water Flows.**

- a. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity’s primary purpose is to impound water. All permanent and temporary crossings of waterbodies and wetlands shall be:
  - i. Suitably spanned, bridged, culverted, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species; and
  - ii. Properly aligned and constructed to prevent bank erosion or streambed scour both adjacent to and inside the crossing.

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<sup>1</sup> Appropriate soil erosion, sediment and turbidity controls include cofferdams, bypass pumping around barriers immediately up and downstream of the work footprint (i.e., dam and pump), installation of sediment control barriers (i.e., silt fence, vegetated filter strips, geotextile silt fences, filter tubes, erosion control mixes, hay bales or other devices) downhill of all exposed areas, stream fords, retention of existing vegetated buffers, application of temporary mulching during construction, phased construction, and permanent seeding and stabilization, etc.

- b. To avoid adverse impacts on aquatic organisms, the low flow channel/thalweg shall remain unobstructed during periods of low flow, except when necessary to perform the authorized work.
- c. For work in tidal waters, in-stream controls (e.g., cofferdams) should be installed in such a way as to not obstruct fish passage.
- d. Riprap and other stream bed materials shall be installed in a manner that avoids organism entrapment in rock voids or water displaced to subterranean flow with crushed stone and riprap.
- e. To the maximum extent practicable, the preconstruction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization, storm water management activities, and temporary and permanent road crossings, except as provided below. The activity must be constructed to withstand expected high flows. The activity shall not restrict or impede the passage of normal or high flows unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

### **27. Spawning, Breeding, and Migratory Areas.**

- a. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized under these GPs.
- b. Activities in waters of the U.S. that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.
- c. The applicant is responsible for obtaining any “take” permits required under the USFWS’s regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The applicant should contact the appropriate local office of the USFWS to determine if such “take” permits are required for a particular activity.
- d. Information on spawning habitat for species managed under the Magnuson-Stevens Fishery Conservation and Management Act (i.e., EFH for spawning adults) can be obtained from NAE Regulatory website, Essential Fish Habitat section, at: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>.
- e. Information regarding diadromous fish habitat can be obtained from the following DMF website at: <https://www.mass.gov/info-details/massgis-data-diadromous-fish>.

### **28. Vernal Pools.**

- a. A PCN is required if a discharge of dredged or fill material is proposed within a vernal pool depression that is also a water of the U.S.
- b. Vernal pools must be identified on the plans that show aquatic resource delineations.
- c. Adverse impacts to vernal pools shall be avoided & minimized to the maximum extent practicable.

### **29. Invasive Species.**

- a. The introduction, spread or the increased risk of invasion of invasive plant or animal species on the project site, into new or disturbed areas, or areas adjacent to the project site caused by the site work shall be avoided. Construction mats shall be thoroughly cleaned before reuse to avoid spread of invasive species.
- b. Unless otherwise directed by USACE, all applications for PCN non-tidal projects proposing fill in USACE jurisdiction shall include an Invasive Species Control Plan. Additional information can be found at: <https://www.nae.usace.army.mil/Missions/Regulatory/Invasive-Species/>, <https://www.nae.usace.army.mil/Missions/Regulatory/Mitigation/>.

**30. Fills Within 100-Year Floodplains.** The activity shall comply with applicable Federal Emergency Management Agency (FEMA) approved, Massachusetts Emergency Management

Agency (MEMA) approved and/or local floodplain management requirements. Applicants should contact FEMA and/or MEMA regarding floodplain management requirements.

### **31. Stream Work and Crossings & Wetland Crossings.**

- a. When feasible, all temporary and permanent crossings of waterbodies and wetlands (hereinafter referred to as “crossings”) shall conform to the “Massachusetts River and Stream Crossing Standards” located at: <https://www.mass.gov/doc/massachusetts-river-and-stream-crossing-standards/download> or <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>. Projects that do not conform to these guidelines shall be reviewed under PCN or IP procedures.
- b. Crossings shall be suitably culverted, bridged, or otherwise designed to withstand and to prevent the restriction of high flows, to maintain existing low flows, maintain water quality, and not obstruct the movement of aquatic life indigenous to the waterbody beyond the duration of construction.
- c. Crossings shall be installed in such a manner as to preserve hydraulic capacity and flow, sediment transport, and organism passage at its present level, between the wetlands on either side of the road. The applicant shall take necessary measures to correct any wetland damage resulting from deficiencies in hydraulic capacity, sediment transport and organism passage.
- d. Stream crossings shall utilize a natural mixed grain-size streambed material composition that matches upstream and downstream substrates to create a stable streambed. Substrate should function appropriately during normal and high flows without washing out. If natural streambed material is not utilized, a PCN is required.
- e. Activities involving open trench excavation in flowing waters require a PCN. Work should not occur in flowing waters (requires using management techniques such as temporary flume pipes, culverts, cofferdams, etc.). Normal flows should be maintained within the stream boundary’s confines when practicable. Projects utilizing these management techniques must meet all applicable terms and conditions of the GP, including the GCs in Section IV.

### **32. Utility Line Installation and Removal**

- a. Subsurface utility lines must be installed at a sufficient depth to avoid damage from anchors, dredging, etc., and to prevent exposure from erosion and stream adjustment.
- b. When utility lines are installed via horizontal directional drilling, a frac-out contingency plan shall be present on site for the duration of construction. As necessary, the applicant shall immediately contain, control, recover, and remove drilling fluids released into the environment.
- c. Abandoned or inactive utility lines must be removed and faulty lines (e.g., leaking hazardous substances, petroleum products, etc.) must be removed or repaired. A written verification from the USACE is required if they are to remain in place, e.g., to protect sensitive areas or ensure safety.
- d. Utility lines shall not adversely alter existing hydrology, and trenches cannot be constructed or backfilled in such a manner as to drain waters of the U.S. (e.g., backfilling with extensive gravel layers, creating a French drain effect). In wetland areas, structures such as ditch plugs, cut-off walls, clay blocks, bentonite, or other suitable material shall be used within utility trenches to ensure that the trench through which the utility line is installed does not drain waters of the U.S. including wetlands.
- e. Stockpiling of tree debris, to the extent where it has the effect of fill material, shall not occur in waters of the U.S. Tree debris shall be removed from waters of the U.S. and placed in uplands without causing additional disturbance to aquatic resources. Failure to meet this condition could change the bottom elevation of the wetland and be considered a discharge of fill material, and depending on the area of alteration, may require a PCN or IP.

**33. Water Supply Intakes.** No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

**34. Coral Reefs.** Impacts to coral reefs are not authorized under these GPs. Coral reefs consist of the skeletal deposit, usually of calcareous or siliceous materials, produced by the vital activities of anthozoan polyps or other invertebrate organisms present in growing portions of the reef.

**35. Blasting.** Blasting in waters of the U.S. associated with work such as dredging, trenching, pile installation, etc. is not authorized under these GPs.

**36. Inspections.** The permittee shall allow USACE to make periodic inspections at any time deemed necessary to ensure that the work is being or has been performed in accordance with the terms and conditions of this permit. To facilitate these inspections, for activities requiring a PCN, the permittee shall complete and return the Certificate of Compliance when it is provided with a PCN verification letter. For SV-eligible activities, the permittee shall complete and submit the SVN to USACE within 30 days of initiating project construction, at which point, USACE may opt to inspect the activity to verify compliance with the terms and conditions of the GP. Post-construction engineering drawings may be required by USACE for completed work. This includes post-dredging survey drawings for any dredging work.

**37. Maintenance.** The permittee shall maintain the activity authorized by these GPs in good condition and in conformance with the terms and conditions of this permit. Some maintenance activities may not be subject to federal regulation under Section 404 in accordance with 33 CFR 323.4(a)(2). This condition is not applicable to maintenance of dredging projects. Prospective permittees should contact USACE to inquire about maintenance of dredging projects, and its eligibility under these GPs. Maintenance dredging is subject to the review thresholds in GP #7 as well as any conditions included in a written USACE authorization. Maintenance dredging includes only those areas and depths previously authorized and dredged.

**38. Property Rights.** Per 33 CFR 320.4(g)(6), these GPs do not convey any property rights, either in real estate or material, or any exclusive privileges, nor do they authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws or regulations.

**39. Transfer of GP Verifications.** When the work authorized by these GPs is still in existence at the time the property is transferred, the terms and conditions of these GPs, including any special conditions, will continue to be binding on the entity or individual who received the GP authorizations, as well as the new owner(s) of the property. If the permittee sells the property associated with a GP authorization, the applicant may transfer the GP authorization to the new owner by submitting a letter to USACE to validate the transfer. A copy of the GP authorization letter must be attached to the letter, and the letter must include the following statement: "The terms and conditions of these general permits, including any special conditions, will continue to be binding on the new owner(s) of the property." This letter shall be signed by both the seller and new property owner(s).

**40. Modification, Suspension, and Revocation.** These GPs and any individual authorization issued thereof may be either modified, suspended, or revoked in whole or in part pursuant to the policies and procedures of 33 CFR 325.7; and any such action shall not be the basis for any claim for damages against the U.S.

**41. Special Conditions.** The USACE may impose other special conditions on a project authorized pursuant to these GPs that are determined necessary to minimize adverse navigational and/or environmental effects or based on any other factor of the public interest. Failure to comply with all conditions of the authorization, including special conditions, constitutes a permit violation and may subject the applicant to criminal, civil, or administrative penalties or restoration.

**42. False or Incomplete Information.** If USACE makes a determination regarding the eligibility of a project under these GPs, and subsequently discovers that it has relied on false, incomplete, or inaccurate information provided by the applicant, the authorization will not be valid, and the U.S. Government may institute appropriate legal proceedings.

**43. Abandonment.** If the permittee decides to abandon the activity authorized under these GPs, unless such abandonment is merely the transfer of property to a third party, he/she/they may be required to restore the area to the satisfaction of USACE.

**44. Enforcement cases.** These GPs do not apply to any existing or proposed activity in USACE jurisdiction associated with an on-going USACE or EPA enforcement action, until such time as the enforcement action is resolved or USACE or EPA determines that the activity may proceed independently without compromising the enforcement action.

**45. Previously Authorized Activities.**

- a. Completed projects that received prior authorization from USACE (SV or PCN), shall remain authorized in accordance with the original terms and conditions of those authorizations, including their terms, GCs, and any special conditions provided in a written verification.
- b. Activities authorized pursuant to 33 CFR 330.3 (activities occurring before certain dates) are not affected by these GPs.

**46. Duration of Authorization.**

These GPs expire on June 1, 2028. Activities authorized under these GPs will remain authorized until the GPs expire, unless discretionary authority has been exercised on a case-by-case basis to modify, suspend, or revoke the authorization in accordance with 33 CFR 325.2(e)(2). Activities authorized under GPs 1-25 that have either commenced (i.e., are under construction) or are under contract to commence in reliance upon this authorization will have until June 1, 2029 to complete the work. If requested by USACE, the permittee shall furnish documentation that demonstrates the project was under construction or under contract to commence by June 1, 2028. If work is not completed before June 1, 2029, the permittee must contact USACE. The USACE may issue a new authorization provided the project meets the terms and conditions of the MA GPs in effect at the time. Activities completed under the SV or PCN authorizations of these GPs will continue to be authorized after their expiration date.

## **SECTION V: MITIGATION STANDARDS**

### **1. Mitigation Types**

For all activities, applicants must (a) demonstrate how the project has been designed to avoid or minimize impacts to aquatic resources; and (b) describe measures taken to avoid or minimize impacts to aquatic resources through construction techniques and/or site access. Please see <https://www.nae.usace.army.mil/Missions/Regulatory/Mitigation/> for assistance with preparing mitigation in accordance with the 2008 Compensatory Mitigation for Losses of Aquatic Resources; Final Rule (33 CFR 332.3), hereafter referred to as “2008 Mitigation Rule.”

Avoidance - Avoidance of impacts (direct and indirect) to aquatic resources means that project activities would not result in the placement of fill material or installation of a structure that could impact the resource area. Avoidance can include, but is not limited to, designing the project to avoid impacts to all or a portion of the aquatic resource areas.

Minimization - Minimization of impacts (direct and indirect) to aquatic resources means that measures are taken to ensure the amount and duration of impacts are limited to the maximum extent practicable. There are many minimization measures that could be implemented, prior to, during, or after the proposed activity, to ensure impacts are minimized. Examples include, but are not limited to:

- Permanent preservation of avoided aquatic features and buffer zone, in perpetuity. In these cases, the preserved area would be under a conservation easement and managed by conservation oriented third-party manager.
- Utilization of best management practices (BMPs) to ensure impacts are limited, and do not result in adverse impacts to the integrity and long-term functions of preserved/avoided features.

Compensatory Mitigation - Compensatory mitigation is generally required for PCN activities in which the impacts to the aquatic resources have been avoided and minimized to the maximum extent practicable but would still result in unavoidable adverse effects to the environment that are considered more than minimal or are contrary to the public interest. *Whatever the case may be, compensatory mitigation is no substitute for avoidance and minimization.*

### **2. Thresholds for Compensatory Mitigation**

The basic objective of compensatory mitigation in the USACE Regulatory Program is to offset environmental losses resulting from unavoidable impacts to waters of the U.S. authorized by Department of the Army permits. **The following compensatory mitigation thresholds apply to all PCN activities that result in loss<sup>1</sup> of the resource area types listed below. Activities<sup>2</sup> in waters of the U.S. associated with the restoration, enhancement, and establishment of tidal and non-tidal aquatic resources are not considered loss and are not subject to the thresholds below.** Thresholds for different resource areas may not be combined to exceed 5,000 SF of total loss of all waters. The USACE will continue to evaluate projects on a case-by-case basis, and may in some cases require compensatory mitigation below these thresholds (e.g. minor impacts that add to a cumulative loss).

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<sup>1</sup> See definition of loss in Section VII.

<sup>2</sup> These activities must result in net increases in aquatic resource functions and services to be exempted from the thresholds above.

Compensatory Mitigation Thresholds in Massachusetts		
Resource Area	Non-Tidal Threshold	Tidal Threshold
Stream	200 LF	200 LF
Bank Stabilization	500 LF	500 LF
Open Water	Project Dependent	Project Dependent
Wetland	5,000 SF	500 SF
Vernal Pool	All	N/A
SAV	Project dependent	25 SF
Mudflat	N/A	1,000 SF
Intertidal	N/A	1,000 SF

These thresholds can be utilized to determine at what point compensatory mitigation is required but are not used to determine how much mitigation may be needed to offset impacts to resources. Per the 2008 Mitigation Rule (33 CFR 332.3(f)(1)) “the amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions. In cases where appropriate functional or condition assessment methods or other suitable metrics are available, these methods should be used where practicable to determine how much compensatory mitigation is required. If a functional or condition assessment or other suitable metric is not used, a minimum one-to-one acreage or linear foot compensation ratios must be used.”

### 3. Compensatory Mitigation Hierarchy

Compensatory mitigation should follow the hierarchy as outlined in 33 CFR 332.3(b)(2-6) or current regulation. This hierarchy in order of preference includes: (1) Mitigation Bank credits, (2) In-Lieu Fee program credits, (3) permittee-responsible mitigation under a watershed approach, (4) permittee-responsible mitigation through on-site and in-kind mitigation, and (5) permittee-responsible mitigation through off-site and/or out-of-kind mitigation. If the proposed mitigation deviates from this mitigation hierarchy, the applicant **must** justify in writing why the proposed mitigation is environmentally preferable to the preferred method of compensatory mitigation (See 2008 Mitigation Rule). **In order for your application to be considered complete, you must provide a statement that discusses how your project will compensate for the loss or impact to aquatic resources.** If you are proposing permittee responsible mitigation, the 12 components of a mitigation plan (33 CFR 332.4(c)(2-14) must be addressed for your application to be considered complete. Prospective applicants are encouraged to contact USACE with questions at any time. Addressing the 12 components of a mitigation plan is commensurate with the amount of compensatory mitigation required, and USACE can assist prospective applicants with the level of information needed to satisfy each component.

For activities resulting in the loss of marine or estuarine resources, permittee-responsible mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee.

### 4. In-Lieu Fee (ILF)

The purchase of credits from the Massachusetts In-Lieu Fee Program (MA ILFP) is the **preferred** method of compensatory mitigation in Massachusetts since, as of the issuance date of this GP, there are no mitigation banks available in Massachusetts. The applicant shall develop a mitigation plan that addresses the baseline conditions at the impact site and the number of credits to be provided (see 33 CFR 332.4(c)(1)(ii)).

The MA ILFP is administered by the Massachusetts Department of Fish & Game (DFG) in accordance with the 2008 Mitigation Rule at 33 CFR 332. The Mitigation Rule governs in-lieu fee compensatory mitigation associated with USACE permits under §404 of the Clean Water Act and/or §9 or §10 of the Rivers and Harbors Act of 1899.

MA ILFP Website: <https://www.mass.gov/in-lieu-fee-program>

Acceptance of an ILF payment into the ILFP established by the 2014 MA ILFP Instrument (link below) is an acknowledgement by DFG that it assumes all legal responsibility for satisfying the mitigation requirements of the USACE (i.e., the implementation, performance, and long-term management and monitoring of the compensatory mitigation project(s) approved under this Instrument and subsequent Compensatory Mitigation Plans). This transfer of legal responsibility is established by: 1) the approval of this In-Lieu Fee Instrument; 2) receipt by the district engineer of a Notice of Credit Sale and Transfer of Legal Responsibility to DFG that is signed by the DFG and the permittee and dated; and 3) the transfer of fees from the permittee to DFG.

MA ILFP Fact Sheet: <https://www.mass.gov/files/documents/2017/01/sj/ilfp-fact-sheet-ma-ilfp-fees.pdf>

MA ILFP Instrument: <https://www.mass.gov/files/documents/2016/08/nd/ilfp-final-instrument-dfg.pdf>

## **5. Permittee-Responsible**

The USACE may determine that the proposed permittee-responsible compensatory mitigation is appropriate on a case-by-case basis. As described in the Compensatory Mitigation Hierarchy section above, applicants must justify in writing why the proposed mitigation is environmentally preferable to the purchase of ILF credits. Applicants are encouraged to contact the USACE prior to submission of a permit application to seek further guidance regarding USACE mitigation requirements.

Applicants will demonstrate their proposed compensatory mitigation in writing by addressing the 12 components of a mitigation plan (33 CFR 332.4(c)(2-14). *Please note that all elements must be addressed, or the permit application will be deemed incomplete.* In certain circumstances, the district engineer may determine that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). Guidance on how to address these components can be found on the New England District Mitigation webpage: <https://www.nae.usace.army.mil/Missions/Regulatory/Mitigation/>

Performance standards will be used to measure the successfulness of the mitigation project. A successful mitigation project is one that is self-sustaining. For a mitigation project that will restore, enhance, or create wetlands, proper performance standards must address hydrology, hydric soils, and hydrophytic vegetation. The mitigation proposal must include an explanation of quantitative methods used to measure the success of performance standards (i.e., percent cover may be measured using vegetation plots, hydrology may be measured using data loggers, soil cores may be taken and evaluated for hydric soil indicators).

Monitoring methods should include quantitative sampling methods following established, scientific protocols. Sampling documentation, as part of monitoring reports, should include maps and coordinates (also shapefiles, if available) showing locations of sampling points, transects, quadrats, etc. In addition, permanent photo stations should be established coincident with sampling locations.

## SECTION VI: FEDERAL & STATE AGENCY CONTACT INFORMATION & ORGANIZATIONAL WEBSITES

### Federal Agencies

U.S. Army Corps of Engineers  
Regulatory Division  
696 Virginia Road  
Concord, Massachusetts 01742-2751  
(978) 318-8338 (phone); (978) 318-8303 (fax)  
[www.nae.usace.army.mil/missions/regulatory](http://www.nae.usace.army.mil/missions/regulatory)

National Marine Fisheries Service  
55 Great Republic Drive  
Gloucester, Massachusetts 01930  
(978) 281-9300 (phone)  
(*Federal endangered species & EFH*)

National Park Service  
15 State Street  
Boston, Massachusetts 02109  
(617) 223-5191 (phone)  
(*Wild and Scenic Rivers*)

Chief, Risk Analysis Branch  
FEMA Region 1  
99 High Street, 6th Floor  
U.S. Department of Homeland Security  
Boston, Massachusetts 02110  
(617) 956-7576 (phone)

U.S. Environmental Protection Agency  
5 Post Office Square  
Suite 100 (OEP06-3)  
Boston, Massachusetts 02109-3912  
(617) 918-1692 (phone)

U.S. Army Corps of Engineers  
Navigation Division – Section 408  
696 Virginia Road  
Concord, Massachusetts 01742-2751  
*See link below for contact information:*  
<https://www.nae.usace.army.mil/Missions/Section-408/>

U.S. Fish & Wildlife Service  
70 Commercial Street, Suite 300  
Concord, New Hampshire 03301  
(603) 223-2541 (phone)  
(*Federal endangered species*)

Bureau of Ocean and Energy Management  
1849 C Street, NW  
Washington D.C. 20240  
202-208-6474 (phone)  
(*Offshore Wind Facilities*)

Commander (dpb)  
First Coast Guard District  
Battery Building  
One South Street  
New York, New York 10004-1466  
(212) 514-4331 (phone); (212) 514-4337 (fax)  
(*Bridge permits*)

## State Agencies in Massachusetts

<u>Massachusetts Department of Environmental Protection (MassDEP)</u>	
<u>DEP Division of Wetlands &amp; Waterways</u>	100 Cambridge Street, Suite 900 Boston, Massachusetts 02114 (617) 292-5695
<u>Northeast Region</u>	150 Presidential Way, Suite 300 Woburn, Massachusetts 01801 (978) 694-3200
<u>Southeast Region</u>	20 Riverside Drive, Route 105 Lakeville, Massachusetts 02347 (508) 946-2800
<u>Central Region</u>	8 New Bond Street Worcester, Massachusetts 01606 (508) 792-7650
<u>Western Region</u>	436 Dwight Street Springfield, Massachusetts 01103 (413) 784-1100

<u>Massachusetts Office of Coastal Zone Management (CZM)</u>	
Emails may be sent to: <a href="mailto:czm@mass.gov">czm@mass.gov</a>	
<u>MA Office of Coastal Zone Management</u>	100 Cambridge Street, Suite 900 Boston, Massachusetts 02114 (617) 626-1200
<u>North Shore Region</u>	2 State Fish Pier Gloucester, Massachusetts 01930 (978) 281-3972
<u>South Shore Region</u>	175 Edward Foster Road Scituate, Massachusetts 02066
<u>Cape Cod and Islands Region</u>	3195 Main Street, P.O. Box 220 Barnstable, MA 02630
<u>South Coastal Region</u>	81-B County Road, Suite E Mattapoisett, MA 02739

<u>Massachusetts Historical Commission (MHC)</u>	
Office Location:	220 Morrissey Boulevard Boston, Massachusetts 02125 (617) 727-8470

<u>Massachusetts Board of Underwater Archaeological Resources (BUAR)</u>	
Emails may be sent to: <a href="mailto:david.s.robinson@mass.gov">david.s.robinson@mass.gov</a>	
Office Location:	100 Cambridge Street, Suite 900 Boston, Massachusetts 02114 (617) 626-1014

## **SECTION VII: Definitions & Acronyms**

**Artificial or Living Reef:** A structure which is constructed or placed in waters for the purpose of enhancing fishery resources and commercial and recreational fishing opportunities.

**Attendant Features:** Occurring with or as a result of; accompanying.

**Biodegradable:** A material that decomposes into elements found in nature within a reasonably short period of time and will not leave a residue of plastic or a petroleum derivative in the environment after degradation. In contrast, degradable plastics break down into plastic fragments that remain in the environment after degradation. Examples of biodegradable materials include jute, sisal, cotton, straw, burlap, coconut husk fiber (coir) or excelsior. In contrast, degradable plastics break down into plastic fragments that remain in the environment after degradation. Photodegradable, UV degradable or Oxo-(bio)degradable plastics are not considered biodegradable under this GP.

**Boating facilities:** These provide, rent or sell mooring space, such as marinas, yacht clubs, boat yards, dockminiums, municipal facilities, land/home owners, etc. Not classified as boating facilities are piers shared between two abutting properties or municipal mooring fields that charge an equitable user fee based on the actual costs incurred.

**Compensatory mitigation:** The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved. Must comply with the applicable provisions of 33 CFR 332. See also the New England District Compensatory Mitigation Guidance at <http://www.nae.usace.army.mil/Missions/Regulatory/Mitigation.aspx>.

**Construction mats:** Constructions, swamp and timber mats (herein referred to as “construction mats”) are generic terms used to describe structures that distribute equipment weight to prevent wetland damage while facilitating passage and providing work platforms for workers and equipment. They are comprised of sheets or mats made from a variety of materials in various sizes. A timber mat consists of large timbers bolted or cabled together. Corduroy roads, which are not considered to be construction mats, are cut trees and/or saplings with the crowns and branches removed, and the trunks lined up next to one another. Corduroy roads are typically installed as permanent structures. Like construction mats, they are considered as fill whether they are installed temporarily or permanently.

**Cumulative Impacts:** The impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.1). Although the impact of a particular discharge may constitute a minor change in itself, the cumulative effect of numerous such piecemeal changes can result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems. See 40 CFR 230.11(g).

**Currently serviceable:** Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

### **Dredging:**

***Improvement Dredging:*** For the purposes of these GPs, this is dredging deeper than previously authorized by the USACE and dredged under that authorization.

***Maintenance Dredging:*** For the purposes of these GPs, this is dredging from an area previously authorized by the USACE and dredged under that authorization. The USACE may require proof of authorization and dredging. Maintenance dredging typically refers to the routine removal of accumulated sediment to maintain the design depths of serviceable navigation channels, harbors, marinas, boat launches and port facilities. Maintenance dredging is conducted for navigational purposes and does not include any expansion of the previously dredged area. The USACE may

review a maintenance dredging activity as new dredging if sufficient time has elapsed to allow for the colonization of SAS, shellfish, etc.

**New Dredging:** For the purposes of these GPs, this is a) first time the USACE authorizes dredging of a particular location or b) dredging has not occurred for an extended period of time, and this has allowed for aquatic resources (i.e., eelgrass, shellfish, etc.) to redevelop in the area.

**Dredged material & discharge of dredged material:** These are defined at 33 CFR 323.2(c) and (d). The term dredged material means material that is excavated or dredged from waters of the U.S.

**Enhancement:** The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s) but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

**Ephemeral stream:** A stream with flowing water only during, and for a short duration, after precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

**Erosion Controls:** Appropriate soil erosion, sediment and turbidity controls include cofferdams, bypass pumping around barriers immediately up and downstream of the work footprint (i.e., dam and pump), installation of sediment control barriers (i.e., silt fence, vegetated filter strips, geotextile silt fences, filter tubes, erosion control mixes, hay bales or other devices) downhill of all exposed areas, stream fords, retention of existing vegetated buffers, application of temporary mulching during construction, phased construction, and permanent seeding and stabilization, etc.

**Establishment (creation):** The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area (33 CFR 332.2).

**Expansions:** Work that increases the footprint of fill, structures, depth of basin or drainage features, or floats, or slip capacity.

**Essential Fish Habitat (EFH):** The Federal Magnuson-Stevens Fishery Management and Conservation Act broadly defines EFH to include those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. See

[www.greateratlantic.fisheries.noaa.gov/habitat](http://www.greateratlantic.fisheries.noaa.gov/habitat) for more information.

**Fill material & discharge of fill material:** Material placed in waters of the U.S. where the material has the effect of either replacing any portion of a water of the U.S. with dry land or changing the bottom elevation of any portion of a water of the U.S. Fill material does not include any pollutant discharged into the water primarily to dispose of waste. These are defined at 33 CFR 323.2 (e) & (f).

**Federal navigation projects (FNPs):** These areas are maintained by the USACE; authorized, constructed and maintained on the premise that they will be accessible and available to all on equal terms; and comprised of USACE Federal anchorages, Federal channels and Federal turning basins. The buffer zone is equal to three times the authorized depth of a FNP. The following are FNPs in MA and more information, including the limits, is provided at

[www.nae.usace.army.mil/missions/navigation](http://www.nae.usace.army.mil/missions/navigation) >> Navigation Projects:

Andrews River, Harwich, MA	Cross Rip Shoals, Nantucket	Gloucester Harbor and
Aunt Lydia's Cove	Sound	Annisquam River
Beverly Harbor	Cuttyhunk Harbor	Green Harbor
Boston Harbor	Dorchester Bay and Neponset	Hingham Harbor
Buttermilk Bay Channel	River	Hyannis Harbor
Canapitsit Channel	Duxbury Harbor	Ipswich River
Cape Cod Canal	Edgartown Harbor	Island End River (Chelsea, MA)
Chatham Harbor	Essex River	Kingston Harbor
Cohasset Harbor	Fall River Harbor	Lagoon Pond
	Falmouth Harbor	Little Harbor Woods Hole

Lynn Harbor  
Malden River  
Menemsha Creek  
Merrimack River  
Mystic River  
Nantucket Harbor of Refuge  
New Bedford and Fairhaven Harbor  
Newburyport Harbor  
Oak Bluffs Harbor  
Pigeon Cove Harbor

Plymouth Harbor  
Pollock Rip Shoals, Nantucket Sound  
Provincetown Harbor  
Red Brook Harbor  
Rockport Harbor  
Salem Harbor  
Sandy Bay Harbor of Refuge  
Saugus River  
Scituate Harbor  
Sesuit Harbor

Taunton River  
Vineyard Haven Harbor  
Wareham Harbor  
Wellfleet Harbor  
Westport River and Harbor  
Weymouth Back River  
Weymouth Fore and Town Rivers  
Winthrop Harbor  
Woods Hole Channel

**Flume:** An open artificial water channel, in the form of a gravity chute, which leads water from a diversion dam or weir alongside a natural flow. A flume can be used to measure the rate of flow.

**FNP buffer zone:** The buffer zone of a USACE Federal Navigation Project (FNP) is equal to three times the authorized depth of the FNP.

**Frac out:** During horizontal directional drilling (HDD) operations, drilling fluid travels up the borehole into a pit. When the borehole becomes obstructed or the pressure becomes too great inside the borehole, the ground fractures and fluid escapes to the surface and may affect surface waters.

**Ground disturbance:** Any activity that compacts, relocates, overturns, removes, mixes, or otherwise disturbs the ground, including under water. Ground disturbance can be caused by the use of hand tools (shovels, pick axe, posthole digger, etc.), heavy equipment (excavators, backhoes, bulldozers, dredgers, trenching and earthmoving equipment, etc.), and heavy trucks (large four wheel drive trucks, dump trucks and tractor trailers, etc.). Trenching, bulldozing, dredging, excavating, scraping, and plowing are typical examples of ground disturbance activities.

**Height:width ratio:** The height of structures shall at all points be equal to or exceed the width of the deck. For the purpose of this definition, height shall be measured from the marsh substrate to the bottom of the longitudinal support beam.

**High Tide Line (HTL):** The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides 58 that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds. (33 CFR 328). Refer to the highest predicted tide for the current year at the nearest NOAA tide gage. <https://tidesandcurrents.noaa.gov/map/index.html>

**Historic Property:** Any prehistoric or historic site (including archaeological sites), district, building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

**Impacts:**

Direct Impacts: Effects that are caused by the activity and occur at the same time and place (40 CFR 1508.7).

Indirect impacts: Effects that are caused by the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.

Secondary impacts: Effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material.

Information about secondary effects on aquatic ecosystems shall be considered prior to the time final section 404 action is taken by permitting authorities. Some examples of secondary effects on an aquatic ecosystem are: aquatic areas drained, flooded, fragmented; fluctuating water levels in an impoundment and downstream associated with the operation of a dam; septic tank leaching and surface runoff from residential or commercial developments on fill; and leachate and runoff from a sanitary landfill located in waters of the U.S. See 40 CFR 230.11(h).

**Incidental Fallback:** Incidental fallback is the redeposit of small volumes of dredged material that is incidental to excavation activity in waters of the U.S. when such material falls back to substantially the same place as the initial removal (33 CFR 323.2(d)(2)(iii)).

**In the dry:** Work that is done under dry conditions, e.g., work behind cofferdams or when the stream or tide is waterward of the work.

**Independent utility:** A test to determine what constitutes a single and complete non-linear project in the USACE Regulatory Program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

**Individual permit:** A Department of the Army authorization that is issued following a case-by-case evaluation of a specific structure or work in accordance with the procedures of 33 CFR 322, or a specific project involving the proposed discharge(s) in accordance with the procedures of 33 CFR 323, and in accordance with the procedures of 33 CFR 325 and a determination that the proposed discharge is in the public interest pursuant to 33 CFR 320.

**Intermittent stream:** An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

**Intertidal:** The area in between mean low water and the high tide line.

**Living reef:** See the definition of “artificial or living reef.”

**Living shoreline:** A term used to describe a low-impact approach with a substantial biological component to shoreline protection and restoration along coastal shores, riparian zones, lacustrine fringe wetlands, or oyster or mussel reef structures. This approach integrates natural features to restore, enhance, maintain, or create habitat, functions, and processes while also functioning to mitigate flooding or shoreline erosion. Living shorelines may stabilize banks and shores with small fetch and gentle slopes that are subject to low-to mid-energy waves. A living shoreline has a footprint that is made up mostly of native material. It incorporates vegetation or other living, natural “soft” elements alone or in combination with some type of harder shoreline structure (e.g., oyster or mussel reefs or rock sills) for added protection and stability. Living shorelines should maintain the natural continuity of the land-water interface and retain or enhance shoreline ecological processes.

**Loss of waters of the United States:** Waters of the U.S. that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. The loss of stream bed includes the acres of stream bed that are permanently adversely affected by filling or excavation because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the U.S. is a threshold measurement of the impact to jurisdictional waters or wetlands for determining whether a project may qualify for a GP; it is not a net threshold that is calculated after considering compensatory mitigation that maybe used to offset losses of aquatic functions and services. Waters of the U.S. temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the U.S. Impacts resulting from activities that do not require Department of the Army authorization, such as activities eligible for exemptions under section 404(f) of the Clean Water Act, are not considered when calculating the loss of waters of the U.S.

**Maintenance:** The repair, rehabilitation, or in-kind replacement of any previously authorized, currently serviceable structure or fill, or of any currently serviceable structure or fill authorized by 33 CFR 330.3 – “Activities occurring before certain dates,” provided that the structure or fill is not to be put to uses differing from those uses specified or contemplated for it in the original permit or the most recently authorized modification. Maintenance includes minor deviations in the structure’s configuration or filled area, including those due to changes in materials, construction techniques, or current construction codes or safety standards that are necessary to make repair, rehabilitation, or replacement are authorized. Currently serviceable means useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

**Maintenance Exemption:** In accordance with 33 CFR 323.4(a)(2), any discharge of dredged or fill material that may result from any of the following activities is not prohibited by or otherwise subject to regulation under Section 404 of the CWA: “Maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, bridge abutments or approaches, and transportation structures. Maintenance does not include any modification that changes the character, scope, or size of the original fill design.”

**Mean high water:** Line on the shore reached by the plane of the average high water. Where precise determination of the actual location of the line becomes necessary, it must be established by survey with reference to the available tidal datum, preferably averaged over a period of 18.6 years. Less precise methods, such as observation of the “apparent shoreline” which is determined by reference to physical markings, lines of vegetation, or changes in type of vegetation, may be used only where an estimate is needed of the line reached by the mean high water.

**Mechanized land clearing:** Land clearing activities using mechanized equipment such as backhoes or bulldozers with shear blades, rakes or discs constitute point source discharges and are subject to section 404 jurisdiction when they take place in wetlands or waters of the U.S (Regulatory Guidance Letter 90-05).

**Metallic mineral:** Any ore or material to be excavated from the natural deposits on or in the earth for its metallic mineral content to be used for commercial or industrial purposes. “Metallic mineral” does not include thorium or uranium.

**Minor deviations:** Deviations in the structure’s configuration or filled area, including those due to changes in materials, construction techniques, or current construction codes or safety standards, which are necessary to make repair, rehabilitation, or replacement are permitted, provided the adverse environmental effects resulting from such repair, rehabilitation, or replacement are minimal.

**Natural Rocky Habitats:** Intertidal and subtidal substrates of pebble-gravel, cobble, boulder, or rock ledge and outcrops. Manufactured stone (e.g., cur or engineered riprap) is not considered a natural rocky habitat. Natural rocky habitats are either found as pavement (consolidated pebble-gravel, cobble, or boulder areas) or as a mixture with fines (i.e., clay and sand) and other substrates. Rocky habitats as EFH are defined as follows: (1) All pebble-gravel, cobble, or boulder pavements; (2) Pebble-gravel mixed with fines: mixed substrate of pebble-gravel and fines where pebble-gravel is an evident component of the substrate (either through visual observation or within sediment samples). Sediment samples with a content of 10% or more of pebble-gravel in the top layer (6-12 inches) should be delineated; (3) Scattered cobble, scattered boulder, scattered cobble/boulder: mixed substrate of cobble and/or boulder and other substrates. The aerial extent of cobbles and/or boulders should be delineated; and (4) All rock ledge outcrops: area should be delineated along the edge of the ledge/outcrop (as defined by NMFS Habitat and Ecosystems Services Branch, Gloucester, MA).

**Navigable waters or Navigable waters of the U.S.:** These waters are subject to section 10 of the Rivers and Harbors Act of 1899 and are defined as those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce (33 CFR Part 329). Work or structures in navigable

waters require permits pursuant to §9 and §10 of the Rivers and Harbors Act of 1899. Also see the definition of “waters of the U.S.” below.

Note: Currently the following non-tidal waters have been determined to be navigable waters of the U.S. subject to permit jurisdiction in Massachusetts: Merrimack River, Connecticut River, and Charles River to the Watertown Dam.

**Nearshore disposal:** This is defined in the USACE Coastal Engineering Manual as “(1) In beach terminology an indefinite zone extending seaward from the shoreline well beyond the breaker zone. (2) The zone which extends from the swash zone to the position marking the start of the offshore zone, typically at water depths of the order of 20m.” A nearshore berm is an artificial berm built in shallow water using dredged material. Often, the berm is intended to renourish the adjacent and downdrift shore over time under the influence of waves and currents.

**Non-regulated activity:** Only structures or fills that were previously authorized and are in compliance with the terms and condition of the original authorization can be maintained as a non-regulated activity under 33 CFR 323.4(a)(2). Minor deviations from the previously authorized footprint do not qualify as a non-regulated activity and require new authorization from the USACE. The state’s maintenance provisions may differ from the USACE and a project may require reporting and written authorization from the state.

**Non-tidal wetlands:** A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. Non-tidal wetlands contiguous to tidal waters are located landward of the HTL (*i.e.*, spring HTL). Also see the definition of “Waters of the U.S.” below.

**Oil or natural gas pipeline:** Any pipe or pipeline for the transportation of any form of oil or natural gas, including products derived from oil or natural gas, such as gasoline, jet fuel, diesel fuel, heating oil, petrochemical feedstocks, waxes, lubricating oils, and asphalt.

**Ordinary High Water Mark (OHWM):** A line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas. See 33 CFR 328.3(e).

**Overall project:** The overall project, for purposes of these GPs, includes all regulated activities that are reasonably related and necessary to accomplish the project purpose. Also see the definition of “single and complete linear project.”

**Perennial stream:** A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

**Practicable:** Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

**Permanent impacts:** Permanent impacts means waters of the U.S. that are permanently affected by filling, flooding, excavation, or drainage because of the regulated activity. Permanent impacts include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody.

**Preconstruction notification (PCN):** A request submitted by the applicant to the USACE for confirmation that a particular activity is authorized by these GPs. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Preconstruction notification may be required by the terms and conditions of these GPs. A PCN may be voluntarily submitted in cases where PCN is not required and the applicant wants confirmation that the activity is authorized under these GPs.

**Preservation:** The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions (33 CFR 332.2).

**Real estate subdivision:** Includes circumstances where a landowner or developer divides a tract of land into smaller parcels for the purpose of selling, conveying, transferring, leasing, or

developing said parcels. This would include the entire area of a residential, commercial or other real estate subdivision, including all parcels and parts thereof

**Reconfiguration zone:** A USACE authorized area in which permittees may rearrange pile-supported structures and floats without additional authorizations. A reconfiguration zone does not grant exclusive privileges to an area or an increase in structure or float area.

**Re-establishment:** The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/ historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in again in aquatic resource area and functions (33 CFR 332.2).

**Reference Site:** Reference sites - Compensatory restoration, rehabilitation, and creation mitigation projects should seek to duplicate the features of reference aquatic resources or enhance connectivity with adjacent natural upland and aquatic resource landscape elements. Performance standards related to reference sites are encouraged. Mitigation project sites must be selected based on their ability to be, and continue to be, resistant to disturbance from the surrounding landscape, by locating them adjacent to refuges, buffers, green spaces, and other preserved natural elements of the landscape. In general, aquatic resource mitigation projects must be designed to be self-sustaining, natural systems within the landscape and climate in which they are located, with little or no ongoing maintenance and/or hydrologic manipulation.

**Rehabilitation:** The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area (33 CFR 332.2).

**Restoration:** The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation (33 CFR 332.2).

**Riffle and pool complex:** Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a coarse substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

**Sedimentation:** Sedimentation is defined as the process of deposition of a solid material from a state of suspension. Deposited sediments may accumulate and have temporal impacts to aquatic resource areas. See secondary effects definition above. For the purposes of this document, "greater than minimal sedimentation" is generally not considered to occur when using proper erosion controls (GC 25) or when sedimentation is considered "de minimis" 33 CFR 323.2(d)(5).

**Single and complete linear project:** A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term "single and complete project" is defined as that portion of the total linear project proposed or accomplished by one owner/ developer or partnership or other association of owners/developers that includes all crossings of a single water of the U.S. (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for the purposes of these GPs. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

**Single and complete non-linear project:** For non-linear projects, the term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete

non-linear project must have independent utility (see the definition of “independent utility”). Single and complete non-linear projects may not be “piecemealed” to avoid the limits in a GP authorization.

**Special aquatic sites (SAS):** These include inland and saltmarsh wetlands, mud flats, vegetated shallows, sanctuaries and refuges, coral reefs, and riffle and pool complexes. These are defined at 40 CFR 230.3 and listed in 40 CFR 230 Subpart E.

**Streambed:** The stream substrate between the OHW marks on each side. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the streambed, but outside of the OHW marks, are not considered part of the streambed.

**Stream channelization:** The manipulation of a stream’s course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized stream remains a water of the U.S.

**Structure:** An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

**Temporal loss:** The time lag between the loss of aquatic resource functions caused by the permitted impacts and the replacement of aquatic resource functions at the compensatory mitigation site(s) (33 CFR 332.2).

**Temporary impacts:** Temporary impacts include, but are not limited to, jurisdictional waters that are temporarily filled, flooded, excavated, or drained because of the regulated activity. Impacts are considered temporary when they are removed immediately upon completion of the activity. Note: An impact is considered temporary when the aquatic resource is restored to pre-project conditions, but effects to archaeological and/or cultural resources may be permanent in duration.

**Tidal wetlands:** A wetland that is subject to the ebb and flow of the tide. See the definition of “Waters of the U.S.” below.

**Tide gates:** Structures such as duckbills, flap gates, manual and self-regulating tide gates, etc. that regulate or prevent upstream tidal flows.

**Turbidity:** A measure of the level of particles such as sediment, plankton, or organic by-products, in a body of water. As the turbidity of water increases, it becomes denser and less clear due to a higher concentration of these light-blocking particles. Suspended solids are more likely to carry toxic chemicals, and can also negatively affect aquatic organisms, water temperature, and dissolved oxygen levels.

**Utility line:** Any pipe or pipeline for the transportation of any gaseous, liquid, liquescent, or slurry substance, for any purpose that is not oil, natural gas, or petrochemicals. A utility line also includes any cable, line, or wire for the transmission for any purpose of electrical energy, telephone, and telegraph messages, and radio and television communication. The term ‘utility line’ does not include activities that drain a water of the U.S., such as drainage tile or French drains, but it does apply to pipes conveying drainage from another area.

**Vegetated shallows:** Permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation, such as eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) in marine systems (does not include salt marsh) as well as a number of freshwater species in rivers and lakes. These are a type of SAS defined at 40 CFR 230.43. Vegetated shallows are commonly referred to as submerged aquatic vegetation or SAV. Vegetated shallow survey guidance is located at [www.nae.usace.army.mil/missions/regulatory/jurisdiction-and-wetlands](http://www.nae.usace.army.mil/missions/regulatory/jurisdiction-and-wetlands). Maps of vegetated shallows in Massachusetts are located at [www.nae.usace.army.mil/missions/regulatory/state-general-permits/massachusetts-general-permit](http://www.nae.usace.army.mil/missions/regulatory/state-general-permits/massachusetts-general-permit).

**Vernal pools:** For the purposes of these GPs, vernal pools are depressional wetland basins that typically dry up in most years and may contain inlets or outlets, typically of intermittent flow. Vernal pools range in both size and depth depending upon landscape position and parent material(s). In

most years, vernal pools support one or more of the following obligate indicator species: wood frog, spotted salamander, blue-spotted salamander, marbled salamander, Jefferson's salamander and fairy shrimp. However, they should preclude sustainable populations of predatory fish.

**Water diversions:** Water diversions are activities such as bypass pumping (e.g., "dam and pump") or water withdrawals. Temporary flume pipes, culverts or cofferdams where normal flows are maintained within the stream boundary's confines aren't water diversions. "Normal flows" are defined as no change in flow from pre-project conditions.

**Waters of the United States (U.S.)** These waterbodies are the waters where permits are required for the discharge of dredged or fill material pursuant to §404 of the CWA. These waters include but are not limited to navigable waters of the U.S. and tidal wetlands and include many non-tidal wetlands and other waterbodies. See definitions for navigable waters of the U.S., tidal wetlands, waterbody, and non-tidal wetlands. (33 CFR 328)

**Waterbody:** Examples of "waterbodies" include oceans, coastal waters, rivers, streams, ditches, lakes, ponds, and wetlands. If a wetland is adjacent to a waterbody determined to be a water of the U.S., that waterbody and any adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)).

**Weir:** A barrier across a river designed to alter the flow characteristics. In most cases, weirs take the form of a barrier, smaller than most conventional dams, across a river that causes water to pool behind the structure and allows water to flow over the top. Weirs are commonly used to alter the flow regime of a river, prevent flooding, measure discharge and help render a river navigable.

**Wetland:** Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. The Corps of Engineers Wetlands Delineation Manual in conjunction with the associated regional supplement should be used to determine if a wetland is present and delineate wetland boundaries.

## **Acronyms**

BMPs	Best Management Practices
BUAR	Massachusetts Board of Underwater Archaeological Resources
CWA	Clean Water Act
CZM	Coastal Zone Management
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
EFH	Essential Fish Habitat
FNP	Federal Navigation Project
GC	General Condition
GP	General Permit
HTL	High Tide Line
IP	Individual Permit
LID	Low impact development
MassDEP	Massachusetts Department of Environmental Protection
MA DMF	Massachusetts Division of Marine Fisheries
MHC	Massachusetts Historical Commission
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
OHW	Ordinary High Water Mark
PCN	Preconstruction Notification
SAS	Special Aquatic Sites
SF	Square Feet
SV	Self-Verification
SHPO	State Historic Preservation Officer
THPO	Tribal Historic Preservation Officer
USFWS	U.S. Fish and Wildlife Service
USCG	U.S. Coast Guard
USFS	U.S. Forest Service
USGS	U.S. Geological Service
WQC	Water Quality Certification

## Appendix A: Guidance for NHPA Section 106 Compliance in Massachusetts

### 1. Purpose & Applicability

Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) (54 U.S.C § 306108), requires Federal agencies to take into account the effects of their undertakings on Historic Properties and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertakings. Therefore, in order for an activity to be eligible for authorization under the 2023 Massachusetts General Permit, the USACE must consider the effect the activity may have on historic properties. Historic properties may include, but are not limited to, historic districts, archaeological districts, sites, buildings, structures, objects, sacred sites, traditional cultural places, and traditional cultural landscapes that are included in, or eligible for inclusion in, the National Register of Historic Places (NRHP).

This guidance applies to projects that require authorization under Section 404 of the Clean Water Act (33 U.S.C. § 1344) and/or Section 10 of the Rivers and Harbors Act (33 U.S.C. §403) and will assist applicants when evaluating and documenting the presence of historic properties within or near their project site(s). The prospective applicant will evaluate their proposed project using the criteria below to determine if their project has the potential to affect historic properties and if so, whether or not historic properties are present or are likely to be present. All activities authorized under these GPs shall follow the terms outlined in General Condition 14: Historic Properties and General Condition 6: Tribal Rights & Burial Sites. Prospective applicants shall complete their due diligence according to the procedures below for their application to be deemed complete.

### 2. No Potential to Affect Historic Properties

Certain activities do not have the potential to cause effects on historic properties, assuming such historic properties were present, based on the nature of the activity and site-specific conditions. Therefore, these activities **do not** require historic property identification efforts or notification of the SHPO, THPOs, and/or BUAR under Section 106. The USACE has determined the following activities within the stated parameters have no potential to affect historic properties:

General Permit	Activity Parameters
1	Temporary buoys, markers and similar structures that are placed during winter events on ice and removed before spring thaw.
2	Repair or rehabilitation of structures that are less than 45 years in age. Any temporary structures or fills or work necessary to complete repairs or rehabilitation must not result in any ground disturbance.
3	Maintenance and replacement of moorings that are less than 45 years in age.
6	Maintenance, repair, replacement, or removal of utility lines, oil or natural gas pipelines, outfall or intake structures, and/or appurtenant features that are less than 45 years in age when all access, staging, and ground disturbance is strictly limited to previously disturbed areas (including any previous ground disturbance). Replacement must be in kind or smaller in size. Installation of tide gates on outfall structures that are less than 45 years in age.
7	Maintenance dredging of previously dredged areas where dredging does not extend beyond the original bottom elevations.

	Disposal of dredged material at an existing established and USACE-approved confined aquatic disposal cell. Beach nourishment in ongoing existing nourishment areas.
11	Fish and wildlife harvesting and attraction devices and activities.
13	Cleanup of hazardous and toxic waste materials, including contaminated sediments, that are less than 45 years in age.
16	Removal of land-based and water-based renewable energy generation facilities and hydropower projects that are less than 45 years in age.
18	Installation of buoys, floats, racks, trays, nets, lines, tubes, containers, and other structures for previously authorized by the USACE and ongoing aquaculture activities. Discharges of dredged or fill material into tidal or non-tidal waters necessary for shellfish seeding, rearing, cultivating, transplanting, and harvesting activities for previously authorized and ongoing aquaculture activities.
20	Maintenance activities for existing living shorelines <u>excluding</u> maintenance activities that require new ground disturbance such as excavation or re-sloping of the bank/shoreline.
22	Reshaping or maintenance of existing drainage ditches less than 45 years in age <u>excluding</u> ditch enlargement.
23	Placement of temporary and removable linear transportation and wetland/stream crossings that have no ground disturbance prior to placement, during placement, and during removal (i.e., placed on the surface and subsequently removed within one year of placement).
24	Placement of temporary and removable crossings and cofferdams that have no ground disturbance prior to placement, during placement, and during removal (i.e., placed on the surface and subsequently removed within one year of placement).
25	Emergency repair of existing structures and/or fills less than 45 years in age.

### 3. Historic Property Identification

If the activity does not fit under the criteria above, the following historic property identification efforts must be completed to demonstrate compliance with Section 106 of the NHPA. This includes documenting previously identified and unidentified historic properties in the project area.

a. Previously Identified Historic Properties: The prospective applicant shall document if previously identified historic properties are present on or adjacent to the project site by notifying the Massachusetts Historical Commission (MHC) and the Massachusetts Board of Underwater Archaeological Resources (BUAR), as appropriate, of the proposed project. The MHC and BUAR will check their records for the presence of any previously identified historic properties. The following outlines how prospective applicants should notify the MHC and BUAR.

i. The prospective applicant will notify the SHPO and BUAR to identify any previously recorded cultural resources. Applicants shall mail a completed Project Notification Form<sup>18</sup>, project narrative, location (coordinates), plans, soil maps, and information on known cultural resources to the MHC. The MHC does not accept submissions via email. Applicants shall email or mail this information to the BUAR when the activity is located in lakes, ponds, rivers, and/or navigable waters in MA. Emailed file attachments should be <10MB. Any files >10MB shall be delivered via a file exchange system or the hard copy documents shall be mailed. Preferred contact information is listed below.

ii. **When sending this information, applicants must also document proof of receipt OR proof the information was delivered.** Proof of receipt constitutes a certified mail receipt, read email receipt, or other mail/email/online tracking services that document the information has reached the intended recipient(s). Proof the information was delivered constitutes a certificate of mailing, email delivery receipt, or other mail/email/online services that document the information was sent at a particular time. When using proof of delivery such (e.g., certificate of mailing), applicants should add 5 days to the 30-day notification period so the mail has time to reach its intended recipient. When using proof of receipt, the applicant may begin the 30-day notification period from the date received by the intended recipient.

iii. When mailing or emailing the application materials, applicants should include the following statement: "Please send responses to this notification directly to the USACE via email: [cenae-r-ma@usace.army.mil](mailto:cenae-r-ma@usace.army.mil) or address regular mail responses to: Regulatory Division, U.S. Army Corps of Engineers, New England District, 696 Virginia Road, Concord, Massachusetts 01742-2751." Email responses to the USACE are strongly preferred. The SHPO and BUAR will contact the USACE and cc the applicant(s) within 30 days of receiving the notification if their records indicate that historic properties are located in the project vicinity, and if additional review and/or surveys are recommended to ensure NHPA compliance. If the SHPO and/or BUAR do not respond within 30 days of receiving the notification, it is presumed that no known historic properties are present.

**b. Previously Unidentified Historic Properties:** The prospective applicant shall evaluate the project site and determine the sensitivity for the presence of historic properties if the project site has not been previously surveyed for cultural resources within the last 10 years. If the sensitivity is determined to be moderate to high, an intensive archaeological and/or architectural survey is required to investigate the potential presence of historic properties. The individual conducting this survey must meet the Secretary of the Interior's Standards for Professional Qualifications (48 FR 44738-44739) in the discipline relevant to a particular resource type. For example, archeologists should not document and evaluate buildings or structures and architectural historians should not document and evaluate archaeological sites. The identification and qualifications for those participating in any survey and evaluation of resources should be included with the survey results. The criteria listed below are indicators of low sensitivity for the presence of historic properties for consideration when determining if an archaeological or architectural survey is needed.

Low sensitivity indicators:

- Previous archaeological and/or architectural survey within the last 10 years with negative results.
- In a location created in modern times (i.e., built on fill placed within the last 45 years or within an area excavated within the last 45 years).
- USACE has reviewed the project description and determined that a survey is not warranted based on the proposed activity and its location.

State survey guidance and standards are provided in the September 1995 Historic Properties Survey Manual Guidelines for the Identification of Historical and Archaeological Resources in Massachusetts available. State survey guidance and standards for underwater surveys are provided

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<sup>18</sup> <https://www.sec.state.ma.us/mhc/mhcform/formidx.htm>

in the Board of Underwater Archaeological Resources' 2022 Policy Guidance on Archaeological Investigations and Related Survey Standards for the Discovery of Underwater Archaeological Resources. This guidance is available on the NAE Regulatory website: <https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/Massachusetts-General-Permit/>.

Please note, a negative result from MHC and/or BUAR does not necessarily mean no historic properties are present. Often proposed project sites have not been previously subject to a survey, so historic properties which may be present have not been previously recorded.

#### **4. Tribal Coordination**

Prospective applicants shall mail the Project Notification Form, project narrative, location (coordinates), plans with locus map, soil maps, and information on cultural resources to the Wampanoag Tribe of Gay Head (Aquinnah), Mashpee Wampanoag Tribe, Narragansett Indian Tribe, and/or Stockbridge-Munsee Community Band of Mohican Indians with interests in the project location. Preferred tribal contact information, including their respective areas of interest, can be found below. Applicants shall follow the same procedures as identified in Section 3(a)i-iii above when notifying Tribes of the proposed activity. Applicants shall provide the USACE with any responses received from the tribe(s) with their PCN application. If a tribe does not respond within 30 days of receiving the notification, the applicant shall provide USACE with all documentation of tribal outreach with their SV or PCN submission (e.g., emails, letters, phone call log, etc.). If the tribe indicates the presence of a previously unrecorded cultural resource, including a traditional cultural property (TCP) or traditional cultural landscape (TCL), a PCN is required.

#### **5. Effect Determination**

The project may have the potential to affect historic properties and/or tribal resources if 1) notification recipients respond within 30 calendar days of notification with concerns, 2) historic properties eligible for listing, or potentially eligible for listing in the NRHP, are present or 3) tribal resources are known to be present. The USACE may need to further review the project to confirm potential effects to historic properties and/or tribal resources. A PCN is required for any activity that may affect a historic property.

The USACE may determine the project will have 'no effect' on historic properties (i.e., no historic properties affected) when procedures outlined in Section 3 above are followed and no cultural resources are identified. Similarly, if historic properties are identified and will be completely avoided, the USACE may determine 'no effect.'

#### **6. Contact Information:**

##### ***Massachusetts Historical Commission***

The Massachusetts Archives Building  
220 Morrissey Boulevard  
Boston, Massachusetts 02125

No email. Applicants or their representatives must send project information via certified mail and submit the certified mail receipt to the USACE or send via regular mail and submit proof of delivery.

Area of concern: All of Massachusetts.

**Massachusetts Board of Underwater Archaeological Resources (BUAR)**

100 Cambridge Street, Suite 900  
Boston, Massachusetts 02114  
Email: [david.s.robinson@mass.gov](mailto:david.s.robinson@mass.gov)

Applicants or their representatives must send project information via email (**strongly preferred**) or regular mail and provide proof of receipt or proof of delivery.

Area of concern: All waterbodies in Massachusetts.

**Wampanoag Tribe of Gay Head (Aquinnah)**

Bettina Washington  
Tribal Historic Preservation Officer (THPO)  
20 Black Brook Road  
Aquinnah, Massachusetts 02535  
Email: [thpo@wampanoagtribe-nsn.gov](mailto:thpo@wampanoagtribe-nsn.gov)

Applicants or their representative must send project information via email (**preferred**) or regular mail and provide proof of receipt or proof of delivery.

Area of concern: All of Massachusetts.

**Mashpee Wampanoag Tribe**

ATTN: David Weeden  
Tribal Historic Preservation Officer (THPO)  
483 Great Neck Road South  
Mashpee, Massachusetts 02649  
Email: [106review@mwtribe-nsn.gov](mailto:106review@mwtribe-nsn.gov)  
Cc: [David.weeden@mwtribe-nsn.gov](mailto:David.weeden@mwtribe-nsn.gov)

Applicants or their representative must send project information via email (**preferred**) or regular mail and provide proof of receipt or proof of delivery.

Area of concern: All of Massachusetts.

**Narragansett Indian Tribe**

ATTN: John Brown  
Tribal Historic Preservation Officer (THPO)  
Narragansett Indian Longhouse  
4425 South County Trail  
Charlestown, Rhode Island 02813  
Email: [tashtesook@aol.com](mailto:tashtesook@aol.com)

Applicants or their representative must send project information via email (**preferred**) or regular mail and provide proof of receipt or proof of delivery.

Area of concern: Massachusetts east of the Connecticut River.

***Stockbridge-Munsee Community Band of Mohican Indians***

ATTN: Jeff Bendremer  
Tribal Historic Preservation Manager  
Stockbridge-Munsee Community  
Tribal Historic Preservation Extension office  
86 Spring Street  
Williamstown, Massachusetts 01267  
Email: [thpo@mohican-nsn.gov](mailto:thpo@mohican-nsn.gov)

Applicants or their representative must send project information via email (***preferred***) or regular mail and provide proof of receipt or proof of delivery.

Area of concern: West of the Connecticut River and Northfield, Montague, Miller's Falls, Turner's Falls, Sunderland, Amherst, Hadley, South Hadley, Chicopee, Springfield and Longmeadow.

## **APPENDIX B PRE-CONSTRUCTION NOTIFICATION**

U.S. Army Corps of Engineers (USACE), New England District (NAE)

**PRE-CONSTRUCTION NOTIFICATION (PCN)**

**DATA REQUIRED BY THE PRIVACY ACT OF 1974**

**Authority** Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332.

**Principal Purpose** The information provided will be used in evaluating activities under Pre-Construction Notification procedures within New England.

**Routine Uses** This information may be shared with other federal, state, and local government agencies during the application review process. Submission of requested information is voluntary. However, if information is not provided the PCN application cannot be fully evaluated nor can USACE render a permit decision.

**Disclosure**

**Instructions** The applicant must complete ALL required sections of this document before their submission to USACE. The PCN submission to USACE shall include one set of drawings which show the location and character of the proposed activity, statements that address each required field below, and documentation that supports each field (e.g., emails, letters, description/narrative, phone calls, surveys, reports, etc.). Electronic submissions to the following address are strongly preferred: [cenae-r-ma@usace.army.mil](mailto:cenae-r-ma@usace.army.mil). The email subject line shall contain the following: General Permit #, PCN, City/Town, and date submitted. An application that is not completed in full will be returned.

**(ITEMS 1 THRU 4 TO BE FILLED BY USACE)**

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE
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**(ITEMS BELOW TO BE FILLED BY APPLICANT)**

5. APPLICANT'S NAME First - Middle - Last - Company - E-mail Address -		8. AUTHORIZED AGENT'S NAME AND TITLE ( <i>agent is not required</i> ) First - Middle - Last - Company - E-mail Address -	
6. APPLICANT'S ADDRESS: Address- City - State - Zip - Country -		9. AGENT'S ADDRESS: Address- City - State - Zip - Country -	
7. APPLICANT'S PHONE NOs. with AREA CODE a. Residence    b. Business    c. Fax    d. Mobile		10. AGENT'S PHONE NOs. with AREA CODE a. Residence    b. Business    c. Fax    d. Mobile	

**STATEMENT OF AUTHORIZATION**

11. I hereby authorize, \_\_\_\_\_ to act on my behalf as my agent in the processing of this general permit PCN application and to furnish, upon request, supplemental information in support of this general permit PCN application.

\_\_\_\_\_  
SIGNATURE OF APPLICANT

\_\_\_\_\_  
DATE

**NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY**

12. PROJECT NAME or TITLE (*see instructions*)

13. NAME OF WATERBODY, IF KNOWN (*if applicable*)

14. PROPOSED ACTIVITY STREET ADDRESS (*if applicable*)

15. LOCATION OF PROPOSED ACTIVITY (*see instructions*)

City: State: Zip:

Latitude: °N Longitude: °W

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (*see instructions*)

State Tax Parcel ID:

Municipality:

Section:

Township:

Range:

17. DIRECTIONS TO THE SITE.

18. IDENTIFY THE SPECIFIC GENERAL PERMIT(S) YOU PROPOSE TO USE:

19. DESCRIPTION OF PROPOSED GENERAL PERMIT ACTIVITY (*see instructions*)

20. DESCRIPTION OF PROPOSED MITIGATION MEASURES (*see instructions*)

21. PURPOSE OF GENERAL PERMIT ACTIVITY (*Describe the reason or purpose of the project, see instructions*)

22. Quantity of Wetlands, Streams, or Other Types of Waters Directly Affected by Proposed General Permit Activity (*see instructions*)

Area (square feet)	Length (linear feet)	Volume (cubic yards)	Duration	Purpose

**Each PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site.**

23. List any other GP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project on any related activity (*see instructions*)

24. If the proposed activity will result in the loss of aquatic resources that exceed those identified in the New England District Compensatory Mitigation Thresholds, explain how the compensatory mitigation requirement will be satisfied. (*see instructions*)



**Instructions for Preparing a  
Department of the Army  
General Permit (GP) Pre-Construction Notification (PCN)**

**Blocks 1 through 4.** To be completed by the U.S. Army Corps of Engineers.

**Block 5. Applicant' Name.** Enter the name and the e-mail address of the responsible party or parties. If the responsible party is an agency, company, corporation, or other organization, indicate the name of the organization and responsible officer and title. If more than one party is associated with the PCN, please attach a sheet of paper with the necessary information marked Block 5.

**Block 6. Address of Applicant.** Please provide the full address of the party or parties responsible for the PCN. If more space is needed, attach an extra sheet of paper marked Block 6.

**Block 7. Applicant Telephone Number(s).** Please provide the telephone number where you can usually be reached during normal business hours.

**Blocks 8 through 11.** To be completed, if you choose to have an agent.

**Block 8. Authorized Agent's Name and Title.** Indicate name of individual or agency, designated by you, to represent you in this process. An agent can be an attorney, builder, contractor, engineer, consultant, or any other person or organization. Note: An agent is not required.

**Blocks 9 and 10. Agent's Address and Telephone Number.** Please provide the complete mailing address of the agent, along with the telephone number where they can be reached during normal business hours.

**Block 11. Statement of Authorization.** To be completed by the applicant, if an agent is to be employed.

**Block 12. Proposed General Permit Activity Name or Title.** Please provide a name identifying the proposed GP activity, e.g., Windward Marina, Rolling Hills Subdivision, or Smith Commercial Center.

**Block 13. Name of Waterbody.** Please provide the name (if it has a name) of any stream, lake, marsh, or other waterway to be directly impacted by the GP activity. If it is a minor (no name) stream, identify the waterbody the minor stream enters.

**Block 14. Proposed Activity Street Address.** If the proposed GP activity is located at a site having a street address (not a box number), enter it in Block 14.

**Block 15. Location of Proposed Activity.** Enter the latitude and longitude of where the proposed GP activity is located. Indicate whether the project location provided is the center of the project or whether the project location is provided as the latitude and longitude for each of the "corners" of the project area requiring evaluation. If there are multiple sites, please list the latitude and longitude of each site (center or corners) on a separate sheet of paper and mark as Block 15.

**Block 16. Other Location Descriptions.** If available, provide the Tax Parcel Identification number of the site, Section, Township, and Range of the site (if known), and / or local Municipality where the site is located.

**Block 17. Directions to the Site.** Provide directions to the site from a known location or landmark. Include highway and street numbers as well as names. Also provide distances from known locations and any other information that would assist in locating the site. You may also provide a description of the location of the proposed GP activity, such as lot numbers, tract numbers, or you may choose to locate the proposed GP activity site from a known point (such as the right descending bank of Smith Creek, one mile downstream from the Highway 14 bridge). If a large river or stream, include the river mile of the proposed GP activity site if known. If there are multiple locations, please indicate directions to each location on a separate sheet of paper and mark as Block 17.

**Block 18. Identify the Specific General Permit(s) You Propose to Use.** List the number(s) of the General Permit(s) you want to use to authorize the proposed activity (e.g., GP 4).

**Block 19. Description of the Proposed General Permit Activity.** Describe the proposed GP activity, including the direct and indirect adverse environmental effects of the proposed activity. The description of the proposed activity should be sufficiently detailed for USACE to determine that the adverse environmental effects of the activity will be no more than minimal. Identify the materials to be used in construction, as well as the methods by which the work is to be done.

Provide drawings to show that the proposed GP activity complies with the terms of the applicable GP(s). Drawings should contain sufficient detail to provide an illustrative description of the proposed GP activity, but do not need to be detailed engineering plans. The written descriptions and illustrations are an important part of the application. Please describe, in detail, what you wish to do. If more space is needed, attach an extra sheet of paper marked Block 19.

**Block 20: Description of Proposed Mitigation Measures.** Describe any proposed mitigation measures intended to reduce the adverse environmental effects caused by the proposed GP activity. The description of any proposed mitigation measures should be sufficiently detailed for USACE to determine how the measures would avoid and minimize adverse environmental effects. If adverse effects exceed the New England District compensatory mitigation thresholds, you must document how compensatory mitigation would be satisfied in Block 24.

**Block 21. Purpose of General Permit Activity.** Describe the purpose and need for the proposed GP activity. What will it be used for and why? Also include a brief description of any related activities associated with the proposed project. Provide the approximate dates you plan to begin and complete all work.

**Block 22. Quantity of Wetlands, Streams, or Other Types of Waters Directly Affected by the Proposed General Permit Activity.** For discharges of dredged or fill material into Waters of the U.S., provide the amount of wetlands, streams, or other types of waters filled, flooded, excavated, or drained by the proposed GP activity. For structures or work in Navigable Waters of the U.S. subject to Section 10 of the Rivers and Harbors Act of 1899, provide the amount of navigable waters filled, dredged, occupied by one or more structures (e.g., aids to navigation, mooring buoys) by the proposed GP activity. The area of impact includes the structures or fills with direct or indirect effects to waters of the U.S. The length of impact includes the length of a stream, including its banks, that are directly affected by the structures or fills. The duration of impact should be identified as temporary (xx days) or permanent. The impact purpose should briefly describe what structure or fill is responsible for the impact.

**Block 23. Identify Any Other General Permit(s), Regional General Permit(s), or Individual Permit(s) Used to Authorize Any Part of Proposed Activity or Any Related Activity.** List any other GP(s) or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. For linear projects, list other separate and distant crossings of waters and wetlands authorized by these GPs that do not require PCNs. If more space is needed, attach an extra sheet of paper marked Block 23.

**Block 24. Compensatory Mitigation Statement for Losses Greater Than the New England District Compensatory Mitigation Thresholds.** New England District requires compensatory mitigation at a minimum one for one replacement ratio or greater for all aquatic resource losses that require a PCN and exceed the New England District Compensatory Mitigation Thresholds, unless USACE determines in writing that either some other form of mitigation is more environmentally appropriate or the adverse environmental effects of the proposed GP activity are no more than minimal without compensatory mitigation, and provides an activity specific waiver of this requirement. Describe the proposed compensatory mitigation for wetland losses greater than the New England District Compensatory Mitigation Thresholds or provide an explanation of why USACE should not require wetland compensatory mitigation for the proposed GP activity. If more space is needed, attach an extra sheet of paper marked Block 24.

**Block 25. Is Any Portion of the General Permit Activity Already Complete?** Describe any work that has already been completed for the GP activity.

**Block 26. List the Name(s) of Any Species Listed As Endangered or Threatened under the Endangered Species Act that Might be Affected by the General Permit Activity.** If you are not a federal agency, and if any listed species or designated critical habitat might be affected or is in the vicinity of the proposed GP activity, or if the proposed GP activity is located in designated critical habitat, list the name(s) of those endangered or threatened species that might be affected by the proposed GP activity or utilize the designated critical habitat that might be affected by the proposed GP activity. If you are a Federal agency, and the proposed GP activity requires a PCN, you must provide documentation demonstrating compliance with Section 7 of the Endangered Species Act.

**Block 27. List Any Historic Properties that Have the Potential to be Affected by the General Permit Activity.** If you are not a federal agency, and if any historic properties have the potential to be affected by the proposed GP activity, list the name(s) of those historic properties that have the potential to be affected by the proposed GP activity. Provide all relevant documentation about these historic properties in the PCN submittal. If you are a Federal agency, and the proposed GP activity requires a PCN, you must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

**Block 28. List the Wild and Scenic River or Congressionally Designated Study River if the General Permit Activity Would Occur in such a River.** If the proposed GP activity will occur in a river in the National Wild and Scenic River System or in a river officially designated by Congress as a "study river" under the Wild and Scenic Rivers Act, provide the name of the river. For a list of Wild and Scenic Rivers and study rivers, please visit <http://www.rivers.gov/>

**Block 29. General Permit Activities that also Require Permission from the USACE Under 33 U.S.C. 408.** If the proposed GP activity also requires permission from the USACE under 33 U.S.C. 408 because it will temporarily or permanently alter, occupy, or use a USACE federal authorized civil works project, indicate whether you have submitted a written request for section 408 permission from the USACE district having jurisdiction over that project.

**Block 30. 401 Water Quality Certification.** As described above, specify if the activity requires a 401 WQC from the certifying authority.

**Block 31. Other Information Required For General Permit Pre Construction Notifications.** The terms of some of the General Permits include additional information requirements for preconstruction notifications:

- \* Maintenance – information regarding the original design capacities and configurations of the outfalls, intakes, small impoundments, and canals.
- \* Temporary Construction, Access, and Dewatering – a restoration plan showing how all temporary fills and structures will be removed and the area restored to pre-project conditions.
- \* Repair of Uplands Damaged by Discrete Events – documentation, such as a recent topographic survey or photographs, to justify the extent of the proposed restoration.
- \* Commercial Shellfish Aquaculture Activities – (1) a map showing the boundaries of the project area, with latitude and longitude coordinates for each corner of the project area; (2) the name(s) of the species that will be cultivated during the period this GP is in effect; (3) whether canopy predator nets will be used; (4) whether suspended cultivation techniques will be used; and (5) general water depths in the project area (a detailed survey is not required). Dredging – (1) a proposed sampling and analysis plan shall be provided to USACE for approval prior to its execution. Pre-application meetings are encouraged.
- \* Beach Nourishment – sediment grain size should be determined for the length of the beach where nourishment is proposed. The frequency and locations of sediment sampling shall be sufficient to identify the sediment composition of the beach profile. This data shall be consolidated to generate a sediment gradation curve for each sampled transect. Each sampled transect should also be identified on the project plans (drawings).

If more space is needed, attach an extra sheet of paper marked Box 31.

**Block 32. Signature of Applicant or Agent.** The PCN must be signed by the person proposing to undertake the GP activity, and if applicable, the authorized party (agent) that prepared the PCN. The signature of the person proposing to undertake the GP activity shall be an affirmation that the party submitting the PCN possesses the requisite property rights to undertake the GP activity (including compliance with special conditions, mitigation, etc.).

### **DELINEATION OF WETLANDS, OTHER SPECIAL AQUATIC SITES, AND OTHER WATERS**

Each PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current wetland delineation manual and regional supplement published by the USACE. The permittee may ask the USACE to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the USACE does the delineation, especially if the project site is large or contains many wetlands, other special aquatic sites, and other waters. The 60-day PCN review period will not start until a delineation has been completed.

### **DRAWINGS AND ILLUSTRATIONS**

#### **General Information.**

Three types of illustrations are needed to properly depict the work to be undertaken. These illustrations or drawings are identified as a Vicinity Map, a Plan View or a Typical Cross Section Map. Identify each illustration with a figure or attachment number. For linear projects (e.g. roads, subsurface utility lines, etc.) gradient drawings should also be included. Please submit one copy of all drawings on 8½ x 11 inch plain white paper (electronic submissions preferred). Use the fewest number of sheets necessary for your drawings or illustrations. Each illustration should identify the project, the applicant, and the type of illustration (vicinity map, plan view, or cross section). While illustrations need not be professional (many small, private project illustrations are prepared by hand), they should be clear, accurate, and contain all necessary information.

### **ADDITIONAL INFORMATION AND REQUIREMENTS**

For proposed GP activities that involve discharges into waters of the United States, water quality certification from the State, Tribe, or EPA must be obtained or waived. Some States, Tribes, or EPA have issued water quality certification for one or more GPs. Please check the New England District website to see if water quality certification has already been issued for the GP(s) you wish to use. For proposed GP activities in coastal states, state Coastal Zone Management Act consistency concurrence must be obtained, or a presumption of concurrence must occur. Some States have issued Coastal Zone Management Act consistency concurrences for one or more GPs. Please check the New England District website to see if Coastal Zone Management Act consistency concurrence has already been issued for the GP(s) you wish to use.

**APPENDIX C SELF-VERIFICATION NOTIFICATION**

U.S. Army Corps of Engineers (USACE)  
**SELF-VERIFICATION NOTIFICATION (SVN)**

**DATA REQUIRED BY THE PRIVACY ACT OF 1974**

**Authority** Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332.

**Principal Purpose** This information will be used in evaluating activities under Self-Verification procedures within Massachusetts.

**Routine Uses** Routine uses will include: (1) Documenting compliance with the terms and conditions of the General Permit (GP) for activities that may require authorization pursuant to one or more of USACE's Regulatory authorities. (2) Records may be referred to other Federal, State, and local agencies for evaluation and enforcement purposes.

**Disclosure** Failure to fully comply and abide by the GP terms and conditions prior to commencing work and after completion project may result in formal enforcement action, up to and including monetary penalties and/or legal action, pursuant to 33 CFR Part 326.

**Instructions** The permittee must complete ALL required sections of this document before commencing USACE-regulated activities. A copy of this completed SVN must be kept on site during construction and be made available for review by USACE and other Federal, State, & Local regulatory authorities at any time. Within 30 days of initiating project construction, the permittee shall submit the completed SVN to USACE. The SVN shall be submitted to USACE as **ONE signed document** that includes project plans and documentation that supports each field (e.g., emails, letters, description, phone calls, surveys). Electronic submissions to the following address are strongly preferred: [cenae-r-ma-sv@usace.army.mil](mailto:cenae-r-ma-sv@usace.army.mil). The email subject line shall contain the following: GP #, SVN, City/Town, and date submitted.

**(ITEMS 1 THRU 3 TO BE FILLED BY USACE)**

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED
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**APPLICANT AND AGENT INFORMATION**

<b>4. APPLICANT'S NAME</b> First -                      Middle -                      Last - Company - E-mail Address -	<b>7. AGENT'S ADDRESS:</b> First -                      Middle -                      Last - Company - E-mail Address -
<b>5. APPLICANT'S ADDRESS:</b> Address- City -                      State -                      Zip -                      Country -	<b>8. AGENT'S ADDRESS:</b> Address- City -                      State -                      Zip -                      Country -
<b>6. APPLICANT'S PHONE NOs. w/AREA CODE</b> a. Residence                      b. Business                      c. Fax	<b>9. AGENTS PHONE NOs. w/AREA CODE</b> a. Residence                      b. Business                      c. Fax

**NAME, LOCATION, AND DESCRIPTION OF PROJECT SITE**

10. PROJECT NAME OR TITLE	
11. FILE NUMBER(S) OF PREVIOUS USACE ACTIONS ON THE SITE (if applicable)	12. NAME OF WATERBODY
13. PROJECT COORDINATES (in decimal degrees) Latitude: °N                      Longitude: °W	14. PROJECT STREET ADDRESS (if applicable) Address City -                      State -                      Zip -

**ACTIVITY TYPE, PROJECT IMPACTS, AVOIDANCE & MINIMIZATION**

<b>15. GENERAL PERMIT ACTIVITIES (CHECK ALL THAT APPLY)</b> <table style="width:100%; border: none;"> <tr> <td style="padding: 2px 10px;">1 <input type="checkbox"/></td> <td style="padding: 2px 10px;">6 <input type="checkbox"/></td> <td style="padding: 2px 10px;">11 <input type="checkbox"/></td> <td style="padding: 2px 10px;">16 <input type="checkbox"/></td> <td style="padding: 2px 10px;">21 <input type="checkbox"/></td> </tr> <tr> <td style="padding: 2px 10px;">2 <input type="checkbox"/></td> <td style="padding: 2px 10px;">7 <input type="checkbox"/></td> <td style="padding: 2px 10px;">12 <input type="checkbox"/></td> <td style="padding: 2px 10px;">17 <input type="checkbox"/></td> <td style="padding: 2px 10px;">22 <input type="checkbox"/></td> </tr> <tr> <td style="padding: 2px 10px;">3 <input type="checkbox"/></td> <td style="padding: 2px 10px;">8 <input type="checkbox"/></td> <td style="padding: 2px 10px;">13 <input type="checkbox"/></td> <td style="padding: 2px 10px;">18 <input type="checkbox"/></td> <td style="padding: 2px 10px;">23 <input type="checkbox"/></td> </tr> <tr> <td style="padding: 2px 10px;">4 <input type="checkbox"/></td> <td style="padding: 2px 10px;">9 <input type="checkbox"/></td> <td style="padding: 2px 10px;">14 <input type="checkbox"/></td> <td style="padding: 2px 10px;">19 <input type="checkbox"/></td> <td style="padding: 2px 10px;">24 <input type="checkbox"/></td> </tr> <tr> <td style="padding: 2px 10px;">5 <input type="checkbox"/></td> <td style="padding: 2px 10px;">10 <input type="checkbox"/></td> <td style="padding: 2px 10px;">15 <input type="checkbox"/></td> <td style="padding: 2px 10px;">20 <input type="checkbox"/></td> <td style="padding: 2px 10px;">25 <input type="checkbox"/></td> </tr> </table>	1 <input type="checkbox"/>	6 <input type="checkbox"/>	11 <input type="checkbox"/>	16 <input type="checkbox"/>	21 <input type="checkbox"/>	2 <input type="checkbox"/>	7 <input type="checkbox"/>	12 <input type="checkbox"/>	17 <input type="checkbox"/>	22 <input type="checkbox"/>	3 <input type="checkbox"/>	8 <input type="checkbox"/>	13 <input type="checkbox"/>	18 <input type="checkbox"/>	23 <input type="checkbox"/>	4 <input type="checkbox"/>	9 <input type="checkbox"/>	14 <input type="checkbox"/>	19 <input type="checkbox"/>	24 <input type="checkbox"/>	5 <input type="checkbox"/>	10 <input type="checkbox"/>	15 <input type="checkbox"/>	20 <input type="checkbox"/>	25 <input type="checkbox"/>	<b>16. SUMMARY OF PROJECT IMPACTS (see instructions)</b> <table border="1" style="width:100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Area (square feet)</th> <th style="padding: 5px;">Length (linear feet)</th> <th style="padding: 5px;">Volume (cubic yards)</th> <th style="padding: 5px;">Duration</th> </tr> </thead> <tbody> <tr><td style="height: 20px;"> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	Area (square feet)	Length (linear feet)	Volume (cubic yards)	Duration																				
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23. STATEMENT OF AUTHORIZATION *(see instructions)*

I certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT

DATE

SIGNATURE OF AGENT

DATE

24. SIGNATURES *(see instructions)*

I hereby certify that the information in this Self-Verification Notification is complete and accurate. As the applicant or their duly authorized agent, I certify the activity was completed in accordance with the terms and conditions of the GP. This includes all applicable terms, general conditions, and activity-specific GP criteria. I agree to allow the duly authorized representatives of the Corps of Engineers Regulatory Program and other regulatory or advisory agencies to enter upon the premises of the project site at reasonable times to evaluate inspect and photograph site conditions. This consent to enter the property is superior to, takes precedence over, and waives any communication to the contrary. For example, if the property is posted as "no trespassing" this consent specifically supersedes and waives that prohibition and grants permission to enter the property despite such posting.

SIGNATURE OF APPLICANT

DATE

SIGNATURE OF AGENT

DATE

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than \$10,000 or imprisoned not more than five years or both.

**Instructions for Preparing a  
Department of the Army  
General Permit (GP) Self-Verification**

**Blocks 1 through 3.** To be completed by the Corps of Engineers.

**Block 4. Applicant' Name.** Enter the name and the e-mail address of the responsible party or parties. If the responsible party is an agency, company, corporation, or other organization, indicate the name of the organization and responsible officer and title. If more than one party is associated with the self-verification, please attach a sheet of paper with the necessary information marked Block 4.

**Block 5. Address of Applicant.** Please provide the full address of the party or parties responsible for the self-verification. If more space is needed, attach an extra sheet of paper marked Block 5.

**Block 6. Applicant Telephone Number(s).** Please provide the telephone number where you can usually be reached during normal business hours.

**Blocks 7 through 9.** To be completed, if you choose to have an agent.

**Block 7. Authorized Agent's Name and Title.** Indicate name of individual or agency, designated by you, to represent you in this process. An agent can be an attorney, builder, contractor, engineer, consultant, or any other person or organization. Note: An agent is not required.

**Blocks 8 and 9. Agent's Address and Telephone Number.** Please provide the complete mailing address of the agent, along with the telephone number where they can be reached during normal business hours.

**Block 10. Proposed General Permit Activity Name or Title.** Please provide a name identifying the proposed GP activity, e.g., Windward Marina, Rolling Hills Subdivision, or Smith Commercial Center.

**Block 11. File Number(s) of Previous USACE Actions on the Site** Please provide any known USACE file number. If the activity does not have a known USACE file number, you may state N/A.

**Block 12. Name of Waterbody.** Please provide the name (if it has a name) of any stream, lake, marsh, or other waterway to be directly impacted by the GP activity. If it is a minor (no name) stream, identify the waterbody the minor stream enters.

**Block 13. Proposed Activity Coordinates.** Please enter the latitude and longitude of where the proposed GP activity is located. Indicate whether the project location provided is the center of the project or whether the project location is provided as the latitude and longitude for each of the "corners" of the project area. If there are multiple sites, please list the latitude and longitude of each site (center or corners) on a separate sheet of paper and mark as Block 13.

**Block 14. Proposed Activity Street Address.** If the proposed activity is located at a site having a street address (not a box number), enter it in Block 14.

**Block 15. General Permit Activity Type.** Please select all GP activity types that apply to the proposed activity. A list of GP activity types can be found in Section III of the GP.

**Block 16. Summary of Project Impacts.** Please provide ALL proposed impacts, both temporary and permanent in duration, that are located in Waters of the United States. The area of impact shall be provided in square feet (SF). When applicable, impacts that result in conversion of stream bank or shoreline must also be identified in linear feet (LF). Dredging or the discharge of dredged or fill material shall also include the volume, cubic yards (CY), of material removed from or placed into Waters of the U.S. If more entries are required, please attach a table matching the desired format in Block 16.

**Block 17. Project Plans.** Please verify that items a-g are included in the project plans. Three types of illustrations are necessary to properly depict the proposed work. These illustrations or drawings are identified as a Vicinity Map, a Plan View (Aerial view) and a Cross Section Map. For linear projects (e.g. roads, subsurface utility lines, etc.) gradient drawings (longitudinal profile) should also be included. Plans must accurately depict the existing conditions and all aspects of the proposed activity located in waters of the U.S. Please submit one copy of all drawings formatted to print on 8½ x 11 inch or 11 x 17 inch plain white paper. Use the fewest number of sheets necessary for your drawings or illustrations. Each illustration should identify the project, the applicant, and the type of illustration (vicinity map, plan view, or cross section). While illustrations need not be certified engineering sheets; they should be clear, accurate, contain all necessary information, and depict all proposed work. Each submission must also include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current wetland delineation manual and regional supplement published by USACE.

**Block 18. Avoidance & Minimization.** Please verify that items a-d have been implemented for the proposed activity.

**Block 19. Due Diligence.** Please complete all the fields and submit documentation to USACE to demonstrate compliance with the above requirements. This Documentation may include emails, letters, meeting notes, phone call log, project narrative, project plans, a species list from the NOAA Section 7 Mapper, a completed copy of the IPAC determination keys, etc. Documentation should be limited to what is necessary to demonstrate how the proposed activity meets each requirement. Refer to the MA GP, Appendix A, for specific guidance on the identification of previously identified historic properties and previously unidentified historic properties. Endangered Species: \*The applicant must be designated as the non-federal representative for the purposes of Section 7 consultation to select the Rangewide D-Key options. Otherwise, the applicant shall select the following option when IPAC indicates the NLEB is present: "The activity IS located within the NLEB Species Range (PCN Required)."

**Block 20. Aquaculture Activities.** Please verify that items a-d have been obtained or completed prior to commencing work in waters of the U.S.

**Block 21. Additional Information/Attachments.** Please verify that items a-d have been completed prior to commencing work in waters of the U.S.

**Block 22. Lead Federal Agency.** Please identify if there is another lead federal agency involved with the proposed activity. Enter the lead federal agency name (e.g., the Federal Emergency Management Agency, FEMA) and the agency's designated person of contact for the activity.

**Block 23. Statement of Authorization.** The applicant shall sign this section for all activities. If an agent is to be employed, the agent shall sign this section.

**Block 24. Signatures.** The SVN must be signed by the person proposing to undertake the GP activity, and if applicable, the authorized party (agent) that prepared the SVN. The signature of the person proposing to undertake the GP activity shall be an affirmation that the party submitting the SVN possesses the requisite property rights to undertake the GP activity.



## **APPENDIX D: PCN APPLICATION CHECKLIST**

The following information shall be submitted for all PCNs for USACE to properly evaluate your application. Some applications may require more information and this checklist is offered as a tool to assist applicants with submitting a complete application.

### **SECTION 1: GENERAL APPLICATION INFORMATION**

1.  Complete the Pre-Construction Notification document (Appendix B).
2.  Specify which local/state/federal authorizations are required for the project and if any have been obtained or applied for at the time of USACE application submittal.
3.  Identify all funding sources the project will receive or has received to date. Provide any relevant information in the application submission.
4.  Is this part of a larger project that is being implemented in phases? If so, describe the project schedule and how each phase will be implemented.
5.  Describe the existing conditions on the site and the general land use in the vicinity of the project at the time application submittal.
6.  Provide any historic information available that you may have of project area, e.g., existing USACE permit numbers, the names under which the permits were obtained if the permit numbers are unknown, construction dates and proof of prior existence (aerials, photos, town hall records, affidavits, state or local permits, etc.) to verify that the project predates regulation and is “vested”.<sup>19</sup>
7.  The anticipated start and end dates for construction.

### **SECTION 2: WETLAND DELINEATION**

8.  Data used to support aquatic resource boundary determinations (delineation forms, delineation map(s) that show the locations of each aquatic resource in the project area, aerial and ground photographs, LIDAR imagery, national wetland inventory maps, soil maps, national hydrography dataset maps, floodplain maps, historical imagery, etc.).
9.  Photographs of the wetland(s) and/or waterway(s) where impacts are proposed. Photos at low tide are preferred for work in tidal waters.
10.  Indicate the relationship of the project area to waters of the U.S., i.e., adjacent wetlands, tidal influence or hydraulic connectivity through culverts, or other conveyances, etc.
11.  At minimum the delineation map/figure should include the following:
  - a. Contour lines showing topography.
  - b. North arrow.
  - c. Bar and text scale.
  - d. Legend.
  - e. Drawn project boundary.
  - f. High tide line, mean high water, mean low water, ordinary high water mark, and/or wetland boundaries.
  - g. Captions with a unique name for each aquatic resource and the area or length of the aquatic resource within the project area.

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<sup>19</sup> Vested is exempt (someone or something) from a new law or regulation.

- h. Appropriate landmarks and features (e.g., culverts, special aquatic sites, etc.).
- i. Points showing the paired upland and wetland delineation locations for tidal and non-tidal wetlands only.

### **SECTION 3: AVOIDANCE & MINIMIZATION**

- 12.  Describe specific measures taken to avoid impacts to aquatic resources or describe why aquatic resources could not be avoided while achieving the project purpose and need.
- 13.  For impacts to aquatic resources that could not be avoided, describe specific considerations/ measures taken to minimize the area of proposed impacts to aquatic resources in designing the project.
- 14.  Describe specific measures taken to avoid and minimize the proposed direct, indirect, and secondary impacts to aquatic resources and their functions through construction techniques and timing.
- 15.  If applicable, provide a restoration plan that describes how all temporary fills and structures will be removed and the area restored to pre-impact conditions (see GC 22).
- 16.  If applicable, provide an Invasive Species Control Plan (see GC 29). For sample control plans, see [www.nae.usace.army.mil/missions/regulatory/invasive-species](http://www.nae.usace.army.mil/missions/regulatory/invasive-species).
- 17.  If applicable, describe how the proposed wetland/waterbody crossing is compliant with GC 31, Stream Work and Crossings, and Wetland Crossings.

### **SECTION 4A: PROJECT IMPACTS**

- 18.  Describe the overall project and the activities located in Waters of the U.S. (WOTUS) that you are seeking authorization for.
- 19.  Identify the following for project impacts in WOTUS:
  - a.  Direct, indirect, secondary impacts<sup>20</sup> within WOTUS.
  - b.  The size of each impact (square feet or acres, or linear feet).
  - c.  For discharges of fill material (§404), specify the volume of fill material to be discharged (cubic yards).
  - d.  The impact duration from each activity, permanent or temporary (X days).

### **SECTION 4B: PROJECT PLANS**

- 20.  Submit project plans that depict all impacts in WOTUS. On the project plans, applicants shall provide:

#### General Information

- a.  Plan view and typical cross-section view sheets that show the existing and proposed conditions. These illustrations should each be identified with a figure number, date of the map, the project title, the name of the applicant and the type of illustration (vicinity map, plan view, or cross section).
- b.  Drawings, sketches, or plans that are legible, reproducible (color is encouraged, but features must be distinguishable in black and white), drawn to scale, and no larger than 11"x17" and 10 MB when submitted in digital format. Numeric and graphic/bar scales must agree, and plan details must be measurable using a standard engineer's scale on printed plans. Reduced plans are not acceptable.
- c.  The north arrow and remove miscellaneous non-wetland or water project related features such as conduits, utility poles, guardrails, etc.

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<sup>20</sup> See definitions section for the definitions of direct, indirect, secondary impacts.

- d.  Clearly draw the overall limits of work, staging areas, disposal sites, access routes, and any permittee responsible mitigation sites. These areas may include both aquatic resources and upland areas.
- e.  Names or numbers of all roads in the site's vicinity and ownership and numbers of abutting parcels.
- f.  Datum in plan and elevation views. The horizontal datum shall be in the NAD 83 Massachusetts State Plane Coordinate System (INSERT) in U.S. survey feet. The vertical data in coastal projects shall be referenced to either MLLW or the North American Vertical Datum of 1988 (NAVD 88). Both the distance and depth units shall be U.S. survey feet and specified on the project plans.

**Aquatic Resources & Project Impacts**

- g.  Delineation of all aquatic resource types on site including salt marsh; other special aquatic sites (vegetated shallows, mudflats, riffles and pools, coral reefs, and sanctuaries and refuges); other waters, such as lakes, ponds, vernal pools, natural rocky habitat (tidal only), and perennial, intermittent, and ephemeral streams.
- h.  Identify the substrate type (cobble/gravel, organic detritus, sand/shell, silt, mud) and the approximate percentage of each substrate type on site. Grain sizes shall be based on Wentworth grain size classification scale for granules, pebbles, cobbles, and boulders. Sediment samples with a content of 10% or more of pebble-gravel-cobble and/or boulder in the top layer (6-12 inches) should be delineated and material with epifauna/macroalgae should be differentiated from bare pebble-gravel-cobble and boulder.
- i.  The direction of ebb and flood in tidal waters and direction of flow in non-tidal waters.
- j.  In tidal waters, the project boundary distance from special aquatic sites identified in 20g above if within 25 feet from that resource.
- k.  USACE jurisdictional boundaries including ordinary high-water mark (OHWM), high tide line (HTL), mean high water (MHW). Other boundaries include mean low water (MLW), mean lower low water (MLLW), as applicable.
  - Non-tidal: OHWM and/or wetland boundaries.
  - Tidal (structures/work only): MHW, MLW.
  - Tidal (Fill and Structures/work): HTL, MHW, MLW.
  - Tidal (Dredging/Beach Nourishment): HTL, MHW, MLW, MLLW.
- l.  Identification of each aquatic resource with a unique name (ex. Wetland 1, Wetland 2, Tributary 1, Beaver Brook, Atlantic Ocean) and the size of each aquatic resource within the project area (square feet or acres).
- m.  Impacts to each aquatic resource with captions denoting the size of each impact (square feet, acres, or linear feet) and the duration of the impact (ex. Permanent, Temporary (X days)).

**SECTION 4C: PROJECT PLANS - SPECIFIC PROJECT INFORMATION**

- 21.  For projects involving Navigation, Structures, Dredging, and/or Beach Nourishment, the applicant shall also address the following:

**Navigation**

- a.  Identify the locations of adjacent Federal navigation project (FNP) and/or state/local navigation projects on the project plans.
- b.  Specify the distance between the FNP and proposed project boundary, the authorized depths of the FNP, and state plane coordinates of seaward end(s) of project structures near an FNP.

### Structures

- a.  Identification of the piling type (steel, timber, concrete) and diameter to be removed and/or installed.
- b.  Specify the minimal height of the structures' frame over saltmarsh. To meet the SV threshold, piers must be  $\leq 4$  feet in width and this minimal height must achieve a 1.5:1 ratio (i.e., a 4-foot-wide pier is 6 feet above a saltmarsh).
- c.  For floats, the methods of securing them (piles, bottom anchors) and for keeping them off substrate (skids, stops) at low water. To meet the SV threshold, a minimum depth of 18-inches of water should be maintained below a floating dock/structure at lower tide levels.

### Dredging

- a.  The area (SF, acre) and volume (CY) of material to be dredged waterward of MHW for each dredge location.
- b.  Dredge boundaries.
- c.  Bathymetry for existing, proposed, and historical (include dates and USACE permits) dredge depths.
- d.  The likely final angle of repose of the side cuts based on the physical characterization of the material to be dredged and based upon the high/ medium/low, wave or current energy of the location.
- e.  Label area whether the dredging is new, maintenance, improvement, or a combination.
- f.  Location of the disposal site (include location sheet). NOTE: For projects proposing open water, nearshore disposal, or beach nourishment, contact USACE as early as possible for sampling and testing protocols. Sediment testing, including physical (e.g., grain-size analysis), chemical and biological testing may be required. Sampling/testing of sediments without such contact should not occur and if done, will be at the applicant's risk.
- g.  The methods and areas used to retain or prevent dredged material from running back into the wetland or waterway. Provide the capacity of the storage area and points of runback, including the overflow route, into the aquatic system.
- h.  For open-water disposal, explain why inland or beneficial reuse sites are not practicable.
- i.  Show the finished top elevation of the disposal site.

### Beach Nourishment

- a.  For beach nourishment, identify the disposal footprint, existing and proposed nourishment profiles (multiple profiles are appropriate if the site is more than 150 feet long or non-contiguous), total fill area (SF) and volume (CY), fill area and volume waterward of the HTL, and delineation of dunes, banks, existing beach vegetation, and contours.
- b.  For beach nourishment identify the substrate type (fine sand, sand, cobble, boulder) and/or grain-size of existing material.

## **SECTION 5: STRUCTURES**

22.  For projects with the removal of existing pilings identify the number, type (steel, timber, concrete) and diameter of pilings to be removed and the methodology for removal (cut off at mud line, pulling, vibratory, etc.).
23.  For projects with the installation of new pilings identify the number, type (steel, timber, concrete) and diameter of pilings to be installed and the methodology for installation (vibratory hammer, impact hammer etc.).
24.  Identify any existing structures and moorings in waters adjacent to the proposed activity, their dimensions, and the distance to the limits and coordinates of any proposed mooring field or reconfiguration zone. For reconfiguration zone and mooring fields, provide the coordinates for all

corners based on the Massachusetts State Plane Coordinate System. Specify the maximum number of slips and/or moorings within proposed reconfiguration zones or anchorage areas.

25.  The dimensions of the structure or work and extent of encroachment waterward of MHW and from affixed point on the shoreline or upland.
26.  Shoreline of adjacent properties and property boundary offset for structures. In narrow waterbodies, the distance to opposite shoreline, waterway width, and structures across from proposed work.
27.  For new commercial boating facilities, anchorage areas or reconfiguration zones, provide a description of the type of vessels that would use the facility, and any plans for sewage pump-out facilities, fueling facilities and contingency plans for oil spills.
28.  See Sections 4A-C above.

## **SECTION 6: AQUACULTURE**

29.  Identify the coordinates for lease area corners and gear configuration area on the project plans.
30.  Identify the proposed aquaculture gear type (buoys, floats, racks, trays, nets, lines, tubes, cages, containers, and other structures). Provide the impacts for each aquaculture gear type (see Section 4A 19a-d).
31.  For a GP 18 to be valid, applicants must have (a) their MA DMF Aquaculture Certification letter for licensed shellfish aquaculture sites, (b) documentation that the applicant has coordinated with the U.S. Coast Guard regarding USCG Private Aids to Navigation standards, (c) their MEPA Certificate (if required), and (d) documentation that the applicant has contacted their local authorities (ex. harbormaster, select board, shellfish constable) for authorization of their facility.
32. Provide information on site the operation, maintenance, and access. Will the site be accessed via boat, kayak, etc.? Will cages be removed in the winter? How often will gear be checked on? Is there an operations plan for the proposed aquaculture area?
33.  See Sections 4A-C above.

## **SECTION 7: DREDGING**

34.  Sampling plan requests for new, improvement or maintenance dredging must submit completed [Dredged Material Evaluation checklist found at Dredged Material Evaluation Checklist, Sampling and Analysis Plan Requirements from Applicant \(army.mil\)](#) and identify the method of handling/transporting the dredged material.
35.  Identify grain-size of material to be dredged (e.g., silty sand) and provide any existing sediment grain size and bulk sediment chemistry data from the proposed project or nearby projects. Include information on any recent spills of oil and/or other hazardous materials and/or nearby outfalls. Document the information source, e.g., EPA database, the harbormaster or fire chief. If there are none, state "none".
36.  See Section 4A, 4B and 4C, Dredging 21(a-i) above.

## **SECTION 8: WETLAND/WATERBODY CROSSINGS**

37.  For the stream crossing, identify the crossing methodology on the project plan (e.g., dam and pump, dry, wet, etc.). Submit a waterway crossing sequencing plan with the application.
38.  If the project includes a permanent crossing of a tidal waterway, your project design should be modified to match the velocity, depth, cross-sectional area, and substrate of the existing waterbody adjacent to the crossing and provide documentation (hydraulic analysis including low lying property analysis) that the size of the crossing will not restrict tidal flow over the full natural tide range and will not adversely affect abutting infrastructure.

39.  If the work includes a permanent crossing of a non-tidal stream, your project design should be modified to match the culvert gradient of the existing stream channel profile, provide clearance for  $\geq 1.2$  times bank full width and conveyance should be embedded  $\geq 1-2$  feet for box culverts and pipe arches or  $\geq 1-2$  feet and at least 25 percent for rounded pipes/culverts in accordance with the Massachusetts Stream Crossing Standards. Provide the basis for any variation to this requirement.
40.  If the work includes a permanent crossing of a non-tidal stream, the structure should be designed to include a natural bottom substrate within the conveyance that matches the characteristics of the substrate in the natural stream channel and the character of the banks (mobility, slope, stability, confinement, grain and rock size). The conveyance should be designed with a minimum openness ratio  $\geq 0.82$ -feet (0.25-meters). For how to calculate openness ratio and stream simulation ecological approach for road and stream crossings, see <https://www.nae.usace.army.mil/Missions/Regulatory/Stream-and-River-Continuity/>.

### **SECTION 9: COMPENSATORY MITIGATION**

41.  Does the project require Compensatory Mitigation<sup>21</sup> for impacts to Waters of the U.S.? (See Section V in the 2023 Massachusetts General Permit)
42.  If the project requires mitigation, does the selected compensatory mitigation option (i.e., In-Lieu Fee, permittee-responsible mitigation) deviate from the order of the options presented in §332.3(b)(2)-(6)? If so, please explain why. <https://www.ecfr.gov/current/title-33/chapter-II/part-332/section-332.3>
43.  For any compensatory mitigation that involves preservation, the applicant must use a site protection instrument to preserve the parcel in perpetuity. (Conservation Easement, Deed Restriction, etc.) <https://www.mass.gov/service-details/conservation-restriction-review-program>.

### **SECTION 10: HISTORIC PROPERTIES & NOTIFICATIONS TO SHPO, THPOs, BUAR**

44.  Notify the SHPO, Massachusetts Historical Commission, of the Project via Certified Mail and include proof of delivery or receipt in the application package (See Appendix A).
45.  As applicable, notify the THPOs, Narragansett Indian Tribe, Wampanoag Tribe of Gay Head (Aquinnah), and Mashpee Wampanoag Tribe, of the Project via email OR mail and include proof of delivery or receipt in the application package (See Appendix A).
46.  As applicable, notify the BUAR via email (*strongly preferred*) OR mail and include proof of delivery or receipt in the application package (See Appendix A).
47.  Include responses to this notification in the permit application.
48.  As applicable, information on historic properties (Tribal and Archaeological) within the project area should be provided in the permit application.

### **SECTION 11: ENDANGERED SPECIES & ESSENTIAL FISH HABITAT**

49.  Provide a USFWS Information for Planning and Consultation (IPaC) Official Species List from <https://ecos.fws.gov/ipac> and the email of the individual who generated the list (see GC 10 of the 2023 Massachusetts General Permit for more information).
50.  Provide a species list from the NMFS Section 7 Endangered Species Act mapper at <https://noaa.maps.arcgis.com/apps/webappviewer/index.html>.
51.  Provide a species list from the NMFS Essential Fish Habitat Mapper at [https://www.habitat.noaa.gov/apps/efhmapper/?page=page\\_3](https://www.habitat.noaa.gov/apps/efhmapper/?page=page_3).

<sup>21</sup> Your mitigation proposal must be consistent with the December 29, 2020 Compensatory Mitigation Standard Operating Procedures at <https://www.nae.usace.army.mil/Portals/74/docs/regulatory/Mitigation/Compensatory-Mitigation-SOP-2020.pdf> and 2008 Mitigation Rule.

52.  If the project will generate turbidity, describe the extent of turbidity and if erosion controls will be used to contain turbidity. If turbidity controls are not operationally feasible, explain the basis for your conclusion and identify any other measures that you will implement to minimize resuspension of sediment.
53.  Identify the substrate type and any aquatic resources that will be affected by the proposed action. (SAV, salt marsh, sand, silt/clay, rocky/hard bottom)
54.  For projects which will include the installation of pilings/sheet-piles, identify the substrate at the project site (sand, cobble, silt/mud/clay), the installation method (vibratory hammer, impact hammer, combination) and indicate whether the following “soft start” procedures at beginning of the workday and after a 30-minute period of rest will be deployed:
- a.  Vibratory Pile Installation: pile driving will be initiated for 15 seconds at reduced energy followed by a one-minute waiting period. This sequence of 15 seconds of reduced energy driving, one-minute waiting period will be repeated two additional times, followed immediately by pile-driving at full rate and energy.
  - b.  Impact Pile Installation: pile driving will commence with an initial set of three strikes by the hammer at 40% energy, followed by a one-minute wait period, then two subsequent 3-strike sets at 40% energy, with one-minute waiting periods, before initiating continuous impact driving.
55.  If the project involves dredging, describe any dredge history, number of dredge events to be covered by the permit, erosion/sediment controls, dredge type, intake structures (mesh screen size), dredged material disposal site.
56.  For project activities associated with structures, identify the number, type (drill barge, work boat, tugboat, etc.), and size of any temporary vessels that will be used. Specify measures that will be implemented to ensure vessels are not berthed in shallow water or will “ground out” at low tide.
57.  For aquaculture projects identify whether any component of the gear is seasonal (will be removed annually) or will be in place year-round. If gear will be present year-round and will be variably managed (e.g., floating in summer, bottom in winter) identify month/date for such configurations.
58.  For aquaculture projects identify whether the project will involve use of an existing vessel or new vessel. Identify the length for all work vessels and identify the distance round trip from vessel berthing location and aquaculture area.
59.  For project activities associated with docking structures (either commercial, industrial, or recreational) identify the number, type (motorized/non-motorized, jet-ski, sailboat, kayak, canoe, other that will be berthed there and the sizes of each.
60.  Information required for Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act:
- a. Results of an eelgrass survey completed per the INSERT.
  - b. Essential Fish Habitat Assessment to determine project-related impacts to essential fish habitat, using guidance developed by the National Marine Fisheries Service.
61.  A document containing the following information (requirements of 50 CFR §600.920(e)(3)):
- a. Description of proposed action.
  - b. Analysis of potential adverse effects on essential fish habitat.
  - c. Conclusions regarding the effects of the action on essential fish habitat.
  - d. If applicable, proposed mitigation.
  - e. Analysis of alternatives to the proposed action.
  - f. Other:

Appendix C  
Geotechnical Report



Consulting  
Engineers and  
Scientists

**Geotechnical Report**  
**Rosemont Street Bridge Over Little**  
**River (Bridge No. H-12-024)**

Haverhill, Massachusetts

**Submitted to:**

BETA Group, Inc.  
315 Norwood Park South  
Norwood, MA 02062

**Submitted by:**

GEI Consultants, Inc.  
400 Unicorn Park Drive  
Woburn, MA 01801  
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December 2022 (Revised August 14, 2024)

Project 1804108



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Stephen J. Sarandis, P.E.  
Project Manager

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Michael Paster, P.E.  
Senior Geotechnical Engineer

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## Executive Summary

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This report presents the results of the subsurface explorations and our geotechnical recommendations for the proposed new replacement bridge that will carry Rosemont Street over the Little River in Haverhill, Massachusetts (Bridge No. H-12-024).

The new bridge will have a single span of about 36 feet and will be about 33 feet wide. The roadway grades will remain roughly the same. The existing bridge abutments will be partially demolished, and the new bridge abutments will be constructed behind the existing abutments.

### Subsurface Conditions

Northern Drill Service Inc. of Northborough Massachusetts drilled two borings (BB-1 and BB-2) between November 1 and November 5, 2018.

Standard Penetration Testing (SPT) with split-spoon sampling was performed using an automatic hammer at about 5-foot intervals in the borings. Ten feet of bedrock was cored in each boring.

Bedrock was encountered at a depth of about 13 feet and 27 feet below existing grade at the east abutment and west abutment, respectively. Groundwater was measured in the completed borings at a depth between 4.5 and 7.9 feet below existing grade and is most likely controlled by the water level in the Little River.

### Recommendations

We recommend that the east abutment and wingwalls be supported on spread footing foundations bearing on tremie concrete over bedrock. We recommend that the west abutment and wingwalls be founded on drilled micropiles obtaining their capacity in side friction in bedrock.

### Construction Considerations

Cofferdams will be required for excavation support, and groundwater will be encountered during excavation for the foundations. At the east abutment (shallow bedrock), we recommend using tremie concrete to create a seal against groundwater inside the cofferdam. At the west abutment (deeper bedrock), we expect that dewatering wells will be needed to maintain a dry excavation.

Our professional services for this project have been performed in accordance with generally accepted engineering practices; no warranty, express or implied, is made.

# 1. Introduction

---

## 1.1 Purpose

This report presents the results of the subsurface explorations and our geotechnical recommendations for the proposed new replacement bridge that will carry Rosemont Street over the Little River in Haverhill, Massachusetts (Bridge No. H-12-024).

## 1.2 Scope

Our scope of work included:

- Conducted a site visit to observe site conditions.
- Reviewed available published geologic data and record drawings for the existing bridge.
- Performed two borings. Provided full-time observation of the explorations.
- Performed four laboratory grain size tests on soil samples collected by hand from surface sampling locations for a scour analysis to be performed by others.
- Obtained one sample of sediment from the bottom of the Little River and sent it to a chemical testing lab for analyses required for a Water Quality Certificate per 314 CMR 9.00.
- Evaluated the soil and bedrock conditions and developed geotechnical design and construction recommendations.
- Prepared this geotechnical report.

## 1.3 Authorization

Mr. Mark R. Gershman of BETA Group, Inc. authorized our work by a subconsultant agreement dated September 25, 2018.

## 1.4 Project Personnel

The following personnel at GEI were involved with the field explorations, evaluations, and preparation of this report:

- |                                 |                       |
|---------------------------------|-----------------------|
| • Stephen J. Sarandis, P.E.     | Project Manager       |
| • Michael Paster, P.E.          | In-House Reviewer     |
| • Joseph R. Giampa, Ph D., P.E. | Geotechnical Engineer |
| • Maria Hernandez-Cabal, P.E.   | Geotechnical Engineer |
| • Kurt Gleichauf, P.E.          | Geotechnical Engineer |
| • William G. Lukas, Ph.D., P.E. | Geotechnical Engineer |

## 2. Site and Project Description

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### 2.1 Site and Project Description

The site is located where Rosemont Street crosses over the Little River in Haverhill, Massachusetts (Fig. 1). The Little River is a generally south-flowing river, and terminates at the Merrimack River in downtown Haverhill, Massachusetts.

We understand that the City of Haverhill plans to construct a new single-span replacement bridge that will be supported on new abutments constructed outside the existing abutments. The new bridge will have a span of about 36 feet and will be about 33 feet wide. The existing abutments and wingwalls will be mostly demolished. The roadway grades will remain approximately the same. The proposed bridge plan and existing conditions are shown in Figs. 2 and 3, respectively.

The surface of Rosemont Street is at about El. 34 to El. 35 as it crosses the bridge over the Little River. The elevation of the riverbed is about El. 22 in the area around the bridge. The ground surface on the riverbanks adjacent to the bridge abutments is generally about El. 25 to El. 30 (Figs. 2 and 3).

Limited information is available regarding the substructure and foundations of the existing bridge. Drawings for construction of a nearby sewer pump station were prepared by the City of Haverhill, Department of Public Works, Engineering Division and are dated July 1980 (Appendix A). Section A-A on Sheet 9 of the drawings shows that the existing bridge is supported by two concrete gravity abutments. The drawing indicates the following foundation dimensions, although it is not clear what the source was for this cross section, or how accurate these dimensions are:

- The abutments bear about 15.5 feet below roadway grade.
- The footings are about 6 feet wide.
- The clear span between the abutments is about 16 feet.

We used the following scour numbers for our analyses, as provided in the Hydraulic and Scour Analysis Report prepared by BETA and dated April 2024.

Scour Type	Design	Check
Contraction	0.78 ft	0.89 ft
Abutment	5.65 ft	7.04 ft
Long Term Degradation	N/A	N/A

## **2.2 Project Design Basis**

Our recommendations are based on:

- AASHTO LRFD Bridge Design Specifications, Ninth Edition, 2020.
- AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2<sup>nd</sup> Edition, 2011, with 2012, 2014, 2015, and 2022 Interim Revisions.
- MassDOT LRFD Bridge Manual, 2013, revised 2020.

## **2.3 Elevation Datum**

Elevations in this report are in feet and are referenced to the 1988 North American Vertical Datum (NAVD 1988).

## **3. Subsurface Conditions**

---

### **3.1 Site Geology**

The site is located in a generally flat area with numerous streams and wetlands. The United States Geological Survey (USGS) “Surficial Geologic Map of the Salem Depot – Newburyport East – Wilmington – Rockport 16-Quarangle Area in Northeast Massachusetts” (Stone et al., 2006) surficial geology map indicates soils near the Little River are “coarse deposits” of glacial origin consisting primarily of sand and gravel. Soils farther away from the Little River are “thin till” described as non-sorted, non-stratified matrix of sand, some silt, and little clay containing scattered gravel clasts and few large boulders.

The USGS “Bedrock Geologic Map of Massachusetts” (Zen et al., 1983) identifies the bedrock in the project vicinity as the Berwick Formation. The Berwick Formation is described as thin- to thick-bedded metamorphosed calcareous sandstone, siltstone, and minor muscovite schist. A mica schist seam of the Berwick Formation is in the project vicinity.

### **3.2 Subsurface Explorations**

Northern Drill Service Inc. of Northborough, Massachusetts drilled two borings (BB-1 and BB-2) between November 1 and November 5, 2018. A second boring behind each abutment was considered. However, due to the presence of overhead wires on either side of the bridge, the additional borings would have been advanced very close to the first borings (BB-1 and BB-2). Therefore, it was our judgement that drilling only one boring at each abutment would be appropriate. The boring locations are shown in Figs. 2 and 3. A GEI engineer logged the explorations and collected samples. GEI logs for the borings are provided in Appendix B.

The borings were completed using driven flush joint steel casing and rotary wash drilling techniques. Standard Penetration Testing (SPT) with split-spoon sampling was performed using an automatic hammer at about 5-foot intervals in the borings. Ten feet of bedrock was cored in each of the borings.

Upon completion, borings were backfilled with cuttings and sand. The road surface was repaired using cold patch.

Ground surface elevations at the boring locations were estimated based on the plan provided by BETA. Ground surface and bedrock elevations were:

Boring	Ground Surface El. (ft, NAVD 88)	Depth to Bedrock	Bedrock El. (ft, NAVD 88)
BB-1	34.8	13.3 ft	21.5
BB-2	34.0	27.0 ft	7.0

We also obtained four sediment samples, by hand, from the banks and channel of the Little River. The samples were obtained on January 18, 2019, upstream of the bridge (Figs. 2 and 3).

### 3.3 Sample Review

The soil samples and rock cores from the borings were examined at GEI’s offices by Stephen Sarandis. Based on our review, it is our opinion that the descriptions in the boring logs in Appendix B are a reasonable characterization of the conditions encountered.

### 3.4 Laboratory Testing

We performed grain size analyses on four soil samples obtained by hand from surface sampling locations (SS1 – SS4) along the banks and channel of the Little River. The grain size curves are presented in Appendix C. Grain size tests were performed in general accordance with ASTM D6913.

A portion of one of the sediment samples collected from the channel of the Little River (SS4) was sent to Alpha Analytical Laboratory in Westborough, Massachusetts for the analyses required for a Water Quality Certificate per 314 CMR 9.00. The Alpha Analytical Laboratory results are summarized in Table 3, and presented in Appendix D.

### 3.5 Subsurface Conditions

The soil layers encountered in the borings are described below in order of increasing depth. The approximate layer boundary depths are shown in the subsurface profile in Fig. 4. Conditions are only known at the boring locations and conditions between borings may differ from those indicated below and shown in the profile.

Asphalt: All the borings were drilled in Rosemont Street, which is paved with about 6 inches of asphalt.

Fill: Fill was encountered below the pavement in both borings to depths of about 13.5 to 19 feet below the ground surface. The fill generally consisted of fine to coarse sand, with some fine to coarse gravel and trace inorganic silt.

Almost all N-values (uncorrected) were higher than 50, including several refusals. In BB-2, the N-value was 13 at a depth of 18 feet. Some of the higher N-values were likely the result of the sampler encountering coarse gravel, cobbles, and boulders during driving.

Lean Clay: Lean clay with trace fine to coarse sand was encountered below the fill in BB-2. The lean clay layer was about 3 feet thick. The uncorrected N-value obtained in the lean clay was 2 blows per foot, indicating a soft soil.

Bedrock: Bedrock was encountered in the borings below the fill and clay at depths of 13 feet in BB-1 and 27 feet in BB-2 (~ El. 21.5 and El. 7, respectively). About 5 feet of gravel, possibly weathered bedrock, was encountered in BB-2 at El. 12, above the cored rock. The bedrock encountered was classified as black, fine-grained, hard, fresh, siltstone in BB-1 and black, coarse-grained, hard, fresh, schist in BB-2 (Berwick Formation). Core recovery ranged from 95 to 100 percent. The Rock Quality Designation (RQD) ranged from 56 to 100 percent, with four out of five values greater than 80 percent, indicating fairly intact bedrock.

### **3.6 Groundwater Levels**

Depth to groundwater was measured in BB-1 at a depth of 4.5 feet below ground surface after drilling (~El. 29.5) and in BB-2 at a depth of 7.9 feet below ground surface after drilling (~El. 27). The borings were drilled with water, so these measurements may not represent stabilized groundwater levels. Based on the proximity of the Little River, we expect the groundwater elevation to be about the same as the water level in the river.

## 4. Design Recommendations

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### 4.1 Soil Properties

Recommended soil properties for design are presented in Table 1. We selected these values based on published correlations to SPT N-values, our review of the soil and rock descriptions, and our engineering judgment.

### 4.2 Foundation Design at East Abutment

Based on conditions encountered in BB-1, we recommend that the east bridge abutment and wingwalls be supported on spread footing foundations bearing on bedrock or tremie concrete over bedrock.

Any soil above bedrock should be removed per the recommendations in Section 5.1.

There is no minimum embedment requirement for frost protection for footings bearing on bedrock. Footings should be at least 3 feet wide.

To design foundations on bedrock or tremie concrete over bedrock, we recommend using the following bearing resistances:

	<b>Bearing Resistance</b>
Strength Limit State	61 ksf (nominal)
Service Limit State	40 ksf

Supporting calculations for these recommendations are provided in Appendix E. Table 2 provides recommended resistance factors that should be applied to the recommended nominal bearing resistance.

Based on the geotechnical conditions, we expect total and differential settlements of foundations on bedrock or concrete over bedrock to be negligible.

The east abutment will be supported on spread footing foundations bearing on bedrock. Scour protection should be provided by excavating a minimum of 6-inches below top of bedrock per Drawing No. 3.6.4 of the MassDOT 2020 Bridge Manual (Part II).

### 4.3 Foundation Design at West Abutment

Based on conditions encountered in BB-2, we recommend that the west (southwest) bridge abutment and wingwalls be supported on drilled micropiles obtaining their resistance in friction in bedrock. Driven piles were also considered, but were judged to be inappropriate because:

1. The short distance to bedrock means the piles would have limited length to develop resistance to lateral loads.
2. Difficult site access due to the size of the pile driving equipment, and the limited size of the work site.

Micropiles are installed by drilling a steel casing in sections to the desired depth. As the casing is advanced, air or water is jetted through the casing to remove the soil cuttings. When the casing reaches the top of rock, a roller bit is used to drill an open socket into the rock. A center reinforcing bar is then lowered to the bottom of the rock socket, and the rock socket and casing are tremie-grouted full of cement grout.

MassDOT design requirements are provided in Section 3.2.4 of the 2020 Bridge Manual. The structural design of the micropiles should be in accordance with Article 10.9.3.10 of the AASHTO LRFD Bridge Design Specifications.

We recommend that pile axial capacity be obtained entirely in competent bedrock, ignoring the contribution of the overlying soil. For preliminary design, we recommend a nominal friction resistance between grout and rock of 15 ksf, based on AASHTO Table C10.9.3.5.2.1 (calculation in Appendix E). A resistance factor of 0.55 should be used for preliminary design.

We recommend that the axial capacity be confirmed with one pre-production pile load test on a sacrificial pile, in accordance with Article 10.9.3.5.4 of the AASHTO Specifications. After the load test, the bond zone may be designed based on a resistance factor of 0.70, per Table 10.5.5.2.5-1 of the AASHTO Specifications. In our opinion, either compression or tension tests on this sacrificial pile may be used to check the capacity. (The recommended minimum rock socket length of 10 feet, to account for variability of rock quality, applies regardless of the bond strength measured during the pile load test.)

In accordance with Article 10.9.1.2 of the AASHTO Specifications, the pile spacing should be at least three times the pile diameter or 2.5 feet, whichever is greater. The piles should extend at least 12 inches into the pile cap.

We estimate that settlement of the micropile foundations will be about ½ inch plus the elastic shortening of the portion of the piles above the top of bedrock.

We developed a preliminary pile design to support the design loadings provided by BETA. For axial load resistance, we assumed the resistance was obtained entirely in competent bedrock, with an assumed uncased (bond) length in bedrock to be a minimum of 8 inches in diameter. This resulted in a required bond length of 6.4 feet (calculations in Appendix E). However, we recommend a minimum rock socket length of 10 feet to account for potential variability in the rock.

For lateral load resistance, we modeled the pile using a 10-foot socket as recommended above. The results of GROUP analyses for lateral loading on the micropiles are provided in Appendix E. Lateral deflection computed in the GROUP analyses for Service I loads were as much as 1.6 inches. The analyses included:

- About 8 feet of scour (the summation of the long term degradation, check contraction and abutment scour).
- Steel casing with a yield stress of 52 kips per square inch and dimensions of 9.625-inch-O.D. and 0.545-inch wall thickness or 10.75-inch-O.D. and 0.5-inch wall thickness.
- Corrosion allowance of 1/16-inch on the exterior surface of the casing.
- Per Section 3.2.4.2.6 of the Bridge Manual, the casing, which provides most of the bending resistance for the pile, extends at least 12 inches into the top of competent bedrock.
- A No. 18 Grade 60 center reinforcing bar will extend to the bottom of the pile.
- A pinned connection between the pile and the pile cap.

The structural capacity of the pile to resist the computed shears and moments should be checked during final design. The bending capacity at the joints is significantly less than the capacity of the intact casing, so the specifications should require that any joints in the casing be located at least 8 feet below the bottom of the pile cap.

#### **4.4 Lateral Earth Pressures and Sliding Resistance**

Lateral earth pressures on abutments and wingwalls should be calculated using the soil properties in Table 1. When evaluating sliding along the base of the footings, we recommend that a nominal (ultimate) coefficient of friction of 0.7 be used for cast-in-place footings on bedrock. Applicable Resistance Factors for evaluating sliding are provided in Table 2.

## 4.5 Seismic Design Information

Based on Section 3.1.2 of the Bridge Manual, and the map at <https://hepgis.fhwa.dot.gov/fhwagis/>, this bridge is considered non-critical and non-essential.

Therefore, per Section 3.4.2.1 of the Bridge Manual, seismic hazard parameters should be based on the maps in the AASHTO Second Edition of the Guide Specifications for LRFD Seismic Bridge Design, which represent a seismic hazard corresponding to a 7 percent probability of exceedance in 75 years (approximately 1,000-year return period). The resulting seismic parameters are:

- Horizontal Peak Ground Coefficient (PGA) = 0.090
- Horizontal Response Spectral Coefficient (period = 0.2 sec) ( $S_s$ ) = 0.180
- Horizontal Response Spectral Coefficient (period = 1.0 sec) ( $S_1$ ) = 0.041

We recommend using Site Class C for seismic design. While the calculations in Appendix E indicate Site Class D, it is our judgement that Site Class D is overly conservative considering the presence of shallow bedrock and the overall site conditions. Site coefficients for peak ground acceleration [ $F_{PGA}$ ], short-period range [ $F_A$ ], and long-period range [ $F_V$ ] are 1.2, 1.2, and 1.7, respectively. Application of these site coefficients results in the following recommended coefficients for development of design response spectra:

- Response Spectral Acceleration,  $A_s = 0.108$
- Design Spectral Acceleration Coefficient at 0.2 second period,  $S_{DS} = 0.216$
- Design Spectral Acceleration Coefficient at 1.0 second period,  $S_{D1} = 0.070$

This site falls into Seismic Design Category (SDC) A, based on the 1-second-period design spectral acceleration being less than 0.15 g. Design requirements for conventional bridges in SDC A are provided in Section 3.4.4 of the 2020 MassDOT “*LRFD Bridge Manual*.”

We did not check liquefaction because the Guide Specifications (Section 6.8) indicate that liquefaction potential need not be evaluated for sites in SDC A. However, it is our opinion that liquefaction is not a concern for this project.

## 5. Construction Recommendations

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### 5.1 Subgrade Preparation

At the east abutment, we recommend that a cofferdam be installed, soil above bedrock be excavated in the wet, and tremie concrete be placed up to the design bottom of footing. The tremie will act to help seal the bottom of the cofferdam against bedrock, and limit infiltration of groundwater and water from the river.

Drawing No. 3.6.4 of the MassDOT Bridge Manual (2020, Part II) indicates that the prepared bedrock surface should be a minimum of 6 inches below top of bedrock. The bedrock surface below the tremie should be relatively level and sound. If the bedrock surface is sloping, the bedrock surface should be cut to provide steps with approximately level surfaces (within 10 degrees of horizontal). We anticipate some combination of mechanical excavation and air lifting will be required to clean off the bedrock surface. We recommend that the special provisions include provisions for inspection of the rock surface by a diver prior to placing tremie concrete.

At the west abutment, we recommend that a cofferdam be installed, and dewatering wells be installed to maintain a dry excavation. The contractor should prepare the subgrade as needed to provide a firm working surface for micropile installation and for pile cap construction. Subsurface conditions are known only at the boring location and conditions may vary along the length of the proposed abutment. It is possible that depth to bedrock may be shallower at other locations. If shallow bedrock is encountered, the contractor may need to adjust their methods, including potential placement of tremie concrete to help seal the bottom of the excavation.

We considered possibly incorporating the existing east and west abutments as part of the cofferdams. However, this seemed impractical for the following reasons:

- The existing abutments are combination of concrete, masonry, and stone rubble and would likely not provide an adequate water cutoff.
- The project environmental permitting requires enclosing the existing abutments in a perimeter cofferdam before they can be partially demolished.

### 5.2 Excavation and Dewatering

All excavations should be made in accordance with OSHA standards. Cofferdams should be designed by a Massachusetts-registered professional engineer experienced in excavation support design. The engineer should be engaged by the contractor and the design should be submitted for review before installation.

Groundwater will likely be encountered during foundation excavations. The contractor should be prepared to manage and control groundwater during excavation and to control surface water from entering excavations to provide a dry and stable subgrade. The contractor should be responsible for selecting the dewatering methods based on their proposed methods and equipment used for excavation. For excavations in soil, groundwater levels should be maintained at least two feet below excavation subgrade levels at all times, or deeper if necessary to maintain stable conditions.

The dewatering plan and systems should be designed by an experienced professional engineer registered in Massachusetts and retained by the contractor. The contractor should submit a dewatering plan for review prior to the start of excavation. Dewatering efforts must satisfy the requirements of local, state, and federal environmental and conservation authorities.

### **5.3 Backfilling**

Gravel Borrow backfill (MassDOT Standard Specification No. M1.03 Type b) should be placed behind the abutments and wingwalls, extending at least one foot beyond the back of the structure, as shown in Drawing No. 3.6.13 of the MassDOT Bridge Manual (Part II). Other backfill (e.g., to fill excavations associated with construction or removal of existing foundations or utilities) should consist of Ordinary Borrow (MassDOT Standard Specification No. M1.01.0) or Gravel Borrow.

In general, fill materials should be placed and compacted in accordance with MassDOT “*Standard Specifications for Highway and Bridges*,” Section 150. However, we recommend that compaction in areas too small for a self-propelled smooth drum vibratory compactor, or within 5 feet of walls, be performed using a vibratory walk-behind roller or plate compactor (weighing at least 200 lbs. imparting an impact load of at least 2.5 tons), with soil placed in maximum 6-inch-loose lifts.

### **5.4 Freezing Conditions**

If construction is performed during freezing weather, special precautions will be required to prevent soil subgrades from freezing. Freezing of the soil beneath foundations and pavements during construction may result in heave and subsequent settlement of the structure.

All soil subgrades should be free of frost before foundation construction. Frost-susceptible soils that have frozen should be removed and replaced with compacted Gravel Borrow or Gravel Borrow for Bridge Foundations, as appropriate. The foundation and the soil adjacent to the foundation should be insulated until they are backfilled.

## 6. Limitations

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Our recommendations are based on the project information provided to us at the time of this report and may require modification if there are any changes in the nature, design, or location of the proposed construction. We recommend that GEI be engaged to review the final plans and specifications to judge whether changes in the project affect the validity of our recommendations and whether our recommendations have been properly implemented in the design.

The recommendations in this report are based in part on the data obtained from the borings. The nature and extent of variations between borings may not become evident until construction. If variations from the anticipated conditions are encountered, it may be necessary to revise the recommendations in this report. Therefore, we recommend that GEI be engaged to make site visits during construction to: a) check that the subsurface conditions exposed during construction are in general conformance with our design assumptions and b) ascertain that, in general, the geotechnical aspects of the work are being performed in compliance with the contract documents.

Our professional services for this project have been performed in accordance with generally accepted engineering practices; no warranty, express or implied, is made.

Geotechnical Report  
Rosemont Street Bridge Over Little River  
(Bridge No. H-12-024)  
Haverhill, Massachusetts  
December 2022 (Revised August 14, 2024)

# Tables

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**Table 1. Recommended Soil and Rock Properties**  
**Rosemont Street Bridge of the Little River, Bridge No. H-12-024**  
**Haverhill, Massachusetts**

Layer/Soil Type (both above and below Groundwater Table)	Total Unit Weight, $\gamma$ (pcf)	Friction Angle, $\phi$ (deg)	Earth Pressure Coefficients <sup>(1,2)</sup>	Nominal Grout to Ground Bond Stress (ksf)	For LPILE or GROUP Analysis	
					Soil Model	p-y Modulus, K (pci)
Fill	125	35	Ka=0.25, Ko=0.43 Kp = 7.1	not used	Sand	86
Clay (drained)	110	30	Ka=0.30, Ko=0.50 Kp = 4.5	not used	Sand	35
Weathered Bedrock	140	38	Ka=0.22, Ko=0.38 Kp = 8.6	not used	Sand	120
Bedrock	170	--	not used	104 psi (15 ksf)	Vuggy Limestone	$q_u = 7$ ksi (1,000 ksf)
Gravel Borrow Backfill	130	35	Ka=0.25, Ko=0.43 Kp = 7.1	not used	not used	not used
Gravel Borrow for Bridge Foundations	135	37	not used	not used	not used	not used

**Notes:**

1. Recommended earth pressure coefficients are associated with horizontal backfill in front and behind the walls, and are in accordance with the recommendations of Section 3.1.6 of the MassDOT LRFD Bridge Design Manual.
2. Seismic earth pressure coefficients are not included because the bridge is classified under Seismic Design Category A, and seismic soil forces need not be included in design of the substructures per the MassDOT LRFD Bridge Design Manual.
3. Passive pressure coefficients are intended for use in Support of Earth design only.

**Table 2. Resistance Factors**  
**Rosemont Street Bridge over the Little River**  
**Bridge No. H-12-024**  
**Haverhill, Massachusetts**

Load Case	Strength Limit State <sup>(2)</sup>	Service Limit State <sup>(3)</sup>	Extreme Limit State <sup>(4)</sup>
<i>Cast-in-Place Cantilever Abutments</i>			
Bearing resistance of shallow foundations on rock	0.45	1.0	1.0
Sliding (Cast-in-place foundation)	0.8	1.0	1.0
Global Stability <sup>(5)</sup>	NA	0.75/0.65 <sup>(6)</sup>	NA
<i>Cast-in-place Cantilever Walls</i>			
Bearing resistance of shallow foundations on rock	0.55	1.0	0.8
Sliding	1.0	1.0	1.0
Global Stability <sup>(5)</sup>	NA	0.75/0.65 <sup>(6)</sup>	NA

**General Notes:**

- Resistance factors above were obtained from the 2020 AASHTO LRFD Bridge Design Specifications (AASHTO).
- The strength limit state resistance factors for bearing and sliding of shallow foundations were obtained from AASHTO Table 10.5.5.2.2-1 and Table 11.5.7-1.
- Both AASHTO Sections 10.5.5.1 and 11.5.7 indicate that a resistance factor of 1.0 should be used for bearing resistance and sliding at the service limit state.
- AASHTO Sections 10.5.5.3 and 11.5.8 provide resistance factors for the Extreme Limit State.
- Per AASHTO 3.4.1, global stability is considered a Strength Limit. However, all load factors are set equal to 1.0, so we have included global stability in the Service Limit column. Per Sections 3.4.4.3 and 3.4.9.1 of the 2020 MassDOT Bridge Manual, seismic analysis is not required for abutments and walls in SDC A.
- The resistance factor for global stability was obtained from AASHTO Section 11.6.3.7. Resistance factor = 0.65 at abutments and retaining walls where soil stratigraphy and soil properties are not well defined; resistance factor = 0.75 for abutments and retaining walls where stratigraphy and properties are well defined.

**Table 3. Chemical Test Results: Sediment Samples**  
**Rosemont St. Over Little River**  
**Bridge No. H-12-024**  
**Haverhill, MA**

			Sample Name: Sample Location: Sample Date:	SS-4 River Channel 1/18/2019
Analyte	Method	Unit		
Volatile Organic Compounds (VOCs)	8260	ug/kg		
Total VOCs			ND	
Polycyclic Aromatic Hydrocarbons (PAHs)	105,8270D-SIM/680(M)	ug/kg		
Acenaphthene			10.6	
Acenaphthylene			63.2	
Anthracene			77.1	
Benz[a]anthracene			211	
Benzo[a]pyrene			1940	
Benzo[b]fluoranthene			222	
Benzo[g,h,i]perylene			159	
Benzo[k]fluoranthene			195	
Chrysene			263	
Dibenz[a,h]anthracene			35.2	
Fluoranthene			546	
Fluorene			18.5	
Indeno[1,2,3-cd]pyrene			147	
Naphthalene			ND	
Phenanthrene			259	
Pyrene			436	
Extractable Petroleum Hydrocarbons (EPH)	98,EPH-04-1.1	mg/kg		
C9-C18 Aliphatics			ND	
C19-C36 Aliphatics			75.1	
C11-C22 Aromatics			34.2	
C11-C22 Aromatics, Adjusted			26.6	
Polychlorinated Biphenyl (PCB) Congeners	8270 SIM	ug/kg		
PCBs, Total			ND	
Total Metals		mg/kg		
Arsenic	6020		2.5	
Cadmium	6020		ND	
Chromium	6020		8.49	
Copper	6020		4.13	
Lead	6020		11.3	
Mercury	7471		ND	
Nickel	6020		5.95	
Zinc	6020		21.7	
Other				
Percent Solids	2540	%	80.6	
Total Organic Carbon (TOC)	9060	%	0.22 - 0.25	

**General Notes:**

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data sheets.
2. < = The analyte was not detected at a concentration above the specified laboratory reporting limit.
3. mg/kg = milligrams per kilogram
4. ug/kg = micrograms per kilogram
5. ND = Not Detected

Geotechnical Report  
Rosemont Street Bridge Over Little River  
(Bridge No. H-12-024)  
Haverhill, Massachusetts  
December 2022 (Revised August 14, 2024)

# Figures

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This Image is from U.S.G.S. Topographic 7.5 Minute Series  
 Haverhill, MA-NH Quadrangle, 2021.  
 Datum is North American Vertical Datum of 1988 (NAVD88).  
 Contour Interval is 10 Feet.



Rosemont Street Over Little River  
 Bridge No. H-12-024  
 Haverhill, Massachusetts

BETA Group, Inc.  
 Norwood, Massachusetts

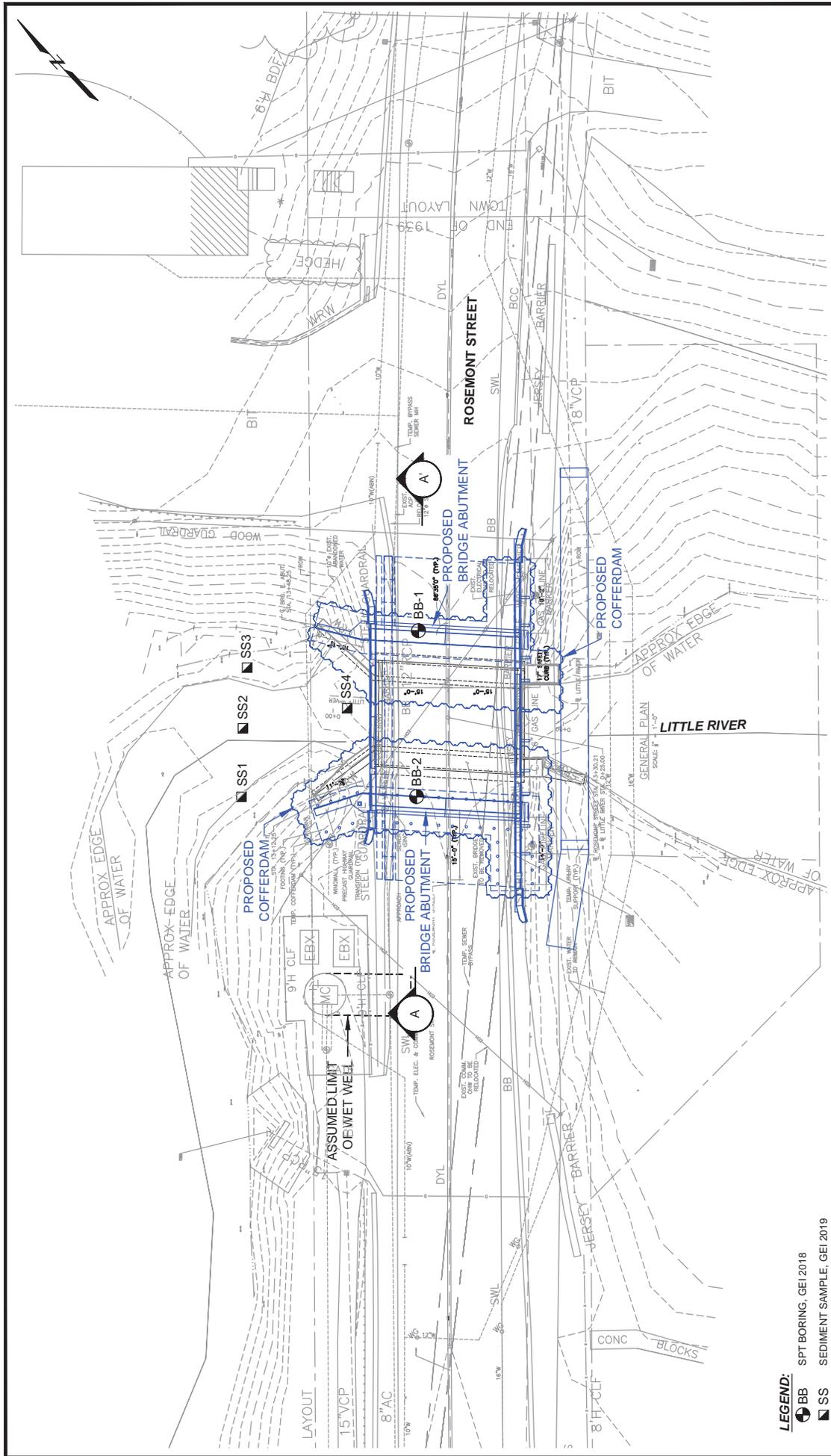


Project 1804108

SITE LOCATION MAP

August 2024

Fig. 1

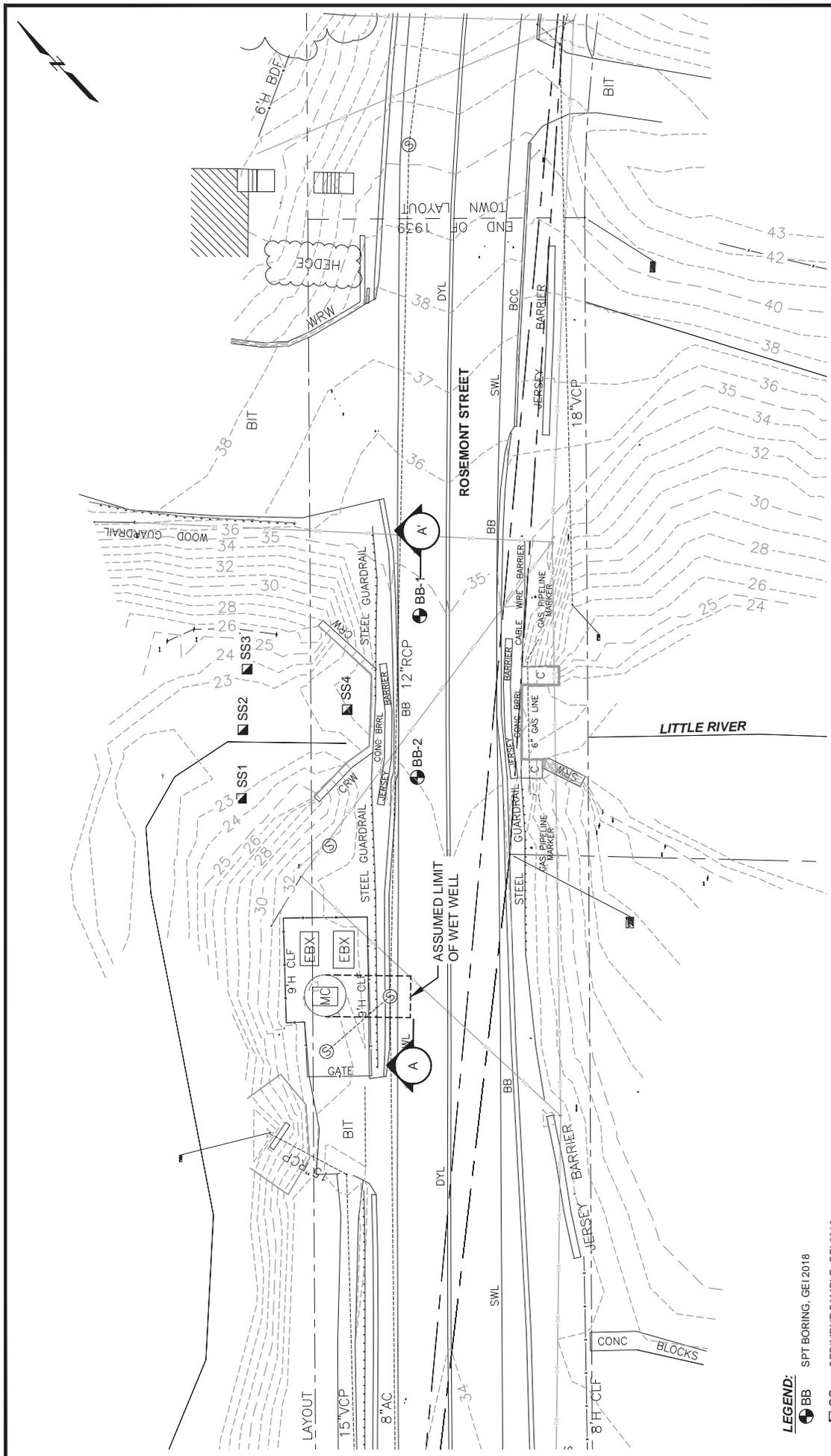


- LEGEND:**
- BB SPT BORING, GEI 2018
  - SS SEDIMENT SAMPLE, GEI 2019
  - A-A CROSS SECTION LOCATION, SEE FIG. 4



		<b>PROPOSED BRIDGE PLAN</b> Project 1804108 August 2024 Fig. 2
Rosemont Street Over Little River Bridge No. H-12-024 Haverhill, Massachusetts BETA Group, Inc. Norwood, Massachusetts		

**SOURCE:**  
 1. BASE PLAN PROVIDED BY BETA GROUP ON JANUARY 31, 2023.



**LEGEND:**

- SPT BORING, GEI 2018
- SS SEDIMENT SAMPLE, GEI 2019
- CROSS SECTION LOCATION, SEE FIG. 4

**SOURCE:**

1. BASE PLAN PROVIDED BY BETA GROUP ON JANUARY 31, 2019.

Rosemont Street Over Little River  
 Bridge No. H-12-024  
 Haverhill, Massachusetts

BETA Group, Inc.  
 Norwood, Massachusetts

Project 1804108

August 2024

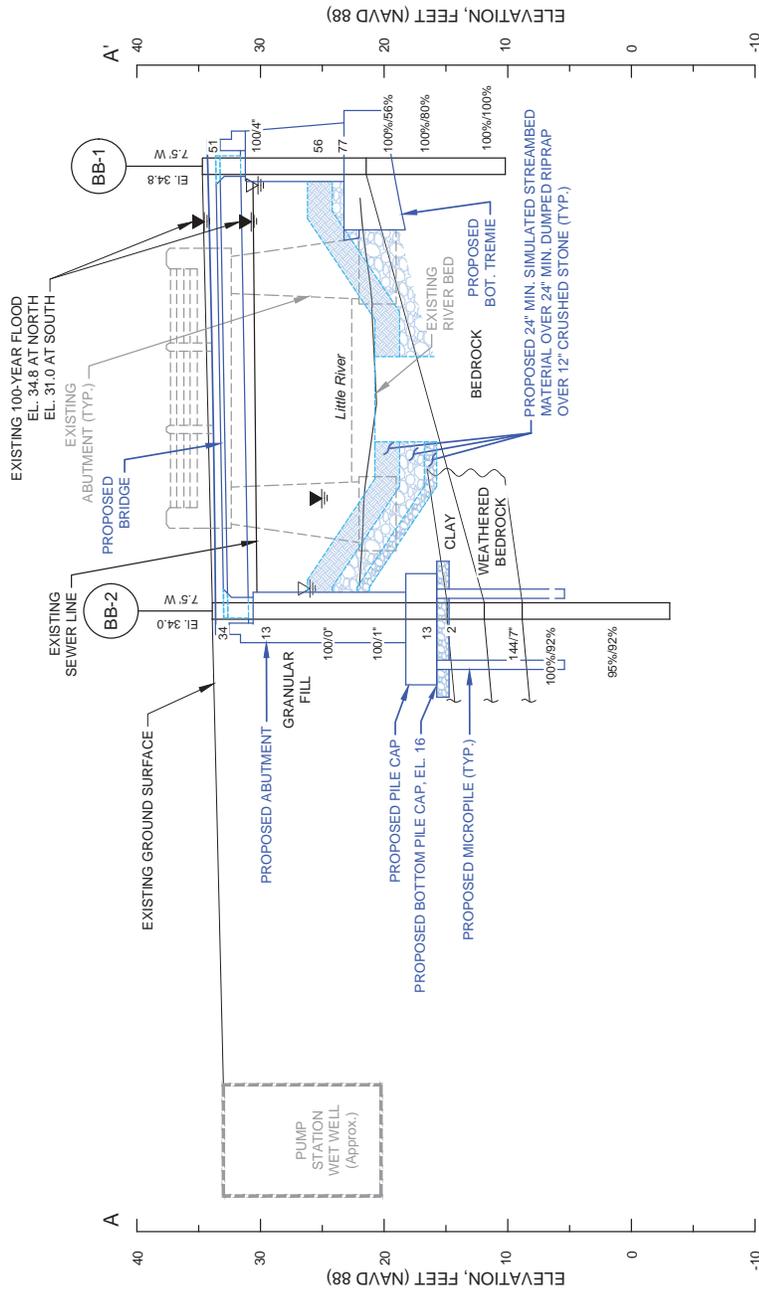
Fig. 3

**GEI** Consultants

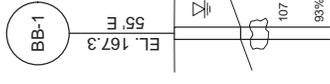
EXPLORATION LOCATION PLAN

SCALE: 1" = 20'

0 20 40



**LEGEND:**



**NOTES:**

1. BORING LOCATIONS ARE SHOWN IN FIG. 2.
2. GROUNDWATER LEVELS MAY VARY AT OTHER LOCATIONS AND AT OTHER TIMES.
3. BOUNDARIES BETWEEN SOIL STRATA MAY BE TRANSITIONAL. THE STRATA BOUNDARIES MAY VARY FROM THE INTERPOLATIONS SHOWN.
4. ESTIMATED LOCATION OF WET WELL PROVIDED BY BETA GROUP ON DECEMBER 14, 2022.
5. EXISTING AND PROPOSED BRIDGE GEOMETRY PROVIDED BY BETA GROUP ON JANUARY 31, 2024 AND MAY 14, 2024, RESPECTIVELY.



Rosemont Street Over Little River  
 Bridge No. H-12-024  
 Haverhill, Massachusetts  
 BETA Group, Inc.  
 Norwood, Massachusetts



Project 1804108

CROSS SECTION  
 A - A'

August 2024

Fig. 4

Geotechnical Report  
Rosemont Street Bridge Over Little River  
(Bridge No. H-12-024)  
Haverhill, Massachusetts  
December 2022 (Revised August 14, 2024)

# Appendix A

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## Pump Station Drawings

# ROSEMONT STREET AREA SANITARY SEWER AND PUMP STATION

## CITY COUNCIL

THEODORE A. PELOSI, JR. - PRESIDENT  
GEORGE DEKEON JR. - VICE PRESIDENT  
HERBERT H. GOECKE, JR.  
MARJORIE E. GOUDREAU  
ARTHUR J. BOWER  
PAUL T. RICE, JR.  
GENE P. GRILLO  
ROBERT H. SCATAMACCHIA  
FRANCIS X. KELLY

1980



## DIRECTOR OF PUBLIC WORKS

HERBERT D. NICKERSON, P.E.

## CITY ENGINEER

ROBERT A. MASYS PE.

## PROJECT DESIGNER

JOHN R. MURPHY

## COMMUNITY DEVELOPMENT COORDINATOR

WILLIAM PILLSBURY

## CITY PLANNER

RICHARD BRYAN SWAIN

## MAYOR

THE HONORABLE THOMAS S. VATHALLY

COMMUNITY DEVELOPMENT

BLOCK GRANT

CONTRACT NO. FY-78-7

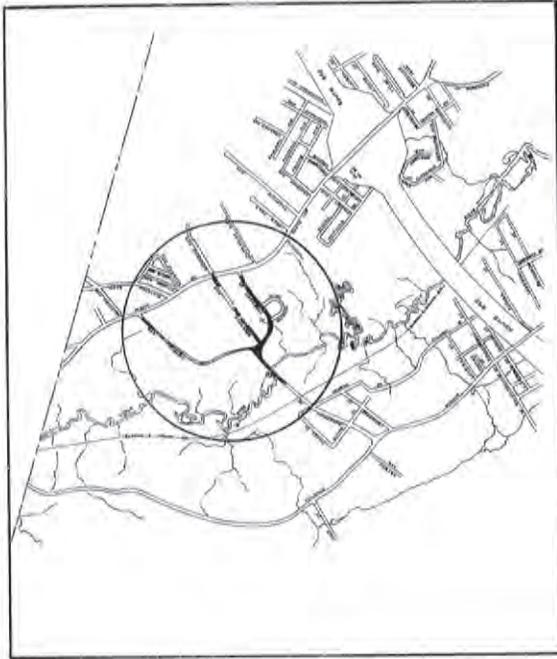
B78-MC-25-0010

ENGINEERING SERVICES BY THE CITY OF HAVERHILL, DEPARTMENT OF PUBLIC WORKS, ENGINEERING DIVISION, 1980.

SEC 1B PLAN 555

9483

NOTE-- ALL SERVICES TO BE 5" ACP AND LAYED AT 5'-005



LEGEND

- HEDGES
- CATCH BASIN
- MANHOLE
- UTILITY POLE
- IRON PIPE
- EXISTING PAVEMENT
- EXISTING TREE
- BASE LINE or CENTER LINE
- BUSHES or SHRUBS
- SURVEY ANGLE POINTS
- FENCE, CHAIN LINK
- STONE BOUND
- STONE WALL



LOCUS  
SCALE: 1"=1000'

ABBREVIATIONS

- REMOVE AND STACK
- REMOVE AND RESET
- REMOVE AND DISPOSE
- AS DIRECTED BY ENGINEER
- RETAIN
- REMOVE AND RELOCATE
- CHAIN LINK FENCE
- EXISTING LIFT STATION
- R. B. S.
- R. B. R.
- Rem.
- ADBE.
- RET.
- R. B. R.L.
- CLF
- L.S.

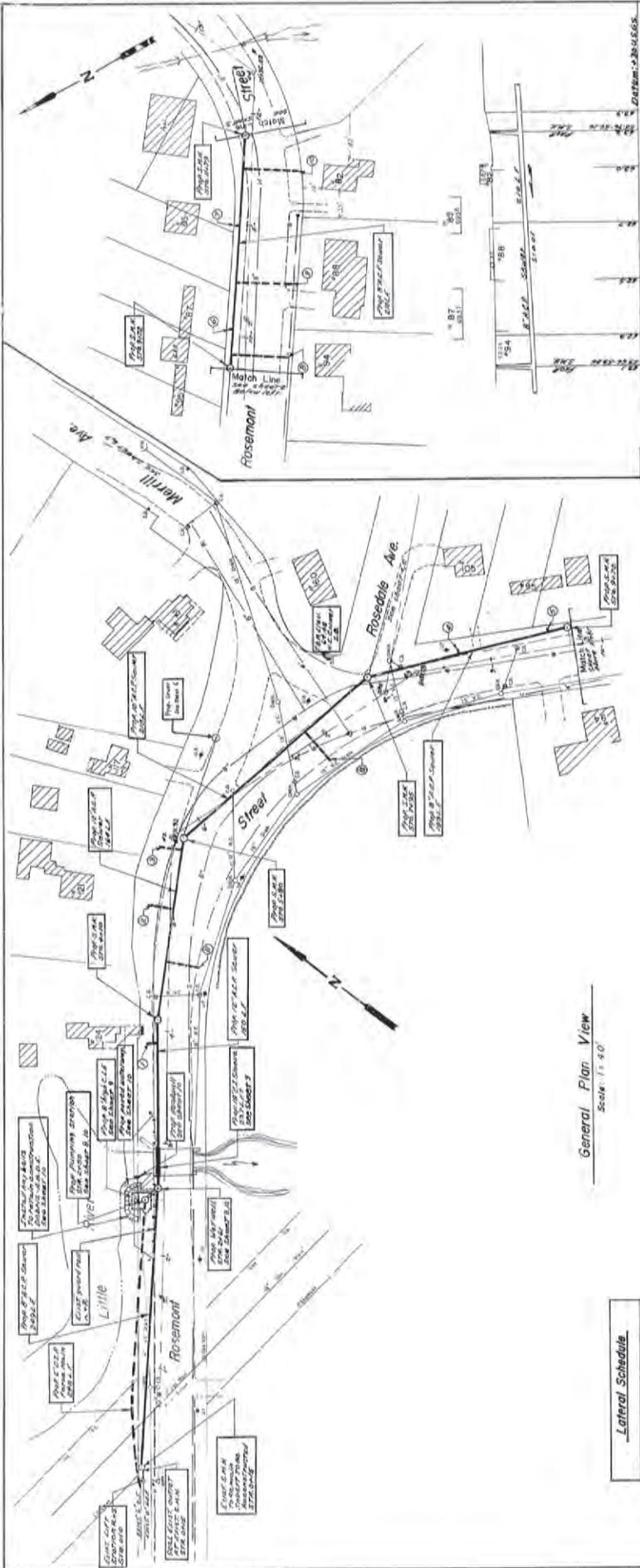
- SHEET 1 LEGEND, LOCUS, and INDEX
- SHEET 2 GENERAL PLAN--ROSEMONT ST. 125-040 to 12500
- SHEET 3 GENERAL PLAN--ROSEMONT ST. 274.12500 to 28400
- SHEET 4 GENERAL PLAN--ROSEDALE AVE. 274.040 to 28400
- SHEET 5 GENERAL PLAN--ROSEDALE AVE. 274.040 to 28400
- SHEET 6 GENERAL PLAN--MERRILL AVE. 274.040 to 28400
- SHEET 7 GENERAL PLAN--MERRILL AVE. 274.040 to 28400
- SHEET 8 DETAIL PLAN PUMPING STATION & WET WELL
- SHEET 9 MISC. X-SECTIONS & DETAILS
- SHEET 10 MISC. X-SECTIONS & DETAILS

SCALES: AS NOTED ON PLANS

Legend, Locus, Index, Plan

Date	CITY ENGINEERING DIVISION	Scale
JULY 1952	HAVERHILL, MASS.	As Shown
Reexamined Street and Sanitary Sewer and Stormwater Department, Haverhill, Mass. Contract No. 7-25-7 B78-MC-25-0200		
Designed by	Sheet	1
Drawn by	Approved by	City Engineer
Checked by		





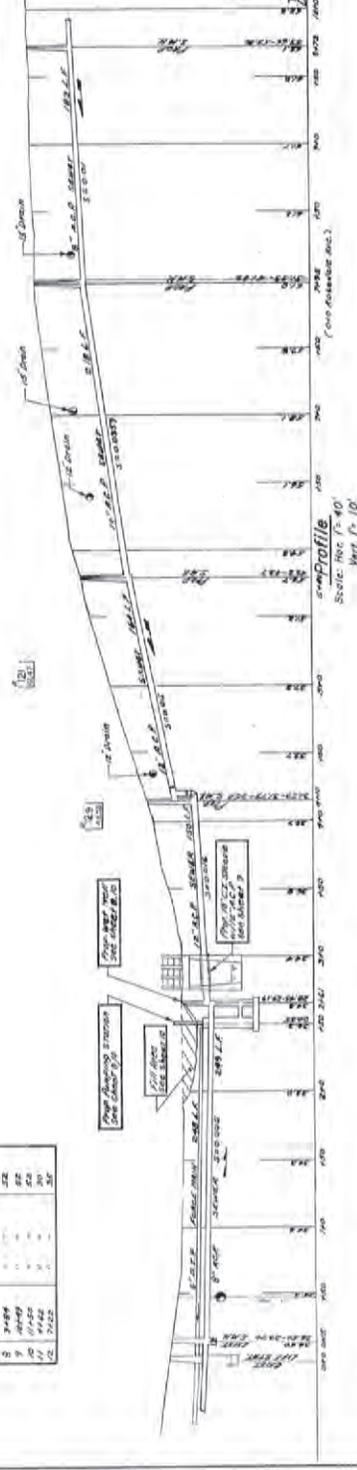
General Plan View  
Scale: 1" = 40'

**Lateral Schedule**

NO. STATION	MATERIAL	LN. FT.
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3	5" IPS	20
4	5" IPS	20
5	5" IPS	20
6	5" IPS	20
7	5" IPS	20
8	5" IPS	20
9	5" IPS	20
10	5" IPS	20
11	5" IPS	20
12	5" IPS	20



Profile  
Scale: 1" = 10'

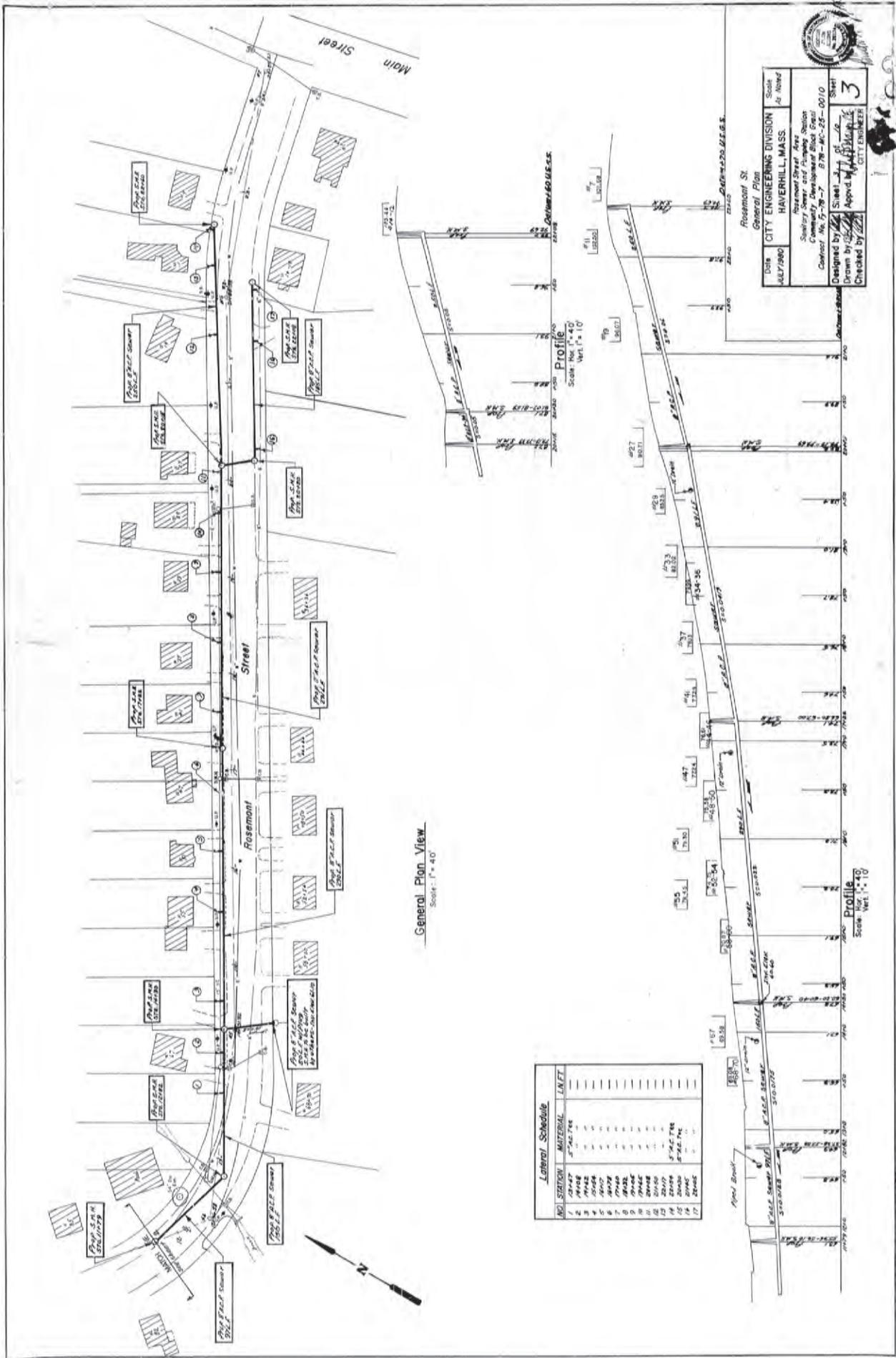


Profile  
Scale: 1" = 40'

Rosemont St.  
 General Plan  
 DATE: 12/19/80  
 CITY ENGINEERING DIVISION  
 HAVERTHILL, MASS.  
 Sanitary Sewer and Potable Water  
 Community Development Block Grant  
 Contract No. 78-7-878-MC-25-0010  
 DESIGNED BY: [Signature]  
 DRAWN BY: [Signature]  
 CHECKED BY: [Signature]  
 CITY ENGINEER

SECTION PLAN 255

9483

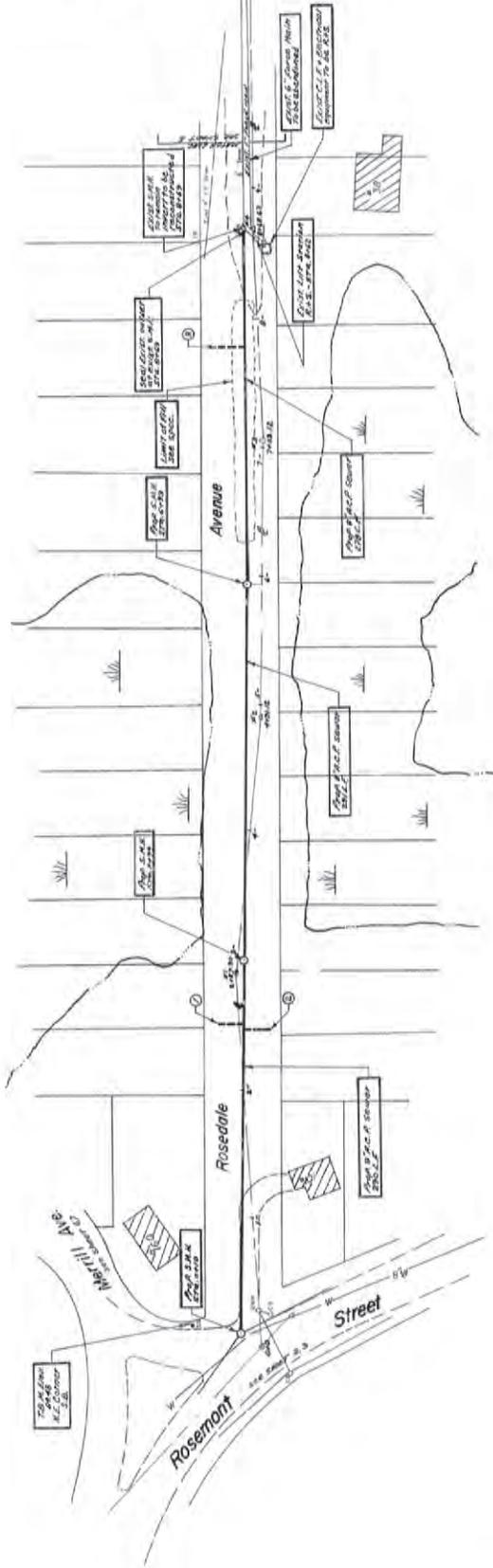


General Plan View  
Scale: 1" = 40'

Profile  
Scale: Vert. 1" = 10'

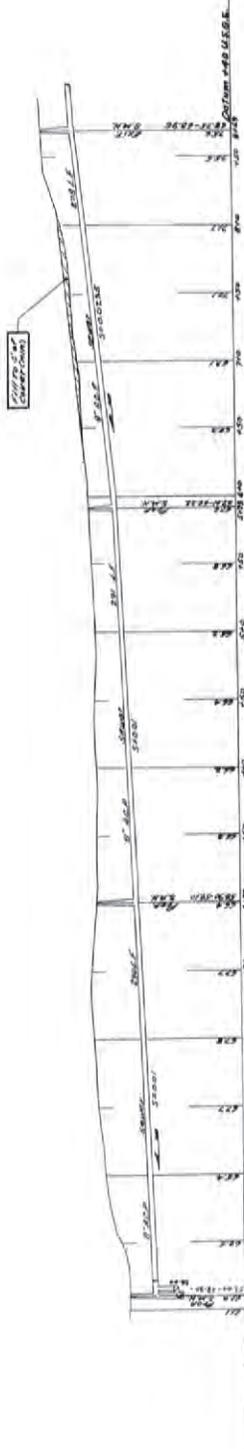
NO.	STATION	MATERIAL	LNFT.
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2	14+08	"	
3	14+58	"	
4	15+07	"	
5	15+57	"	
6	16+06	"	
7	16+56	"	
8	17+05	"	
9	17+55	"	
10	18+04	"	
11	18+54	"	
12	19+03	"	
13	19+53	"	
14	20+02	3" GAL. TEE	
15	20+52	6" GAL. TEE	
16	21+01	"	
17	21+51	"	

DATE: JUL 1960  
 CITY ENGINEERING DIVISION  
 HAVERHILL, MASS.  
 Rosemont Street Area  
 Sewer Line and Pumping Station  
 Contract No. 5-78-7  
 878-MC-25-0010  
 Sheet 3 of 3  
 Drawn by: [Signature]  
 Checked by: [Signature]  
 CITY ENGINEER



General Plan View  
Scale 1" = 40'

NO.	STATION	MATERIAL	INLET
1	2+40	8" AC. T.C.	4.0
2	2+47	8" AC. T.C.	4.0
3	2+58	8" AC. T.C.	4.0



Profile  
Scale Hor. 1" = 40'  
Vert. 1" = 10'

Rosedale Ave.  
General Plan

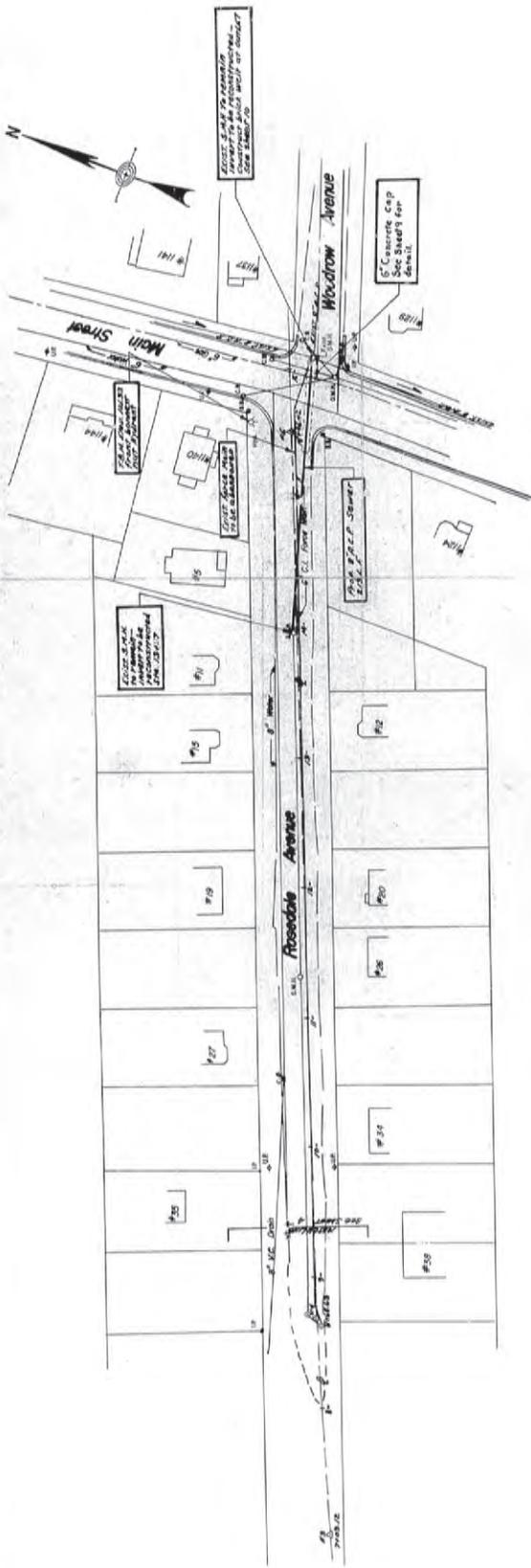
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CITY ENGINEERING DIVISION  
HAVERHILL, MASS.  
Scale: As Shown

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CHECKED BY: [Signature]

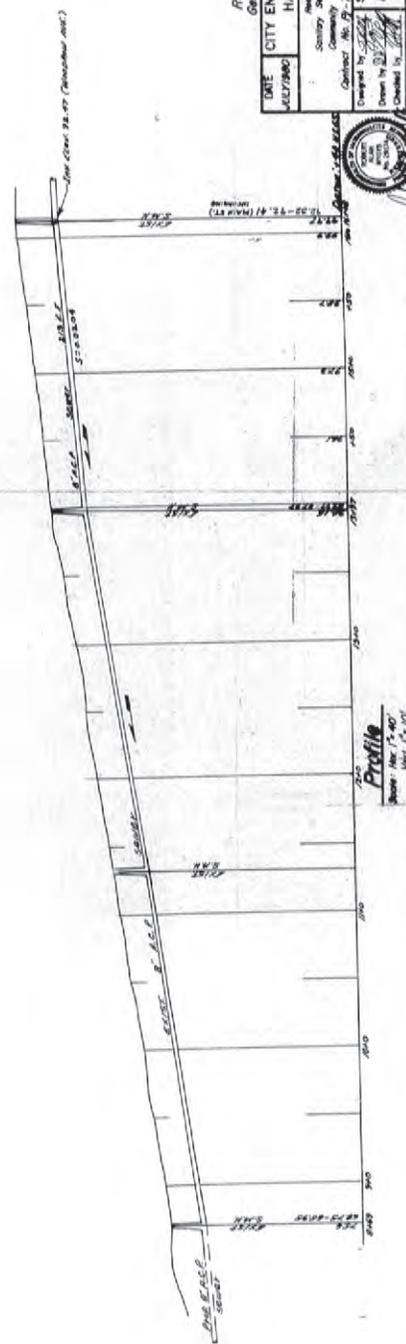
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SECTION PLAN 253



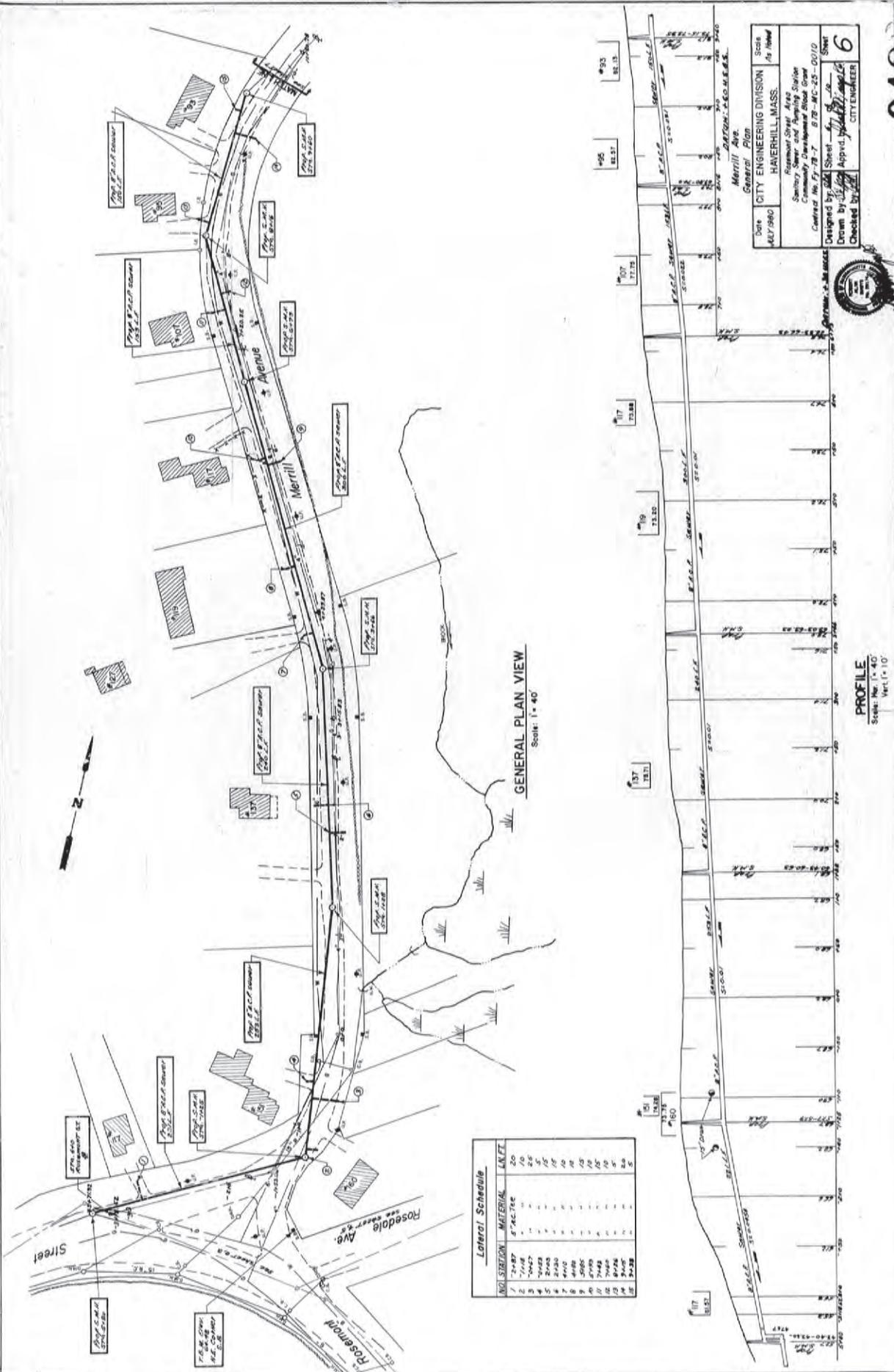
General Plan View  
Scale 1" = 40'



Profile  
Scale: Hor. 1" = 40'  
Vert. 1" = 10'

DATE	10/27/80	CITY ENGINEERING DIVISION	HAVERHILL, MASS.	SHEET	5
PROJECT	Rosedale Ave CITY ENGINEERING DIVISION				
DESIGNED BY	CITY ENGINEERING DIVISION				
CHECKED BY	CITY ENGINEERING DIVISION				
DATE	10/27/80				

SEC 2 B PLAN 255



GENERAL PLAN VIEW  
Scale: 1" = 40'

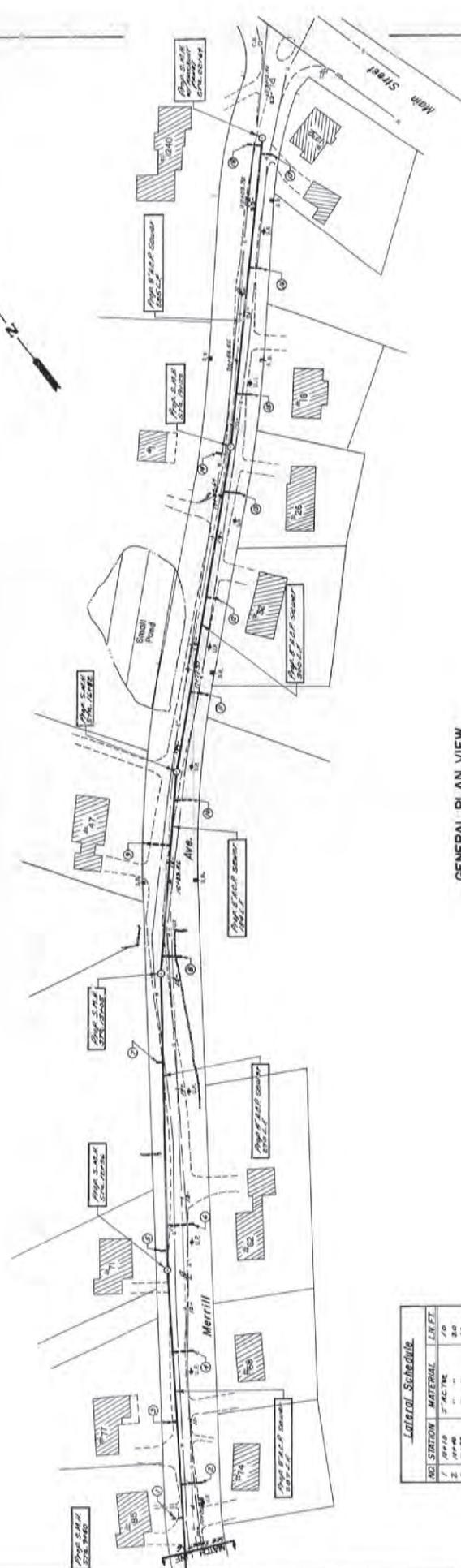
PROFILE  
Scale: Vert. 1" = 4' Horiz. 1" = 10'

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4	2+50	2" P.V.C.	25
5	3+00	2" P.V.C.	25
6	3+50	2" P.V.C.	25
7	4+00	2" P.V.C.	25
8	4+50	2" P.V.C.	25
9	5+00	2" P.V.C.	25
10	5+50	2" P.V.C.	25
11	6+00	2" P.V.C.	25
12	6+50	2" P.V.C.	25
13	7+00	2" P.V.C.	25
14	7+50	2" P.V.C.	25
15	8+00	2" P.V.C.	25
16	8+50	2" P.V.C.	25
17	9+00	2" P.V.C.	25
18	9+50	2" P.V.C.	25
19	10+00	2" P.V.C.	25
20	10+50	2" P.V.C.	25
21	11+00	2" P.V.C.	25
22	11+50	2" P.V.C.	25
23	12+00	2" P.V.C.	25
24	12+50	2" P.V.C.	25
25	13+00	2" P.V.C.	25
26	13+50	2" P.V.C.	25
27	14+00	2" P.V.C.	25
28	14+50	2" P.V.C.	25
29	15+00	2" P.V.C.	25
30	15+50	2" P.V.C.	25
31	16+00	2" P.V.C.	25
32	16+50	2" P.V.C.	25
33	17+00	2" P.V.C.	25
34	17+50	2" P.V.C.	25
35	18+00	2" P.V.C.	25
36	18+50	2" P.V.C.	25
37	19+00	2" P.V.C.	25
38	19+50	2" P.V.C.	25
39	20+00	2" P.V.C.	25
40	20+50	2" P.V.C.	25
41	21+00	2" P.V.C.	25
42	21+50	2" P.V.C.	25
43	22+00	2" P.V.C.	25
44	22+50	2" P.V.C.	25
45	23+00	2" P.V.C.	25
46	23+50	2" P.V.C.	25
47	24+00	2" P.V.C.	25
48	24+50	2" P.V.C.	25
49	25+00	2" P.V.C.	25
50	25+50	2" P.V.C.	25

Date: JULY 1960  
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 HAVERHILL, MASS.  
 Rosemont Street Area  
 Sanitary Sewer and Pumping Station  
 Contract No. F-78-7-278-10-25-0010  
 Designed by: [Signature]  
 Drawn by: [Signature]  
 Checked by: [Signature]  
 SHEET NO. 6  
 CITY ENGINEER

9483

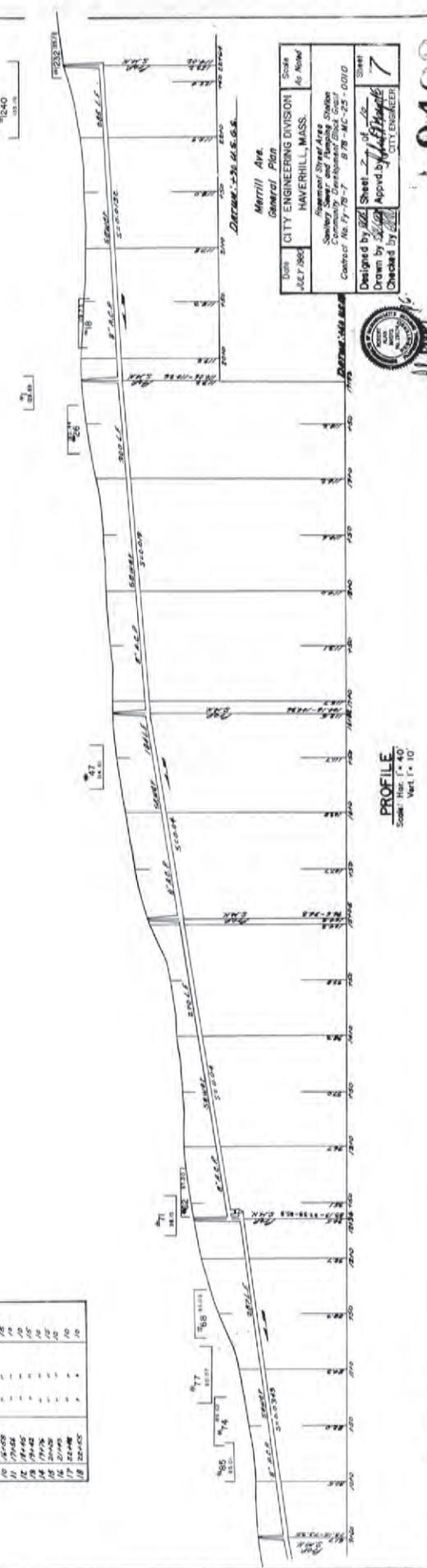
SECA B PLAN 355



**GENERAL PLAN VIEW**  
Scale: 1" = 40'

**Lateral Schedule**

NO. STATION	MATERIAL	LN. FT.
1	18" S.P.	10
2	18" S.P.	20
3	18" S.P.	20
4	18" S.P.	20
5	18" S.P.	20
6	18" S.P.	20
7	18" S.P.	20
8	18" S.P.	20
9	18" S.P.	20
10	18" S.P.	20
11	18" S.P.	20
12	18" S.P.	20
13	18" S.P.	20
14	18" S.P.	20
15	18" S.P.	20
16	18" S.P.	20
17	18" S.P.	20
18	18" S.P.	20



**PROFILE**  
Scale: Hor. 1" = 40'  
Vert. 1" = 10'

**Merrill Ave**  
General Plan  
HAVERHILL, MASS.  
City Engineer  
Contract No. 78-7  
City Engineer



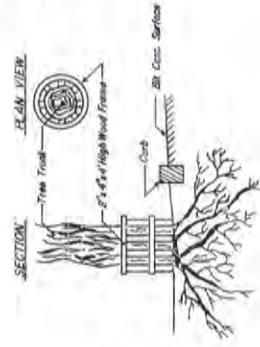
94893

SECTION PLAN 255

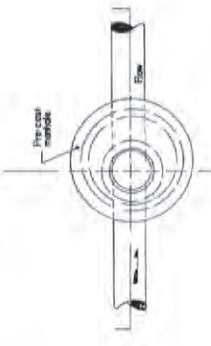


**Tree Protection Notes**

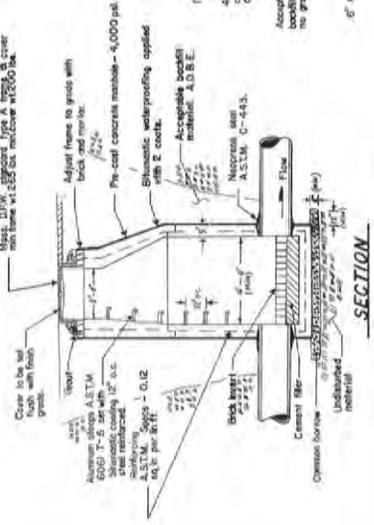
- 1- Show and be in the contract, any work to be approved in rock with
- 2- Insuring protection of tree trunk and other parts of the tree.
- 3- The contractor shall be responsible for the protection of the tree trunk and other parts of the tree.
- 4- The contractor shall be responsible for the protection of the tree trunk and other parts of the tree.
- 5- The contractor shall be responsible for the protection of the tree trunk and other parts of the tree.



**TREE PROTECTION DETAIL**  
N.T.S.

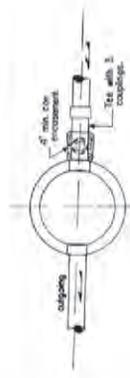


**PLAN**

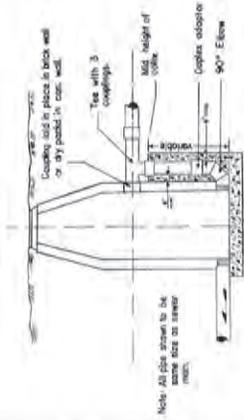


**SECTION**

**TYP. PRE-CAST MANHOLE**  
N.T.S.

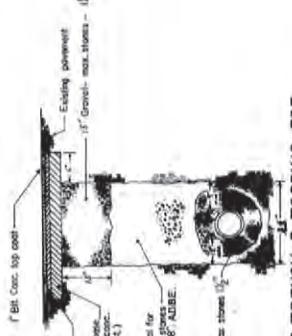


**PLAN**

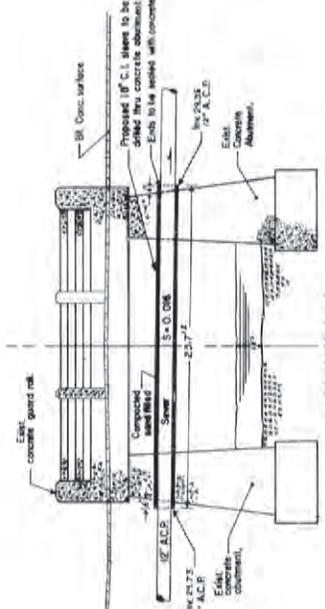


**ELEVATION**

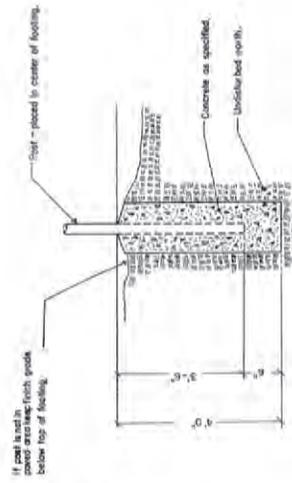
**TYP. DROP TEE MANHOLE**  
N.T.S.



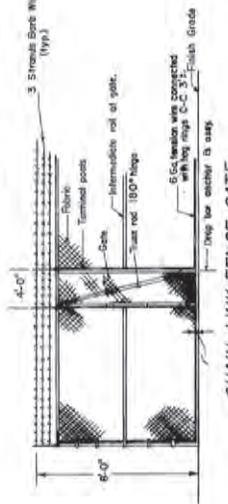
**TYP. TRENCH & TOPPING FOR ROSEMONT ST. & MA'V ST. OPENINGS**  
N.T.S.



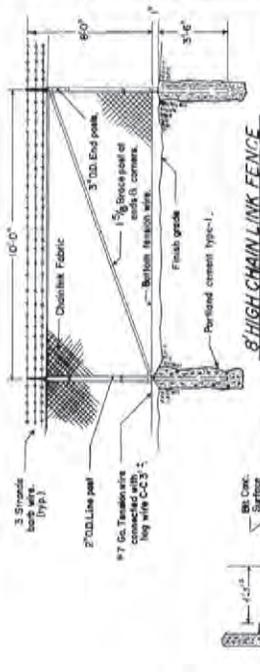
**SECTION A-A**  
**SLEEVE THRU ABUTMENT DETAIL**  
Scale: 1" = 4"



**FENCE POST FOOTING**  
N.T.S.



**CHAIN LINK FENCE GATE**  
N.T.S.

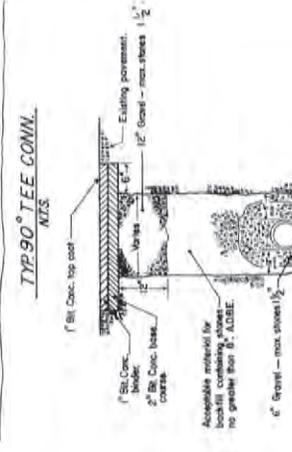
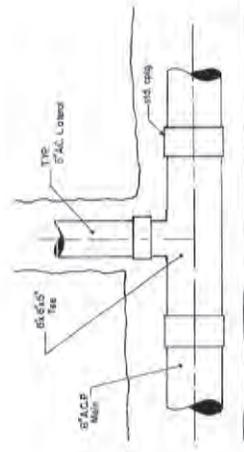
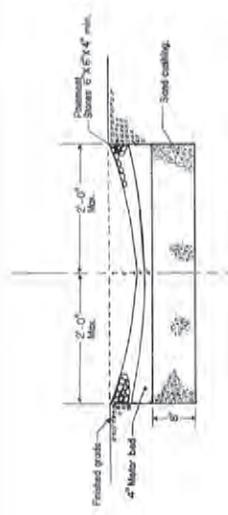


**8\"/>**

Date	1-27-1956	City	HAVERHILL, MASS.
Drawn by	J.S.S.	Checked by	J.S.S.
Designed by	J.S.S.	Approved by	J.S.S.
Contract No.	79-7	Sheet No.	9
Project No.	79-7	City	HAVERHILL, MASS.

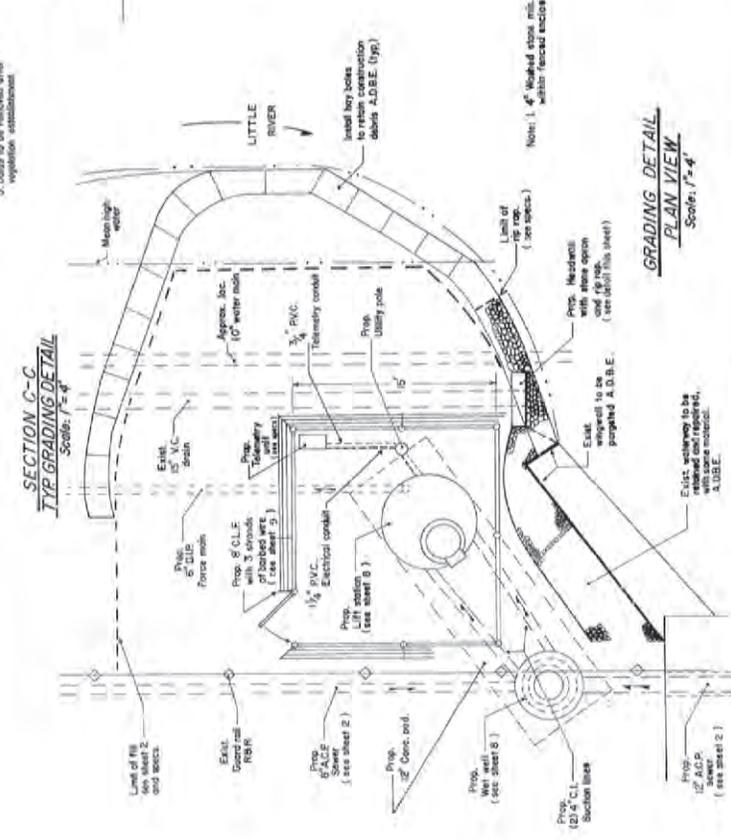
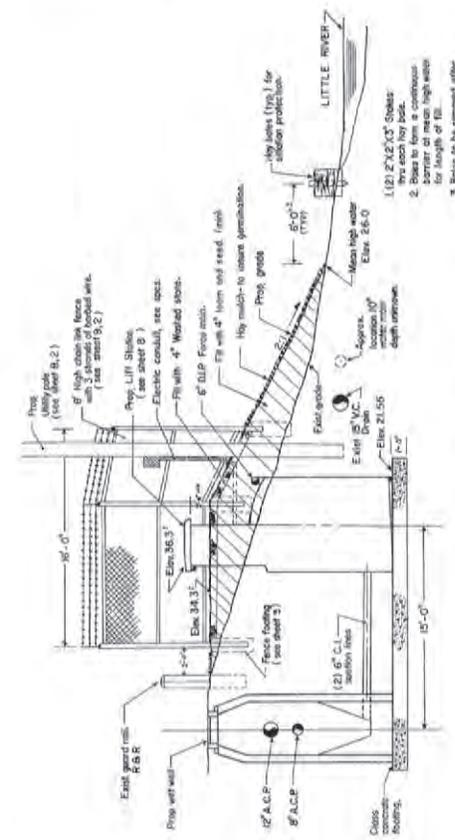
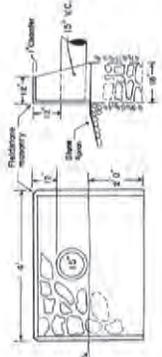
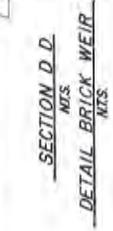
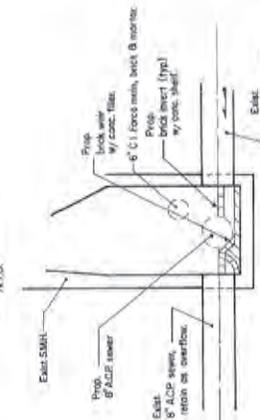
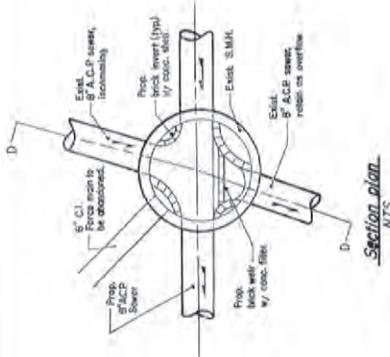


**SECTION B-B**  
Scale: 1" = 4"



**Mrs. K. Section and Details**

City	CITY ENGINEERING DIVISION	Scale	1:100
Date	JULY 1952	Location	Haverhill, MA.
Drawn by	Sanitary Sewer and Plumbing Section	Checked by	City Engineer
Project No.	10	Sheet No.	10
Project Name	Merrill Ave & Rosedale Ave Street Openings	Drawn by	K. Section
Checked by	City Engineer	Approved by	City Engineer



REC AB PLAN 156

Geotechnical Report  
Rosemont Street Bridge Over Little River  
(Bridge No. H-12-024)  
Haverhill, Massachusetts  
December 2022 (Revised August 14, 2024)

# Appendix B

---

## Boring Logs

**BORING INFORMATION**

NORTHING (ft): 3,118,801.30  
 GROUND SURFACE EL. (ft): 34.8  
 VERT./HORIZ. DATUMS: NAVD 88/NAD 1983  
 TOTAL DEPTH (ft): 24.5  
 LOGGED BY: K. Gleichauf

EASTING (ft): 761,254.44  
 DATE START/END: 11/2/2018 - 11/5/2018  
 DRILLING COMPANY: Northern Drill Service, Inc.  
 DRILLER NAME: C. Beirholm  
 RIG TYPE: Mobile B-57

**BORING**

**BB-1**

PAGE 1 of 2

**DRILLING INFORMATION**

HAMMER TYPE: Automatic CASING I.D./O.D.: 4 inch/ 4-1/2 inch CORE BARREL TYPE: NX  
 AUGER I.D./O.D.: NA / NA DRILL ROD O.D.: 2.625 inch CORE BARREL I.D./O.D.: 2 inch / 3 inch  
 DRILLING METHOD: Driven casing and washed with rotary tooling.  
 WATER LEVEL DEPTHS (ft): 4.5 11/5/2018

**ABBREVIATIONS:** Pen. = Penetration Length S = Split Spoon Sample Qp = Pocket Penetrometer Strength NA, NM = Not Applicable, Not Measured  
 Rec. = Recovery Length C = Core Sample Sv = Pocket Torvane Shear Strength Blows per 6 in.: 140-lb hammer falling  
 RQD = Rock Quality Designation U = Undisturbed Sample LL = Liquid Limit 30 inches to drive a 2-inch-O.D.  
 = Length of Sound Cores > 4 in / Pen., % SC = Sonic Core PI = Plasticity Index split spoon sampler.  
 WOR = Weight of Rods DP = Direct Push Sample PID = Photoionization Detector  
 WOH = Weight of Hammer HSA = Hollow-Stem Auger I.D./O.D. = Inside Diameter/Outside Diameter

Elev. (ft)	Depth (ft)	Sample Information				Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		Sample No.	Depth (ft)	Pen./Rec. (in)	Blows per 6 in. or RQD			
		S1	0.5 to 2	18/10	9-30-21	~6" asphalt surface	GRANULAR FILL	S1: Dry, very dense, brown, FINE TO COARSE SAND, some fine to medium gravel, trace nonplastic fines.
	5	S2	4 to 5.3	16/6	7-5-100/4"			S2: Wet, very dense, brown, FINE TO COARSE SAND, some fine to medium gravel, some nonplastic fines.
	10	S3	9 to 11	24/8	9-17-39-29			S3: Wet, very dense, brown, FINE TO COARSE SAND AND GRAVEL, some nonplastic fines. Gravel is fractured by spoon.
		S4	11 to 13	24/9	57-35-42-22			S4: Wet, very dense, brown, FINE TO COARSE SAND, some fine to coarse gravel, trace nonplastic fines.
						Casing driven to refusal at 13.25 ft.	ROCK	
	15	C1	14.5 to 17.5	36/36	56	Advanced rollerbit to 14.5 ft., rock chips in wash, driller notes irregular advancement, possible rock fractures from blasting.		C1: SCHIST, very hard, black with white layers spaced about 2" at 15 degrees. Joints spaced 1-9" at 15-75 degrees, slight to no weathering. Most joints are along bedding planes. BERWICK FORMATION. Core Times: 2-3-9.
		C2	17.5 to 22.5	60/60	80			C2: SCHIST, Similar to C1. BERWICK FORMATION. Core Times: 3-3-4-5-9.
	20							C3: SCHIST, Similar to C1. BERWICK FORMATION. Core Times: 4-7.
		C3	22.5 to 24.5	24/24	100			

**NOTES:**

**PROJECT NAME:** Rosemont Street Bridge Replacement  
**CITY/STATE:** Haverhill, MA  
**GEI PROJECT NUMBER:** 1804108



GEI WOBURN STD 5-NORTH-EAST-LAYER NAME TYPED BORING LOGS.GPJ 8/14/24



**BORING**

**BB-2**

**BORING INFORMATION**

NORTHING (ft): 3,118,776.07  
 GROUND SURFACE EL. (ft): 34.0  
 VERT./HORIZ. DATUMS: NAVD 88/NAD 1983  
 TOTAL DEPTH (ft): 37.0  
 LOGGED BY: K. Gleichauf

EASTING (ft): 761,230.19  
 DATE START/END: 11/1/2018 - 11/2/2018  
 DRILLING COMPANY: Northern Drill Service, Inc.  
 DRILLER NAME: C. Beirholm  
 RIG TYPE: Mobile B-57

**DRILLING INFORMATION**

HAMMER TYPE: Automatic CASING I.D./O.D.: 4 inch/ 4-1/2 inch CORE BARREL TYPE: NX  
 AUGER I.D./O.D.: NA / NA DRILL ROD O.D.: 2.625 inch CORE BARREL I.D./O.D.: 2 inch / 3 inch  
 DRILLING METHOD: Driven casing and washed with rotary tooling.  
 WATER LEVEL DEPTHS (ft): 7.9 11/2/2018 7.6 11/1/2018

**ABBREVIATIONS:** Pen. = Penetration Length S = Split Spoon Sample Qp = Pocket Penetrometer Strength NA, NM = Not Applicable, Not Measured  
 Rec. = Recovery Length C = Core Sample Sv = Pocket Torvane Shear Strength Blows per 6 in.: 140-lb hammer falling  
 RQD = Rock Quality Designation U = Undisturbed Sample LL = Liquid Limit 30 inches to drive a 2-inch-O.D.  
 = Length of Sound Cores > 4 in / Pen., % SC = Sonic Core PI = Plasticity Index split spoon sampler.  
 WOR = Weight of Rods DP = Direct Push Sample PID = Photoionization Detector  
 WOH = Weight of Hammer HSA = Hollow-Stem Auger I.D./O.D. = Inside Diameter/Outside Diameter

Elev. (ft)	Depth (ft)	Sample Information				Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		Sample No.	Depth (ft)	Pen./Rec. (in)	Blows per 6 in. or RQD			
		S1	0.5 to 2	18/10	10-15-19	~6" asphalt surface	GRANULAR FILL	S1: Moist, dense, brown, FINE TO COARSE SAND, some fine to coarse gravel, trace nonplastic fines.
30	5	S2	4 to 5.8	22/5	10-9-4-100/4"	Possible cobble 3.5-4 ft. Split spoon bent while driving S2. Casing driven to refusal at 5 ft. drilled ahead through cobbles and bent drive shoe while trying to advance casing. Casing spun to 9 ft.		S2: Wet, medium dense, dark brown, FINE TO COARSE SAND AND GRAVEL, some nonplastic fines. Gravel stuck in tip is fractured by spoon. Spoon bent, possibly wedged between blocks
	10	S3	9 to 9	0/0	100/0"			S3: Small piece of fractured gravel in tip, appears similar to granite blocks visible on abutment slopes.
20	15	S4	13 to 13.6	7/3	18-100/1"	Advanced rollerbit through obstruction, broke through at 13 ft.	CLAY	S4: Wet, very dense, gray, FINE TO COARSE GRAVEL, some fine to coarse sand, trace nonplastic fines. Gravel is fractured by spoon.
		S5	17 to 19	24/0	6-5-8-8	Advanced rollerbit through obstruction, broke through at 16 ft.		S5: No recovery.
	20	S6	19 to 21	24/15	1-1-1-1	Redrove 3" spoon for 15" recovery.		S5 (Redrive): Wet, medium dense, gray, FINE TO COARSE SAND, trace fine to coarse gravel, trace nonplastic fines. (0-7) coarse sand, (7-15) fine sand with some organic material (wood and sticks). S6: Wet, very soft, gray, LEAN CLAY, trace fine to coarse sand.
						Rig chatter at 22 ft, driller notes gravel.	W. ROCK	

**NOTES:**

PROJECT NAME: Rosemont Street Bridge Replacement  
 CITY/STATE: Haverhill, MA  
 GEI PROJECT NUMBER: 1804108



GEI WOBURN STD 5-NORTH-EAST-LAYER NAME TYPED BORING LOGS.GPJ 8/14/24

NORTHING (ft): 3,118,776.07  
 GROUND SURFACE EL. (ft): 34.0  
 VERT./HORIZ. DATUMS: NAVD 88/NAD 1983

EASTING (ft): 761,230.19  
 DATE START/END: 11/1/2018 - 11/2/2018  
 DRILLING COMPANY: Northern Drill Service, Inc.

**BORING  
 BB-2**  
 PAGE 2 of 2

Elev. (ft)	Depth (ft)	Sample Information				Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD			
	25	S7	24 to 25.1	13/6	18-44-100/1"		S7: Wet, very dense, gray, FINE TO MEDIUM GRAVEL, some fine to coarse sand, trace nonplastic fines. Possible weathered bedrock.	
	27 to 32	C1		60/60	92	Advanced rollerbit to 27 ft. through rock.	ROCK  C1: SILTSTONE, very hard, fine-grained, black with white coarse rectangular crystals, small pyrite crystals visible throughout. Joints spaced 2-16" at 0-60 degrees, slightly to non weathered. BERWICK FORMATION. Core Times: 3-4-3-4-4.	
	32 to 37	C2		60/57	92			C2 SILTSTONE, Similar to C1. Joints spaced 1-15" at 0-30 degrees, slightly to non weathered. BERWICK FORMATION. Core Times: 3-3-3-3-4.
	37						End boring at 37 ft. Backfilled with cuttings and gravel, topped with cold patch.	

NOTES:

PROJECT NAME: Rosemont Street Bridge Replacement  
 CITY/STATE: Haverhill, MA  
 GEI PROJECT NUMBER: 1804108



GEI WOBURN STD 5-NORTH-EAST-LAYER NAME TYPED BORING LOGS.GPJ 8/14/24

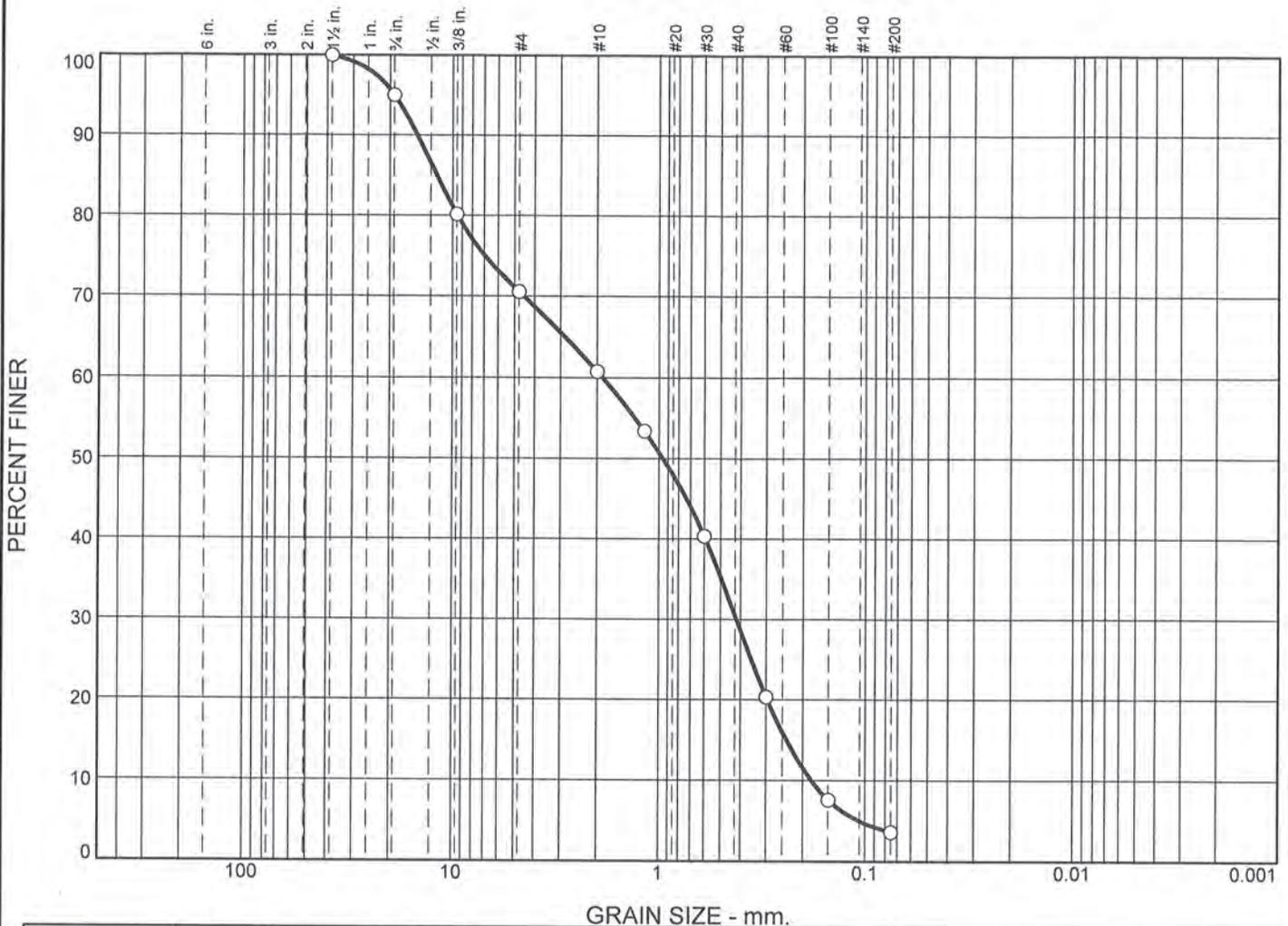
## Appendix C

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### Grain Size Distribution Test Results

- Samples SS-1 through SS-4: Sediment samples

# Particle Size Distribution Report



%	Boulders	% +3"	% Gravel			% Sand		% Fines
			Coarse	Medium	Fine	Coarse	Fine	
○	0.0	0.0	1.8	18.1	19.3	30.4	26.8	3.6

⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○	-	-	11.9002	1.8844	0.9540	0.4193	0.2396	0.1814	0.51	10.39

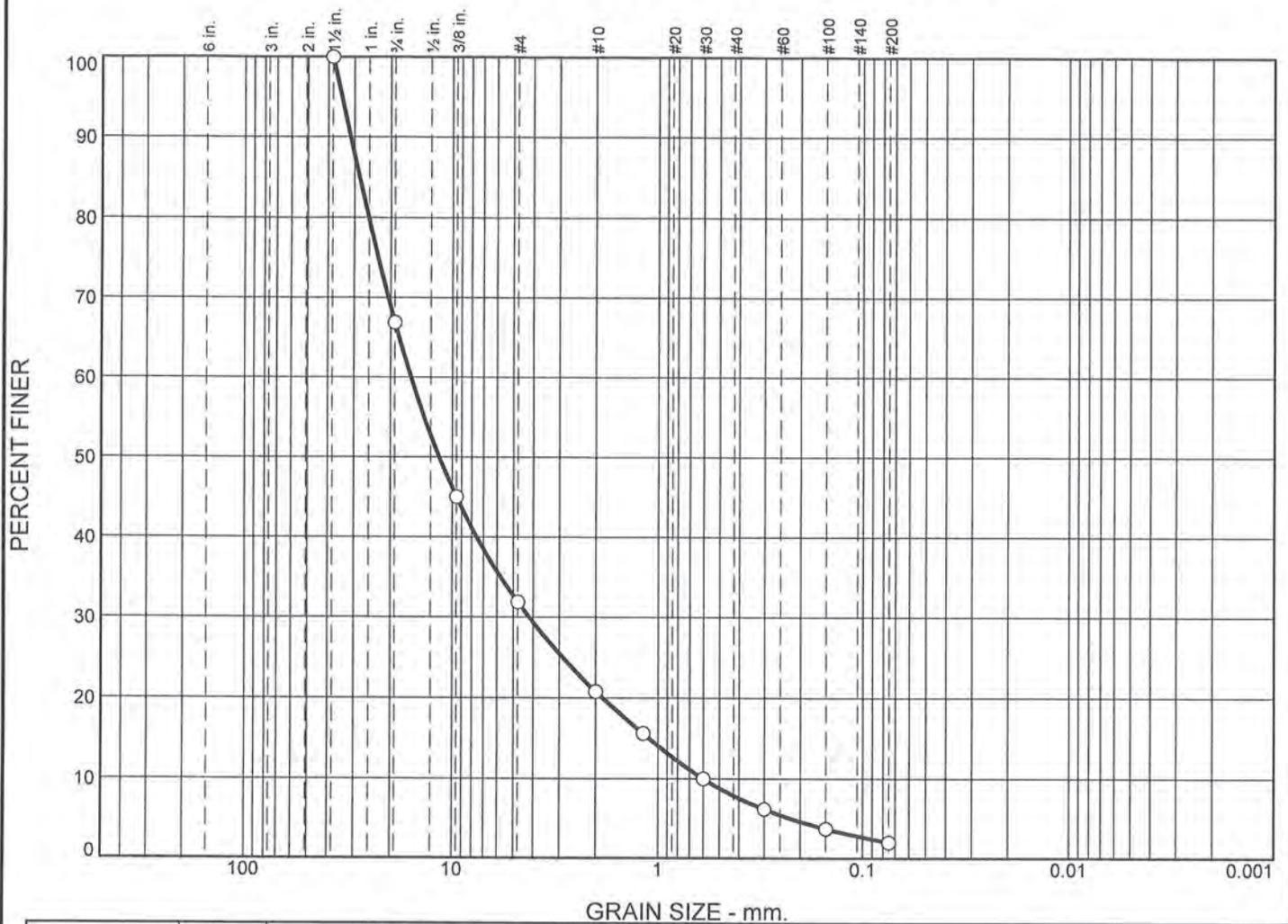
Material Description	USCS	AASHTO
○ FINE TO COARSE SAND, some fine to coarse Gravel, trace Silt	SP	-

<p><b>Project No.</b> 1801408      <b>Client:</b> City of Haverhill</p> <p><b>Project:</b> Rosemont Street over the Little River</p> <p>○ <b>Source of Sample:</b> SSI      <b>Depth:</b> -      <b>Sample Number:</b> -</p>	<p><b>Remarks:</b></p> <p>○ As Received WC = 21.3%</p>
<p>GEI Consultants, Inc. 400 Unicorn Park Drive Woburn, MA 01801</p>	

Figure

Tested By: EF

# Particle Size Distribution Report



% Boulders	% +3"	% Gravel			% Sand		% Fines
		Coarse	Medium	Fine	Coarse	Fine	
0.0	0.0	20.3	34.7	24.2	12.9	5.9	2.0

LL	PL	D85	D60	D50	D30	D15	D10	C <sub>c</sub>	C <sub>u</sub>
-	-	28.3386	15.8985	11.5653	4.1932	1.1043	0.6025	1.84	26.39

Material Description	USCS	AASHTO
○ FINE TO COARSE GRAVEL, some fine to coarse Sand, trace Silt	GW	-

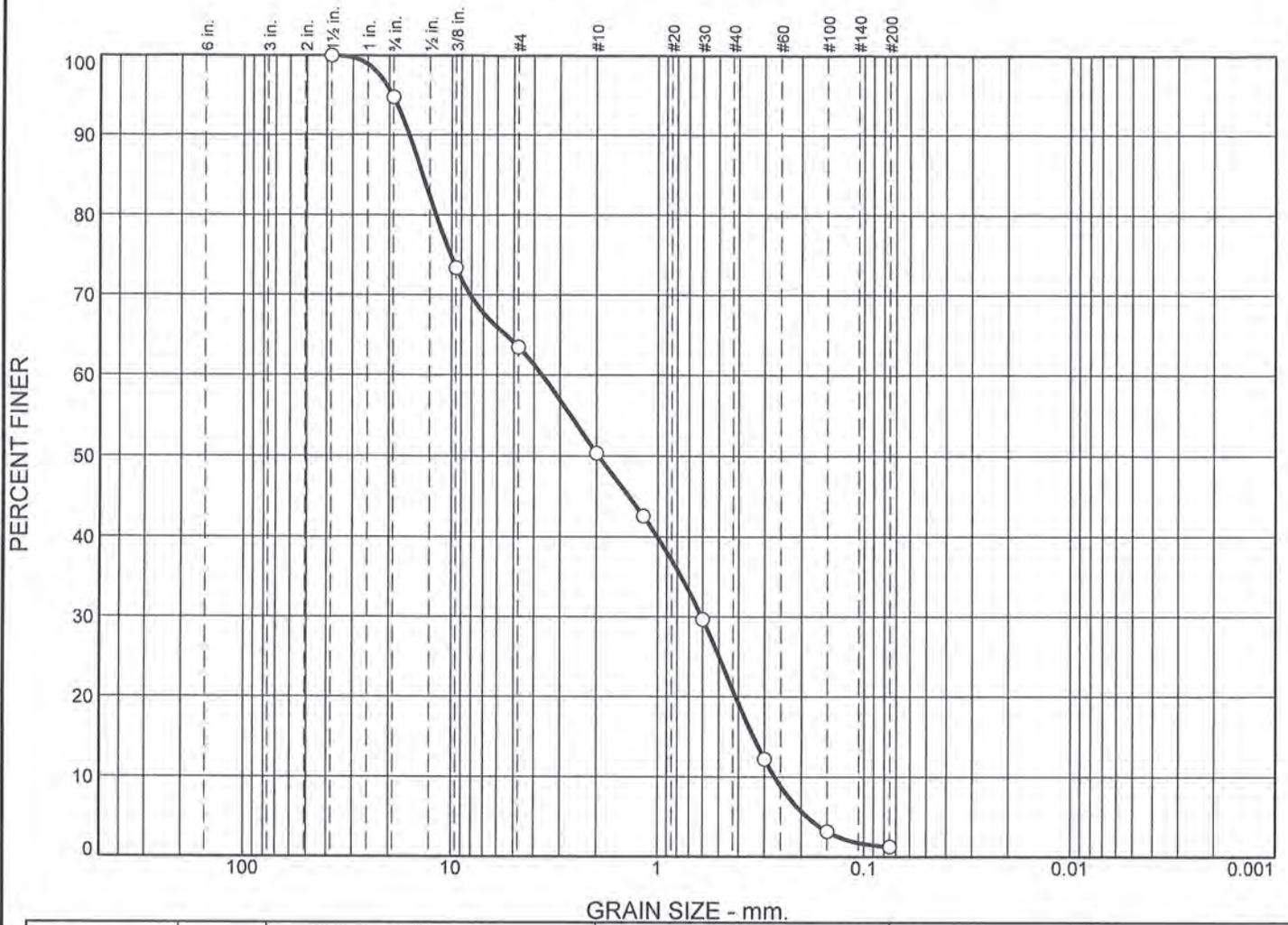
<p><b>Project No.</b> 1801408      <b>Client:</b> City of Haverhill</p> <p><b>Project:</b> Rosemont Street over the Little River</p> <p>○ <b>Source of Sample:</b> SS2      <b>Depth:</b> -      <b>Sample Number:</b> -</p>	<p><b>Remarks:</b></p> <p>○ As Received WC = 12.7%</p>
<p>GEI Consultants, Inc. 400 Unicorn Park Drive Woburn, MA 01801</p>	

Figure

Tested By: EF



# Particle Size Distribution Report



% Boulders	% +3"	% Gravel			% Sand		% Fines
		Coarse	Medium	Fine	Coarse	Fine	
0.0	0.0	1.1	25.5	23.0	29.7	19.5	1.2

LL	PL	D85	D60	D50	D30	D15	D10	Cc	Cu
-	-	13.7484	3.6591	1.9497	0.6081	0.3395	0.2681	0.38	13.65

Material Description	USCS	AASHTO
○ FINE TO COARSE GRAVEL and fine to coarse sand, trace silt	SP	-

<p><b>Project No.</b> 1801408      <b>Client:</b> City of Haverhill</p> <p><b>Project:</b> Rosemont Street over the Little River</p> <p>○ <b>Source of Sample:</b> SS4      <b>Depth:</b> -      <b>Sample Number:</b> -</p>	<p><b>Remarks:</b></p> <p>○ As Received WC = 16.6%</p>
<p>GEI Consultants, Inc. 400 Unicorn Park Drive Woburn, MA 01801</p>	

Figure

Tested By: EF

Geotechnical Report  
Rosemont Street Bridge Over Little River  
(Bridge No. H-12-024)  
Haverhill, Massachusetts  
December 2022 (Revised August 14, 2024)

## Appendix D

---

### Chemical Test Results



## ANALYTICAL REPORT

Lab Number:	L1903327
Client:	GEI Consultants 400 Unicorn Park Drive Woburn, MA 01801
ATTN:	Steve Sarandis
Phone:	(781) 721-4098
Project Name:	ROSEMONT ST. OVER LITTLE RIVER
Project Number:	1801408
Report Date:	02/08/19

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-17-00196).

---

Eight Walkup Drive, Westborough, MA 01581-1019  
508-898-9220 (Fax) 508-898-9193 800-624-9220 - [www.alphalab.com](http://www.alphalab.com)



**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1903327-01	1801408-SS4	SEDIMENT	HAVERHILL, MA	01/18/19 12:21	01/25/19



Project Name: ROSEMONT ST. OVER LITTLE RIVER

Lab Number: L1903327

Project Number: 1801408

Report Date: 02/08/19

**MADEP MCP Response Action Analytical Report Certification**

**This form provides certifications for all samples performed by MCP methods. Please refer to the Sample Results and Container Information sections of this report for specification of MCP methods used for each analysis. The following questions pertain only to MCP Analytical Methods.**

<b>An affirmative response to questions A through F is required for "Presumptive Certainty" status</b>		
A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	YES
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	YES
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	YES
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data?"	YES
E a.	VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	YES
E b.	APH and TO-15 Methods only: Was the complete analyte list reported for each method?	N/A
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	YES
<b>A response to questions G, H and I is required for "Presumptive Certainty" status</b>		
G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	NO
H	Were all QC performance standards specified in the CAM protocol(s) achieved?	NO
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	NO
<b>For any questions answered "No", please refer to the case narrative section on the following page(s).</b>		

**Please note that sample matrix information is located in the Sample Results section of this report.**



**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

### Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

**HOLD POLICY** - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

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**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

### Case Narrative (continued)

#### MCP Related Narratives

##### Sample Receipt

The water-preserved VOA vials for Volatile Organics Low-Level analysis were received at the laboratory beyond the 48 hour holding time required for freezing. At the client's request, a Volatile Organics High-Level analysis was performed.

In reference to question H:

A Matrix Spike was not submitted for the analysis of Total Metals.

##### Volatile Organics

In reference to question G:

L1903327-01: One or more of the target analytes did not achieve the requested CAM reporting limits.

In reference to question H:

The initial calibration, associated with L1903327-01, did not meet the method required minimum response factor on the lowest calibration standard for 1,4-dioxane (0.0017), as well as the average response factor for 1,4-dioxane.

The continuing calibration standard, associated with L1903327-01, is outside the acceptance criteria for several compounds; however, it is within overall method allowances. A copy of the continuing calibration standard is included as an addendum to this report.

##### EPH

In reference to question I:

All samples were analyzed for a subset of MCP analytes per client request.

##### Total Metals

In reference to question I:

All samples were analyzed for a subset of MCP analytes per client request.

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

### Case Narrative (continued)

#### Non-MCP Related Narratives

##### PAHs/PCB Congeners

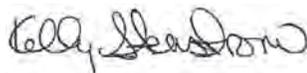
WG1201633-1: The surrogate recovery is above the acceptance criteria for dbob (131%). Since the blank was non-detect for all target analytes, re-analysis was not required.

##### Grain Size Analysis

The WG1204174-1 Laboratory Duplicate RPD for % total gravel (26%), performed on L1903327-01, is outside the acceptance criteria. The elevated RPD has been attributed to the non-homogeneous nature of the native sample.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:

 Kelly Stenstrom

Title: Technical Director/Representative

Date: 02/08/19

## QC OUTLIER SUMMARY REPORT

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER

**Lab Number:** L1903327

**Project Number:** 1801408

**Report Date:** 02/08/19

Method	Client ID (Native ID)	Lab ID	Parameter	QC Type	Recovery/RPD (%)	QC Limits (%)	Associated Samples	Data Quality Assessment
PAHs/PCB Congeners by GC/MS - Mansfield Lab								
8270D-SIM/68 Laboratory Method BI		WG1201633-1	DBOB	Surrogate	131	50-125	-	potential high bias
Grain Size Analysis - Mansfield Lab								
D6913/D7928 Batch QC (L1903327-01)		WG1204174-1	% Total Gravel	Duplicate	26	20	01	non-directional bias



# ORGANICS

# VOLATILES

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**SAMPLE RESULTS**

**Lab ID:** L1903327-01  
**Client ID:** 1801408-SS4  
**Sample Location:** HAVERHILL, MA

**Date Collected:** 01/18/19 12:21  
**Date Received:** 01/25/19  
**Field Prep:** Not Specified

**Sample Depth:**

**Matrix:** Sediment  
**Analytical Method:** 97,8260C  
**Analytical Date:** 02/01/19 13:15  
**Analyst:** JC  
**Percent Solids:** 81%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
<b>MCP Volatile Organics by EPA 5035 High - Westborough Lab</b>						
Methylene chloride	ND		ug/kg	360	--	1
1,1-Dichloroethane	ND		ug/kg	73	--	1
Chloroform	ND		ug/kg	110	--	1
Carbon tetrachloride	ND		ug/kg	73	--	1
1,2-Dichloropropane	ND		ug/kg	73	--	1
Dibromochloromethane	ND		ug/kg	73	--	1
1,1,2-Trichloroethane	ND		ug/kg	73	--	1
Tetrachloroethene	ND		ug/kg	36	--	1
Chlorobenzene	ND		ug/kg	36	--	1
Trichlorofluoromethane	ND		ug/kg	290	--	1
1,2-Dichloroethane	ND		ug/kg	73	--	1
1,1,1-Trichloroethane	ND		ug/kg	36	--	1
Bromodichloromethane	ND		ug/kg	36	--	1
trans-1,3-Dichloropropene	ND		ug/kg	73	--	1
cis-1,3-Dichloropropene	ND		ug/kg	36	--	1
1,3-Dichloropropene, Total	ND		ug/kg	36	--	1
1,1-Dichloropropene	ND		ug/kg	36	--	1
Bromoform	ND		ug/kg	290	--	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	36	--	1
Benzene	ND		ug/kg	36	--	1
Toluene	ND		ug/kg	73	--	1
Ethylbenzene	ND		ug/kg	73	--	1
Chloromethane	ND		ug/kg	290	--	1
Bromomethane	ND		ug/kg	150	--	1
Vinyl chloride	ND		ug/kg	73	--	1
Chloroethane	ND		ug/kg	150	--	1
1,1-Dichloroethene	ND		ug/kg	73	--	1
trans-1,2-Dichloroethene	ND		ug/kg	110	--	1

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**SAMPLE RESULTS**

**Lab ID:** L1903327-01  
**Client ID:** 1801408-SS4  
**Sample Location:** HAVERHILL, MA

**Date Collected:** 01/18/19 12:21  
**Date Received:** 01/25/19  
**Field Prep:** Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
<b>MCP Volatile Organics by EPA 5035 High - Westborough Lab</b>						
Trichloroethene	ND		ug/kg	36	--	1
1,2-Dichlorobenzene	ND		ug/kg	150	--	1
1,3-Dichlorobenzene	ND		ug/kg	150	--	1
1,4-Dichlorobenzene	ND		ug/kg	150	--	1
Methyl tert butyl ether	ND		ug/kg	150	--	1
p/m-Xylene	ND		ug/kg	150	--	1
o-Xylene	ND		ug/kg	73	--	1
Xylenes, Total	ND		ug/kg	73	--	1
cis-1,2-Dichloroethene	ND		ug/kg	73	--	1
1,2-Dichloroethene, Total	ND		ug/kg	73	--	1
Dibromomethane	ND		ug/kg	150	--	1
1,2,3-Trichloropropane	ND		ug/kg	150	--	1
Styrene	ND		ug/kg	73	--	1
Dichlorodifluoromethane	ND		ug/kg	730	--	1
Acetone	ND		ug/kg	730	--	1
Carbon disulfide	ND		ug/kg	730	--	1
Methyl ethyl ketone	ND		ug/kg	730	--	1
Methyl isobutyl ketone	ND		ug/kg	730	--	1
2-Hexanone	ND		ug/kg	730	--	1
Bromochloromethane	ND		ug/kg	150	--	1
Tetrahydrofuran	ND		ug/kg	290	--	1
2,2-Dichloropropane	ND		ug/kg	150	--	1
1,2-Dibromoethane	ND		ug/kg	73	--	1
1,3-Dichloropropane	ND		ug/kg	150	--	1
1,1,1,2-Tetrachloroethane	ND		ug/kg	36	--	1
Bromobenzene	ND		ug/kg	150	--	1
n-Butylbenzene	ND		ug/kg	73	--	1
sec-Butylbenzene	ND		ug/kg	73	--	1
tert-Butylbenzene	ND		ug/kg	150	--	1
o-Chlorotoluene	ND		ug/kg	150	--	1
p-Chlorotoluene	ND		ug/kg	150	--	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	220	--	1
Hexachlorobutadiene	ND		ug/kg	290	--	1
Isopropylbenzene	ND		ug/kg	73	--	1
p-Isopropyltoluene	ND		ug/kg	73	--	1
Naphthalene	ND		ug/kg	290	--	1
n-Propylbenzene	ND		ug/kg	73	--	1

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**SAMPLE RESULTS**

**Lab ID:** L1903327-01  
**Client ID:** 1801408-SS4  
**Sample Location:** HAVERHILL, MA

**Date Collected:** 01/18/19 12:21  
**Date Received:** 01/25/19  
**Field Prep:** Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
<b>MCP Volatile Organics by EPA 5035 High - Westborough Lab</b>						
1,2,3-Trichlorobenzene	ND		ug/kg	150	--	1
1,2,4-Trichlorobenzene	ND		ug/kg	150	--	1
1,3,5-Trimethylbenzene	ND		ug/kg	150	--	1
1,2,4-Trimethylbenzene	ND		ug/kg	150	--	1
Diethyl ether	ND		ug/kg	150	--	1
Diisopropyl Ether	ND		ug/kg	150	--	1
Ethyl-Tert-Butyl-Ether	ND		ug/kg	150	--	1
Tertiary-Amyl Methyl Ether	ND		ug/kg	150	--	1
1,4-Dioxane	ND		ug/kg	7300	--	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	97		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	96		70-130
Dibromofluoromethane	98		70-130

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**Method Blank Analysis**  
**Batch Quality Control**

Analytical Method: 97,8260C  
Analytical Date: 02/01/19 08:20  
Analyst: MV

Parameter	Result	Qualifier	Units	RL	MDL
MCP Volatile Organics by EPA 5035 High - Westborough Lab for sample(s): 01 Batch: WG1203203-5					
Methylene chloride	ND		ug/kg	250	--
1,1-Dichloroethane	ND		ug/kg	50	--
Chloroform	ND		ug/kg	75	--
Carbon tetrachloride	ND		ug/kg	50	--
1,2-Dichloropropane	ND		ug/kg	50	--
Dibromochloromethane	ND		ug/kg	50	--
1,1,2-Trichloroethane	ND		ug/kg	50	--
Tetrachloroethene	ND		ug/kg	25	--
Chlorobenzene	ND		ug/kg	25	--
Trichlorofluoromethane	ND		ug/kg	200	--
1,2-Dichloroethane	ND		ug/kg	50	--
1,1,1-Trichloroethane	ND		ug/kg	25	--
Bromodichloromethane	ND		ug/kg	25	--
trans-1,3-Dichloropropene	ND		ug/kg	50	--
cis-1,3-Dichloropropene	ND		ug/kg	25	--
1,3-Dichloropropene, Total	ND		ug/kg	25	--
1,1-Dichloropropene	ND		ug/kg	25	--
Bromoform	ND		ug/kg	200	--
1,1,2,2-Tetrachloroethane	ND		ug/kg	25	--
Benzene	ND		ug/kg	25	--
Toluene	ND		ug/kg	50	--
Ethylbenzene	ND		ug/kg	50	--
Chloromethane	ND		ug/kg	200	--
Bromomethane	ND		ug/kg	100	--
Vinyl chloride	ND		ug/kg	50	--
Chloroethane	ND		ug/kg	100	--
1,1-Dichloroethene	ND		ug/kg	50	--
trans-1,2-Dichloroethene	ND		ug/kg	75	--
Trichloroethene	ND		ug/kg	25	--



**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**Method Blank Analysis**  
**Batch Quality Control**

Analytical Method: 97,8260C  
Analytical Date: 02/01/19 08:20  
Analyst: MV

Parameter	Result	Qualifier	Units	RL	MDL
MCP Volatile Organics by EPA 5035 High - Westborough Lab for sample(s): 01 Batch: WG1203203-5					
1,2-Dichlorobenzene	ND		ug/kg	100	--
1,3-Dichlorobenzene	ND		ug/kg	100	--
1,4-Dichlorobenzene	ND		ug/kg	100	--
Methyl tert butyl ether	ND		ug/kg	100	--
p/m-Xylene	ND		ug/kg	100	--
o-Xylene	ND		ug/kg	50	--
Xylenes, Total	ND		ug/kg	50	--
cis-1,2-Dichloroethene	ND		ug/kg	50	--
1,2-Dichloroethene, Total	ND		ug/kg	50	--
Dibromomethane	ND		ug/kg	100	--
1,2,3-Trichloropropane	ND		ug/kg	100	--
Styrene	ND		ug/kg	50	--
Dichlorodifluoromethane	ND		ug/kg	500	--
Acetone	ND		ug/kg	500	--
Carbon disulfide	ND		ug/kg	500	--
Methyl ethyl ketone	ND		ug/kg	500	--
Methyl isobutyl ketone	ND		ug/kg	500	--
2-Hexanone	ND		ug/kg	500	--
Bromochloromethane	ND		ug/kg	100	--
Tetrahydrofuran	ND		ug/kg	200	--
2,2-Dichloropropane	ND		ug/kg	100	--
1,2-Dibromoethane	ND		ug/kg	50	--
1,3-Dichloropropane	ND		ug/kg	100	--
1,1,1,2-Tetrachloroethane	ND		ug/kg	25	--
Bromobenzene	ND		ug/kg	100	--
n-Butylbenzene	ND		ug/kg	50	--
sec-Butylbenzene	ND		ug/kg	50	--
tert-Butylbenzene	ND		ug/kg	100	--
o-Chlorotoluene	ND		ug/kg	100	--

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**Method Blank Analysis  
Batch Quality Control**

**Analytical Method:** 97,8260C  
**Analytical Date:** 02/01/19 08:20  
**Analyst:** MV

Parameter	Result	Qualifier	Units	RL	MDL
MCP Volatile Organics by EPA 5035 High - Westborough Lab for sample(s): 01 Batch: WG1203203-5					
p-Chlorotoluene	ND		ug/kg	100	--
1,2-Dibromo-3-chloropropane	ND		ug/kg	150	--
Hexachlorobutadiene	ND		ug/kg	200	--
Isopropylbenzene	ND		ug/kg	50	--
p-Isopropyltoluene	ND		ug/kg	50	--
Naphthalene	ND		ug/kg	200	--
n-Propylbenzene	ND		ug/kg	50	--
1,2,3-Trichlorobenzene	ND		ug/kg	100	--
1,2,4-Trichlorobenzene	ND		ug/kg	100	--
1,3,5-Trimethylbenzene	ND		ug/kg	100	--
1,2,4-Trimethylbenzene	ND		ug/kg	100	--
Diethyl ether	ND		ug/kg	100	--
Diisopropyl Ether	ND		ug/kg	100	--
Ethyl-Tert-Butyl-Ether	ND		ug/kg	100	--
Tertiary-Amyl Methyl Ether	ND		ug/kg	100	--
1,4-Dioxane	ND		ug/kg	5000	--

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	99		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	94		70-130
Dibromofluoromethane	98		70-130



### Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCSD		%Recovery		RPD	
	%Recovery	Qual	%Recovery	Qual	Limits	Qual	RPD	Limits
MCP Volatile Organics by EPA 5035 High - Westborough Lab Associated sample(s): 01 Batch: WG1203203-3 WG1203203-4								
Methylene chloride	94		92		70-130		2	20
1,1-Dichloroethane	101		100		70-130		1	20
Chloroform	102		96		70-130		6	20
Carbon tetrachloride	98		95		70-130		3	20
1,2-Dichloropropane	101		100		70-130		1	20
Dibromochloromethane	94		97		70-130		3	20
1,1,2-Trichloroethane	99		101		70-130		2	20
Tetrachloroethene	98		97		70-130		1	20
Chlorobenzene	95		94		70-130		1	20
Trichlorofluoromethane	106		104		70-130		2	20
1,2-Dichloroethane	103		105		70-130		2	20
1,1,1-Trichloroethane	99		96		70-130		3	20
Bromodichloromethane	96		98		70-130		2	20
trans-1,3-Dichloropropene	97		98		70-130		1	20
cis-1,3-Dichloropropene	96		97		70-130		1	20
1,1-Dichloropropene	98		97		70-130		1	20
Bromoform	95		97		70-130		2	20
1,1,2,2-Tetrachloroethane	94		96		70-130		2	20
Benzene	99		96		70-130		3	20
Toluene	98		95		70-130		3	20
Ethylbenzene	98		96		70-130		2	20
Chloromethane	106		98		70-130		8	20
Bromomethane	109		105		70-130		4	20



## Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCS D		%Recovery		RPD	Qual	RPD	Qual	RPD	Limits
	%Recovery	Qual	%Recovery	Qual	%Recovery	Limits						
MCP Volatile Organics by EPA 5035 High - Westborough Lab Associated sample(s): 01 Batch: WG1203203-3 WG1203203-4												
Vinyl chloride	101		96		70-130		5		5			20
Chloroethane	123		118		70-130		4		4			20
1,1-Dichloroethene	96		93		70-130		3		3			20
trans-1,2-Dichloroethene	94		92		70-130		2		2			20
Trichloroethene	99		97		70-130		2		2			20
1,2-Dichlorobenzene	94		95		70-130		1		1			20
1,3-Dichlorobenzene	96		94		70-130		2		2			20
1,4-Dichlorobenzene	95		95		70-130		0		0			20
Methyl tert butyl ether	92		94		70-130		2		2			20
p/m-Xylene	96		93		70-130		3		3			20
o-Xylene	94		93		70-130		1		1			20
cis-1,2-Dichloroethene	95		95		70-130		0		0			20
Dibromomethane	99		99		70-130		0		0			20
1,2,3-Trichloropropane	97		102		70-130		5		5			20
Styrene	92		92		70-130		0		0			20
Dichlorodifluoromethane	87		84		70-130		4		4			20
Acetone	102		100		70-130		2		2			20
Carbon disulfide	109		105		70-130		4		4			20
Methyl ethyl ketone	101		106		70-130		5		5			20
Methyl isobutyl ketone	83		86		70-130		4		4			20
2-Hexanone	88		93		70-130		6		6			20
Bromochloromethane	100		100		70-130		0		0			20
Tetrahydrofuran	102		112		70-130		9		9			20



## Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCS D		%Recovery		RPD	
	%Recovery	Qual	%Recovery	Qual	Limits	Qual	RPD	Limits
MCP Volatile Organics by EPA 5035 High - Westborough Lab Associated sample(s): 01 Batch: WG1203203-3 WG1203203-4								
2,2-Dichloropropane	99		98		70-130		1	20
1,2-Dibromoethane	94		97		70-130		3	20
1,3-Dichloropropane	99		99		70-130		0	20
1,1,1,2-Tetrachloroethane	95		94		70-130		1	20
Bromobenzene	93		94		70-130		1	20
n-Butylbenzene	101		98		70-130		3	20
sec-Butylbenzene	97		94		70-130		3	20
tert-Butylbenzene	92		90		70-130		2	20
o-Chlorotoluene	94		93		70-130		1	20
p-Chlorotoluene	95		94		70-130		1	20
1,2-Dibromo-3-chloropropane	84		84		70-130		0	20
Hexachlorobutadiene	94		92		70-130		2	20
Isopropylbenzene	94		92		70-130		2	20
p-Isopropyltoluene	95		93		70-130		2	20
Naphthalene	84		87		70-130		4	20
n-Propylbenzene	98		95		70-130		3	20
1,2,3-Trichlorobenzene	92		93		70-130		1	20
1,2,4-Trichlorobenzene	92		92		70-130		0	20
1,3,5-Trimethylbenzene	95		94		70-130		1	20
1,2,4-Trimethylbenzene	95		93		70-130		2	20
Diethyl ether	112		108		70-130		4	20
Diisopropyl Ether	100		99		70-130		1	20
Ethyl-Tert-Butyl-Ether	93		94		70-130		1	20



### Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCSD		%Recovery		RPD	
	%Recovery	Qual	%Recovery	Qual	Limits	RPD	Qual	Limits
MCP Volatile Organics by EPA 5035 High - Westborough Lab Associated sample(s): 01 Batch: WG1203203-3 WG1203203-4								
Tertiary-Amyl Methyl Ether	88		90		70-130	2		20
1,4-Dioxane	75		74		70-130	1		20

Surrogate	LCS		LCSD		Acceptance	
	%Recovery	Qual	%Recovery	Qual	Criteria	Criteria
1,2-Dichloroethane-d4	101		102		70-130	70-130
Toluene-d8	99		98		70-130	70-130
4-Bromofluorobenzene	94		93		70-130	70-130
Dibromofluoromethane	98		99		70-130	70-130



# SEMIVOLATILES

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**SAMPLE RESULTS**

**Lab ID:** L1903327-01  
**Client ID:** 1801408-SS4  
**Sample Location:** HAVERHILL, MA

**Date Collected:** 01/18/19 12:21  
**Date Received:** 01/25/19  
**Field Prep:** Not Specified

**Sample Depth:**

**Matrix:** Sediment  
**Analytical Method:** 105,8270D-SIM/680(M)  
**Analytical Date:** 01/29/19 14:25  
**Analyst:** GP  
**Percent Solids:** 81%

**Extraction Method:** EPA 3570  
**Extraction Date:** 01/28/19 13:05  
**Cleanup Method:** EPA 3630  
**Cleanup Date:** 01/28/19

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
<b>PAHs/PCB Congeners by GC/MS - Mansfield Lab</b>						
Naphthalene	ND		ug/kg	4.62	--	1
Acenaphthylene	63.2		ug/kg	4.62	--	1
Acenaphthene	10.6		ug/kg	4.62	--	1
Fluorene	18.5		ug/kg	4.62	--	1
Phenanthrene	259		ug/kg	4.62	--	1
Anthracene	77.1		ug/kg	4.62	--	1
Fluoranthene	546		ug/kg	4.62	--	1
Pyrene	436		ug/kg	4.62	--	1
Benz(a)anthracene	211		ug/kg	4.62	--	1
Chrysene	263		ug/kg	4.62	--	1
Benzo(b)fluoranthene	222		ug/kg	4.62	--	1
Benzo(k)fluoranthene	195		ug/kg	4.62	--	1
Benzo(a)pyrene	228		ug/kg	4.62	--	1
Indeno(1,2,3-cd)Pyrene	147		ug/kg	4.62	--	1
Dibenz(a,h)anthracene	35.2		ug/kg	4.62	--	1
Benzo(ghi)perylene	159		ug/kg	4.62	--	1
Cl2-BZ#8	ND		ug/kg	0.462	--	1
Cl3-BZ#18	ND		ug/kg	0.462	--	1
Cl3-BZ#28	ND		ug/kg	0.462	--	1
Cl4-BZ#44	ND		ug/kg	0.462	--	1
Cl4-BZ#49	ND		ug/kg	0.462	--	1
Cl4-BZ#52	ND		ug/kg	0.462	--	1
Cl4-BZ#66	ND		ug/kg	0.462	--	1
Cl5-BZ#87	ND		ug/kg	0.462	--	1
Cl5-BZ#101	ND		ug/kg	0.462	--	1
Cl5-BZ#105	ND		ug/kg	0.462	--	1
Cl5-BZ#118	ND		ug/kg	0.462	--	1
Cl6-BZ#128	ND		ug/kg	0.462	--	1

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**SAMPLE RESULTS**

**Lab ID:** L1903327-01  
**Client ID:** 1801408-SS4  
**Sample Location:** HAVERHILL, MA

**Date Collected:** 01/18/19 12:21  
**Date Received:** 01/25/19  
**Field Prep:** Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
PAHs/PCB Congeners by GC/MS - Mansfield Lab						
Cl6-BZ#138	ND		ug/kg	0.462	--	1
Cl6-BZ#153	ND		ug/kg	0.462	--	1
Cl7-BZ#170	ND		ug/kg	0.462	--	1
Cl7-BZ#180	ND		ug/kg	0.462	--	1
Cl7-BZ#183	ND		ug/kg	0.462	--	1
Cl7-BZ#184	ND		ug/kg	0.462	--	1
Cl7-BZ#187	ND		ug/kg	0.462	--	1
Cl8-BZ#195	ND		ug/kg	0.462	--	1
Cl9-BZ#206	ND		ug/kg	0.462	--	1
Cl10-BZ#209	ND		ug/kg	0.462	--	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
2-Methylnaphthalene-d10	106		30-150
Pyrene-d10	112		30-150
Benzo(b)fluoranthene-d12	102		30-150
DBOB	108		50-125
BZ 198	82		50-125

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**Method Blank Analysis**  
**Batch Quality Control**

**Analytical Method:** 105,8270D-SIM/680(M)  
**Analytical Date:** 01/29/19 12:43  
**Analyst:** GP

**Extraction Method:** EPA 3570  
**Extraction Date:** 01/28/19 13:05  
**Cleanup Method:** EPA 3630  
**Cleanup Date:** 01/28/19

Parameter	Result	Qualifier	Units	RL	MDL
PAHs/PCB Congeners by GC/MS - Mansfield Lab for sample(s): 01 Batch: WG1201633-1					
Naphthalene	ND		ug/kg	4.00	--
Acenaphthylene	ND		ug/kg	4.00	--
Acenaphthene	ND		ug/kg	4.00	--
Fluorene	ND		ug/kg	4.00	--
Phenanthrene	ND		ug/kg	4.00	--
Anthracene	ND		ug/kg	4.00	--
Fluoranthene	ND		ug/kg	4.00	--
Pyrene	ND		ug/kg	4.00	--
Benz(a)anthracene	ND		ug/kg	4.00	--
Chrysene	ND		ug/kg	4.00	--
Benzo(b)fluoranthene	ND		ug/kg	4.00	--
Benzo(k)fluoranthene	ND		ug/kg	4.00	--
Benzo(a)pyrene	ND		ug/kg	4.00	--
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	4.00	--
Dibenz(a,h)anthracene	ND		ug/kg	4.00	--
Benzo(ghi)perylene	ND		ug/kg	4.00	--
Cl2-BZ#8	ND		ug/kg	0.400	--
Cl3-BZ#18	ND		ug/kg	0.400	--
Cl3-BZ#28	ND		ug/kg	0.400	--
Cl4-BZ#44	ND		ug/kg	0.400	--
Cl4-BZ#49	ND		ug/kg	0.400	--
Cl4-BZ#52	ND		ug/kg	0.400	--
Cl4-BZ#66	ND		ug/kg	0.400	--
Cl5-BZ#87	ND		ug/kg	0.400	--
Cl5-BZ#101	ND		ug/kg	0.400	--
Cl5-BZ#105	ND		ug/kg	0.400	--
Cl5-BZ#118	ND		ug/kg	0.400	--
Cl6-BZ#128	ND		ug/kg	0.400	--
Cl6-BZ#138	ND		ug/kg	0.400	--



**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**Method Blank Analysis  
 Batch Quality Control**

Analytical Method: 105,8270D-SIM/680(M)  
 Analytical Date: 01/29/19 12:43  
 Analyst: GP

Extraction Method: EPA 3570  
 Extraction Date: 01/28/19 13:05  
 Cleanup Method: EPA 3630  
 Cleanup Date: 01/28/19

Parameter	Result	Qualifier	Units	RL	MDL
PAHs/PCB Congeners by GC/MS - Mansfield Lab for sample(s): 01 Batch: WG1201633-1					
Cl6-BZ#153	ND		ug/kg	0.400	--
Cl7-BZ#170	ND		ug/kg	0.400	--
Cl7-BZ#180	ND		ug/kg	0.400	--
Cl7-BZ#183	ND		ug/kg	0.400	--
Cl7-BZ#184	ND		ug/kg	0.400	--
Cl7-BZ#187	ND		ug/kg	0.400	--
Cl8-BZ#195	ND		ug/kg	0.400	--
Cl9-BZ#206	ND		ug/kg	0.400	--
Cl10-BZ#209	ND		ug/kg	0.400	--

Surrogate	%Recovery	Qualifier	Acceptance Criteria
2-Methylnaphthalene-d10	64		30-150
Pyrene-d10	66		30-150
Benzo(b)fluoranthene-d12	62		30-150
DBOB	131	Q	50-125
BZ 198	100		50-125

### Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCS D		%Recovery		RPD	
	%Recovery	Qual	%Recovery	Qual	Limits	Qual	RPD	Limits
PAHs/PCB Congeners by GC/MS - Mansfield Lab Associated sample(s): 01 Batch: WG1201633-2 WG1201633-3								
Naphthalene	81		84		40-140		4	30
Acenaphthylene	79		81		40-140		3	30
Acenaphthene	79		81		40-140		3	30
Fluorene	81		82		40-140		1	30
Phenanthrene	75		74		40-140		1	30
Anthracene	84		85		40-140		1	30
Fluoranthene	83		85		40-140		2	30
Pyrene	77		79		40-140		3	30
Benz(a)anthracene	85		88		40-140		3	30
Chrysene	86		88		40-140		2	30
Benzo(b)fluoranthene	73		79		40-140		8	30
Benzo(k)fluoranthene	91		92		40-140		1	30
Benzo(a)pyrene	85		91		40-140		7	30
Indeno(1,2,3-cd)Pyrene	69		80		40-140		15	30
Dibenz(a,h)anthracene	84		87		40-140		4	30
Benzo(ghi)perylene	81		85		40-140		5	30
C12-BZ#8	86		88		40-140		2	50
C13-BZ#18	82		83		40-140		1	50
C13-BZ#28	86		87		40-140		1	50
C14-BZ#44	91		93		40-140		2	50
C14-BZ#49	88		91		40-140		3	50
C14-BZ#52	86		86		40-140		0	50
C14-BZ#66	91		94		40-140		3	50



## Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCSD		%Recovery		RPD		
	%Recovery	Qual	%Recovery	Qual	Limits	RPD	Qual	Limits	
PAHs/PCB Congeners by GC/MS - Mansfield Lab Associated sample(s): 01 Batch: WG1201633-2 WG1201633-3									
C15-BZ#87	92		95		40-140	3		50	
C15-BZ#101	98		99		40-140	1		50	
C15-BZ#105	95		98		40-140	3		50	
C15-BZ#118	88		90		40-140	2		50	
C16-BZ#128	94		97		40-140	3		50	
C16-BZ#138	95		99		40-140	4		50	
C16-BZ#153	97		100		40-140	3		50	
C17-BZ#170	96		99		40-140	3		50	
C17-BZ#180	90		93		40-140	3		50	
C17-BZ#183	88		92		40-140	4		50	
C17-BZ#184	93		96		40-140	3		50	
C17-BZ#187	92		94		40-140	2		50	
C18-BZ#195	96		99		40-140	3		50	
C19-BZ#206	88		92		40-140	4		50	
C110-BZ#209	97		102		40-140	5		50	

Surrogate	LCS		LCSD		Acceptance Criteria	
	%Recovery	Qual	%Recovery	Qual	Criteria	Criteria
2-Methylnaphthalene-d10	91		92		30-150	30-150
Pyrene-d10	93		95		30-150	30-150
Benzo(b)fluoranthene-d12	92		94		30-150	30-150
DBOB	118		118		50-125	50-125
BZ 198	86		94		50-125	50-125



# PETROLEUM HYDROCARBONS

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**SAMPLE RESULTS**

Lab ID: L1903327-01  
 Client ID: 1801408-SS4  
 Sample Location: HAVERHILL, MA

Date Collected: 01/18/19 12:21  
 Date Received: 01/25/19  
 Field Prep: Not Specified

Sample Depth:  
 Matrix: Sediment  
 Analytical Method: 98,EPH-04-1.1  
 Analytical Date: 01/30/19 01:47  
 Analyst: MEO  
 Percent Solids: 81%

Extraction Method: EPA 3546  
 Extraction Date: 01/27/19 05:09  
 Cleanup Method1: EPH-04-1  
 Cleanup Date1: 01/29/19

**Quality Control Information**

Condition of sample received: Satisfactory  
 Sample Temperature upon receipt: Received on Ice  
 Sample Extraction method: Extracted Per the Method

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
<b>Extractable Petroleum Hydrocarbons - Westborough Lab</b>						
C9-C18 Aliphatics	ND		mg/kg	7.92	--	1
C19-C36 Aliphatics	75.1		mg/kg	7.92	--	1
C11-C22 Aromatics	34.2		mg/kg	7.92	--	1
C11-C22 Aromatics, Adjusted	26.6		mg/kg	7.92	--	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Chloro-Octadecane	72		40-140
o-Terphenyl	76		40-140
2-Fluorobiphenyl	79		40-140
2-Bromonaphthalene	76		40-140

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**Method Blank Analysis  
 Batch Quality Control**

Analytical Method: 98,EPH-04-1.1  
 Analytical Date: 01/29/19 23:45  
 Analyst: MEO

Extraction Method: EPA 3546  
 Extraction Date: 01/27/19 03:46  
 Cleanup Method: EPH-04-1  
 Cleanup Date: 01/29/19

Parameter	Result	Qualifier	Units	RL	MDL
Extractable Petroleum Hydrocarbons - Westborough Lab for sample(s): 01 Batch: WG1201391-1					
C9-C18 Aliphatics	ND		mg/kg	6.40	--
C19-C36 Aliphatics	ND		mg/kg	6.40	--
C11-C22 Aromatics	ND		mg/kg	6.40	--
C11-C22 Aromatics, Adjusted	ND		mg/kg	6.40	--

Surrogate	%Recovery	Qualifier	Acceptance Criteria
Chloro-Octadecane	52		40-140
o-Terphenyl	57		40-140
2-Fluorobiphenyl	88		40-140
2-Bromonaphthalene	79		40-140

## Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCS D		%Recovery		RPD	
	%Recovery	Qual	%Recovery	Qual	Limits	Qual	RPD	Limits
Extractable Petroleum Hydrocarbons - Westborough Lab Associated sample(s): 01 Batch: WG1201391-2 WG1201391-3								
C9-C18 Aliphatics	77		66		40-140		15	25
C19-C36 Aliphatics	81		68		40-140		17	25
C11-C22 Aromatics	82		70		40-140		16	25
Naphthalene	72		62		40-140		15	25
2-Methylnaphthalene	71		60		40-140		17	25
Acenaphthylene	76		66		40-140		14	25
Acenaphthene	77		66		40-140		15	25
Fluorene	77		68		40-140		12	25
Phenanthrene	77		68		40-140		12	25
Anthracene	78		69		40-140		12	25
Fluoranthene	78		69		40-140		12	25
Pyrene	80		70		40-140		13	25
Benzo(a)anthracene	79		69		40-140		14	25
Chrysene	80		70		40-140		13	25
Benzo(b)fluoranthene	81		70		40-140		15	25
Benzo(k)fluoranthene	80		69		40-140		15	25
Benzo(a)pyrene	79		68		40-140		15	25
Indeno(1,2,3-cd)Pyrene	81		67		40-140		19	25
Dibenzo(a,h)anthracene	81		67		40-140		19	25
Benzo(ghi)perylene	78		64		40-140		20	25
Nonane (C9)	62		53		30-140		16	25
Decane (C10)	68		58		40-140		16	25
Dodecane (C12)	72		59		40-140		20	25



### Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCSD		%Recovery		RPD	
	%Recovery	Qual	%Recovery	Qual	Limits	RPD	Qual	Limits
Extractable Petroleum Hydrocarbons - Westborough Lab Associated sample(s): 01 Batch: WG1201391-2 WG1201391-3								
Tetradecane (C14)	74		62		40-140	18		25
Hexadecane (C16)	75		66		40-140	13		25
Octadecane (C18)	77		67		40-140	14		25
Nonadecane (C19)	77		67		40-140	14		25
Eicosane (C20)	79		68		40-140	15		25
Docosane (C22)	78		68		40-140	14		25
Tetracosane (C24)	78		67		40-140	15		25
Hexacosane (C26)	78		67		40-140	15		25
Octacosane (C28)	78		67		40-140	15		25
Triacosane (C30)	77		66		40-140	15		25
Hexatriacontane (C36)	77		62		40-140	22		25

Surrogate	LCS		LCSD		Acceptance Criteria	
	%Recovery	Qual	%Recovery	Qual	Criteria	Criteria
Chloro-Octadecane	63		53		40-140	40-140
o-Terphenyl	72		62		40-140	40-140
2-Fluorobiphenyl	88		91		40-140	40-140
2-Bromonaphthalene	80		83		40-140	40-140
% Naphthalene Breakthrough	0		0			
% 2-Methylnaphthalene Breakthrough	0		0			



## METALS

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER**Lab Number:** L1903327**Project Number:** 1801408**Report Date:** 02/08/19**SAMPLE RESULTS**

Lab ID: L1903327-01

Date Collected: 01/18/19 12:21

Client ID: 1801408-SS4

Date Received: 01/25/19

Sample Location: HAVERHILL, MA

Field Prep: Not Specified

Sample Depth:

Matrix: Sediment

Percent Solids: 81%

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
<b>MCP Total Metals - Mansfield Lab</b>											
Arsenic, Total	2.50		mg/kg	0.615	--	10	01/28/19 13:27	01/29/19 13:56	EPA 3050B	97,6020B	AM
Cadmium, Total	ND		mg/kg	0.2462	--	10	01/28/19 13:27	01/29/19 13:56	EPA 3050B	97,6020B	AM
Chromium, Total	8.49		mg/kg	2.46	--	10	01/28/19 13:27	01/29/19 13:56	EPA 3050B	97,6020B	AM
Copper, Total	4.13		mg/kg	2.46	--	10	01/28/19 13:27	01/29/19 13:56	EPA 3050B	97,6020B	AM
Lead, Total	11.3		mg/kg	0.738	--	10	01/28/19 13:27	01/29/19 13:56	EPA 3050B	97,6020B	AM
Mercury, Total	ND		mg/kg	0.079	--	1	02/01/19 10:35	02/04/19 14:51	EPA 7471B	97,7471B	GD
Nickel, Total	5.95		mg/kg	1.23	--	10	01/28/19 13:27	01/29/19 13:56	EPA 3050B	97,6020B	AM
Zinc, Total	21.7		mg/kg	12.3	--	10	01/28/19 13:27	01/29/19 13:56	EPA 3050B	97,6020B	AM



**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

## Method Blank Analysis Batch Quality Control

Parameter	Result Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
MCP Total Metals - Mansfield Lab for sample(s): 01 Batch: WG1201647-1									
Arsenic, Total	ND	mg/kg	0.625	--	10	01/28/19 13:27	01/29/19 13:44	97,6020B	AM
Cadmium, Total	ND	mg/kg	0.2500	--	10	01/28/19 13:27	01/29/19 13:44	97,6020B	AM
Chromium, Total	ND	mg/kg	2.50	--	10	01/28/19 13:27	01/29/19 13:44	97,6020B	AM
Copper, Total	ND	mg/kg	2.50	--	10	01/28/19 13:27	01/29/19 13:44	97,6020B	AM
Lead, Total	ND	mg/kg	0.750	--	10	01/28/19 13:27	01/29/19 13:44	97,6020B	AM
Nickel, Total	ND	mg/kg	1.25	--	10	01/28/19 13:27	01/29/19 13:44	97,6020B	AM
Zinc, Total	ND	mg/kg	12.5	--	10	01/28/19 13:27	01/29/19 13:44	97,6020B	AM

### Prep Information

Digestion Method: EPA 3050B

Parameter	Result Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
MCP Total Metals - Mansfield Lab for sample(s): 01 Batch: WG1201961-1									
Mercury, Total	ND	mg/kg	0.083	--	1	02/01/19 10:35	02/04/19 14:41	97,7471B	GD

### Prep Information

Digestion Method: EPA 7471B



## Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS		LCSD		%Recovery		RPD	Qual	RPD Limits
	%Recovery	Qual	%Recovery	Qual	Limits	Limits			
MCP Total Metals - Mansfield Lab Associated sample(s): 01 Batch: WG1201647-2 WG1201647-3 SRM Lot Number: D101-540									
Arsenic, Total	90		89		83-117		12		30
Cadmium, Total	94		94		83-117		11		30
Chromium, Total	86		87		81-118		12		30
Copper, Total	87		88		83-116		12		30
Lead, Total	89		92		83-117		18		30
Nickel, Total	90		91		82-117		10		30
Zinc, Total	92		90		81-119		11		30
MCP Total Metals - Mansfield Lab Associated sample(s): 01 Batch: WG1201961-2 WG1201961-3 SRM Lot Number: D101-540									
Mercury, Total	75		66		65-135		13		30



# **INORGANICS & MISCELLANEOUS**

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

**SAMPLE RESULTS**

**Lab ID:** L1903327-01  
**Client ID:** 1801408-SS4  
**Sample Location:** HAVERHILL, MA

**Date Collected:** 01/18/19 12:21  
**Date Received:** 01/25/19  
**Field Prep:** Not Specified

**Sample Depth:**  
**Matrix:** Sediment

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
<b>Total Organic Carbon - Mansfield Lab</b>										
Total Organic Carbon (Rep1)	0.217		%	0.010	--	1	-	02/04/19 15:04	1,9060A	SP
Total Organic Carbon (Rep2)	0.254		%	0.010	--	1	-	02/04/19 15:04	1,9060A	SP
Total Organic Carbon (Average)	0.236		%	0.010	--	1	-	02/04/19 15:04	1,9060A	SP
<b>Grain Size Analysis - Mansfield Lab</b>										
% Total Gravel	14.8		%	0.100	NA	1	-	02/06/19 09:56	12,D6913/D7928	SP
% Coarse Sand	10.4		%	0.100	NA	1	-	02/06/19 09:56	12,D6913/D7928	SP
% Medium Sand	38.1		%	0.100	NA	1	-	02/06/19 09:56	12,D6913/D7928	SP
% Fine Sand	34.4		%	0.100	NA	1	-	02/06/19 09:56	12,D6913/D7928	SP
% Total Fines	2.30		%	0.100	NA	1	-	02/06/19 09:56	12,D6913/D7928	SP
<b>General Chemistry - Mansfield Lab</b>										
Solids, Total	80.6		%	0.100	--	1	-	01/28/19 13:58	121,2540G	GD



Project Name: ROSEMONT ST. OVER LITTLE RIVER

Lab Number: L1903327

Project Number: 1801408

Report Date: 02/08/19

**Method Blank Analysis**  
**Batch Quality Control**

Parameter	Result Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab for sample(s): 01 Batch: WG1203820-1									
Total Organic Carbon (Rep1)	ND	%	0.010	--	1	-	02/04/19 15:04	1,9060A	SP
Total Organic Carbon (Rep2)	ND	%	0.010	--	1	-	02/04/19 15:04	1,9060A	SP



## Lab Control Sample Analysis

Batch Quality Control

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

Parameter	LCS %Recovery	Qual	LCS %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
<b>Total Organic Carbon - Mansfield Lab Associated sample(s): 01 Batch: WG1203820-2</b>								
Total Organic Carbon (Rep1)	115		-		75-125	-		25
Total Organic Carbon (Rep2)	78		-		75-125	-		25



## Lab Duplicate Analysis *Batch Quality Control*

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER

**Project Number:** 1801408

**Lab Number:** L1903327

**Report Date:** 02/08/19

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Grain Size Analysis - Mansfield Lab Associated sample(s): 01 QC Batch ID: WG1204174-1 QC Sample: L1903327-01 Client ID: 1801408-SS4						
% Total Gravel	14.8	19.2	%	26	Q	20
% Coarse Sand	10.4	12.4	%	18		20
% Medium Sand	38.1	34.3	%	10		20
% Fine Sand	34.4	31.5	%	9		20
% Total Fines	2.30	2.60	%	12		20



**Sample Receipt and Container Information**

Were project specific reporting limits specified? YES

**Cooler Information**  
**Cooler** A  
**Custody Seal** Absent

<b>Container Information</b>		<b>Initial pH</b>	<b>Final pH</b>	<b>Temp deg C</b>	<b>Pres</b>	<b>Seal</b>	<b>Frozen Date/Time</b>	<b>Analysis(*)</b>
<b>Container ID</b>	<b>Container Type</b>							
L1903327-01A	Vial MeOH preserved	NA	3.8	3.8	Y	Absent		MCP-8260H-10(14)
L1903327-01B	Vial water preserved	NA	3.8	3.8	Y	Absent	25-JAN-19 23:11	MCP-8260H-10(14)
L1903327-01C	Vial water preserved	NA	3.8	3.8	Y	Absent	25-JAN-19 23:11	MCP-8260H-10(14)
L1903327-01D	Plastic 2oz unpreserved for TS	NA	3.8	3.8	Y	Absent		A2-TS(7)
L1903327-01E	Glass 120ml/4oz unpreserved	NA	3.8	3.8	Y	Absent		A2-CR-MCP6020T-10(180),A2-AS-MCP6020T-10(180),A2-CD-MCP6020T-10(180),A2-ZN-MCP6020T-10(180),A2-CU-MCP6020T-10(180),A2-HG-MCP747TT-10(28),A2-HGPREP-AF(28),A2-NI-MCP6020T-10(180),A2-PB-MCP6020T-10(180),A2-PREP-3050:2T(180)
L1903327-01F	Glass 120ml/4oz unpreserved	NA	3.8	3.8	Y	Absent		A2-TOC-9060-2REPS(28),A2-PAH/PCBCONG(14)
L1903327-01G	Plastic 8oz unpreserved for Grain Size	NA	3.8	3.8	Y	Absent		A2-HYDRO-TFINE(),A2-HYDRO-FSAND(),A2-HYDRO-MSAND(),A2-HYDRO-TGRAVEL(),A2-HYDRO-CSAND()
L1903327-01H	Glass 250ml/8oz unpreserved	NA	3.8	3.8	Y	Absent		EPH-10(14)

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

## GLOSSARY

### Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

### Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

### Terms

**Analytical Method:** Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

**Final pH:** As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

**Frozen Date/Time:** With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

**Initial pH:** As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

**PFAS Total:** With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. If a 'Total' result is requested, the results of its individual components will also be reported.

**Total:** With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total'

*Report Format: Data Usability Report*



**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

#### Data Qualifiers

- A** - Spectra identified as "Aldol Condensation Product".
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- G** - The concentration may be biased high due to matrix interferences (i.e. co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- J** - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
- ND** - Not detected at the reporting limit (RL) for the sample.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.

**Project Name:** ROSEMONT ST. OVER LITTLE RIVER  
**Project Number:** 1801408

**Lab Number:** L1903327  
**Report Date:** 02/08/19

## REFERENCES

- 1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.
- 12 Annual Book of ASTM Standards. (American Society for Testing and Materials) ASTM International.
- 97 EPA Test Methods (SW-846) with QC Requirements & Performance Standards for the Analysis of EPA SW-846 Methods under the Massachusetts Contingency Plan, WSC-CAM-IIA, IIB, IIIA, IIIB, IIIC, IIID, VA, VB, VC, VIA, VIB, VIIIA and VIIIB, July 2010.
- 98 Method for the Determination of Extractable Petroleum Hydrocarbons (EPH), MassDEP, May 2004, Revision 1.1 with QC Requirements & Performance Standards for the Analysis of EPH under the Massachusetts Contingency Plan, WSC-CAM-IVB, July 2010.
- 105 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IIIA, 1997 in conjunction with NOAA Technical Memorandum NMFS-NWFSC-59: Extraction, Cleanup and GC/MS Analysis of Sediments and Tissues for Organic Contaminants, March 2004 and the Determination of Pesticides and PCBs in Water and Oil/Sediment by GC/MS: Method 680, EPA 01A0005295, November 1985.
- 121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

## LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

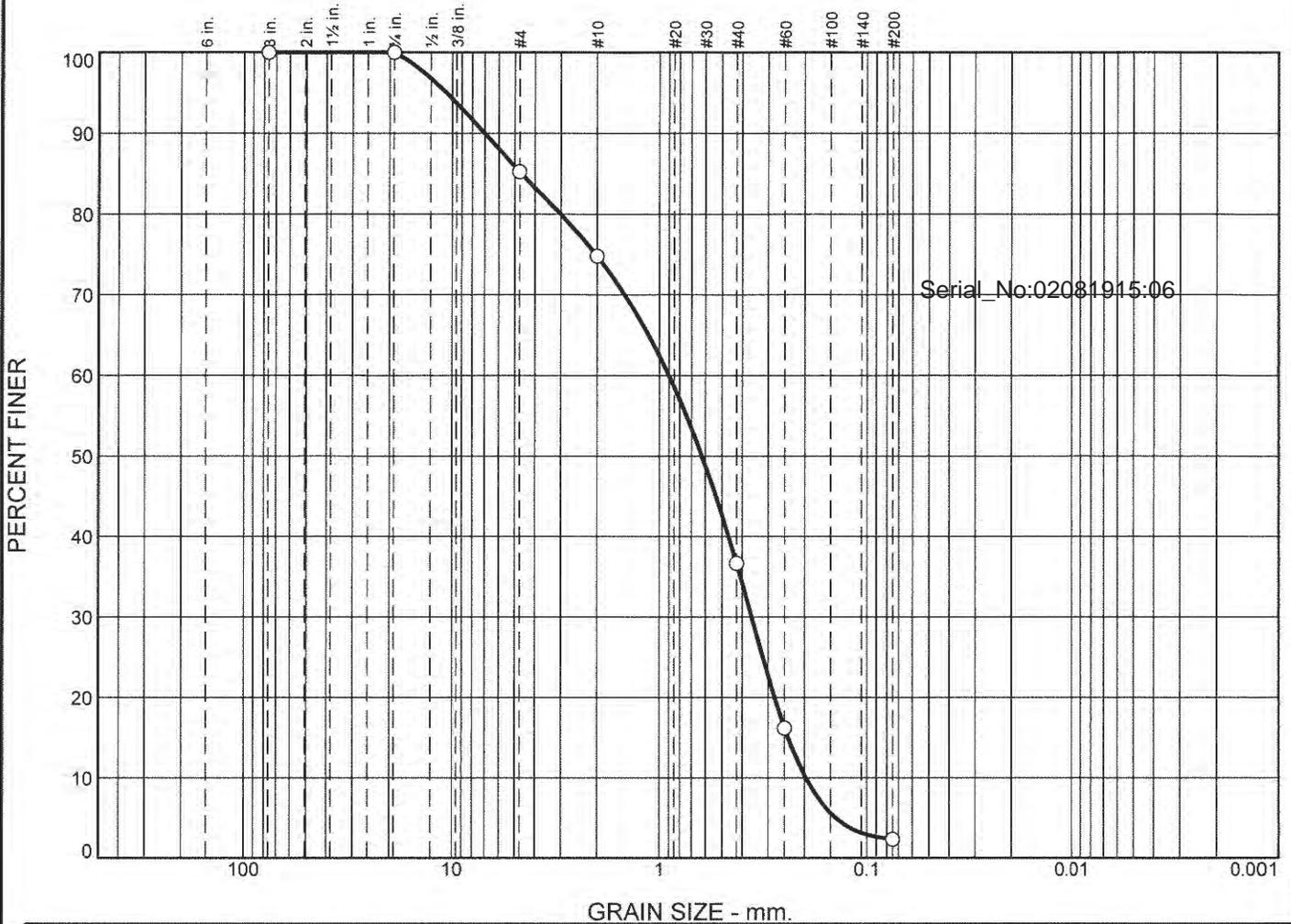


Serial\_No:02081915:06

# **ASTM D6913/D7928**

## **GRAIN SIZE ANALYSIS**

# Particle Size Distribution Report



%	+3"		% Gravel		% Sand			% Fines			
	Coarse	Fine	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
<input type="radio"/>	0.0		0.0	14.8	10.4	38.1	34.4	2.3			
<input checked="" type="checkbox"/>	Colloids	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
<input type="radio"/>				4.6508	0.9011	0.6242	0.3600	0.2404	0.1972	0.73	4.57

Material Description	USCS	AASHTO
<input type="radio"/>	SP	

<p><b>Project No.</b>                      <b>Client:</b></p> <p><b>Project:</b></p> <p><input type="radio"/> <b>Source of Sample:</b> 1801408-SS4                      <b>Sample Number:</b> L1903327-01</p> <p><b>Date:</b> <input type="radio"/></p> <p style="text-align: center;"><b>Alpha Analytical</b></p> <p style="text-align: center;"><b>Mansfield, MA</b></p>	<p><b>Remarks:</b></p> <p style="text-align: right;"><b>Figure</b></p>
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**GRAIN SIZE DISTRIBUTION TEST DATA**

2/6/2019

Location: 1801408-SS4

Sample Number: L1903327-01

USCS Classification: SP

**Sieve Test Data**

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 62.03  
 Tare Wt. = 0.00  
 Minus #200 from wash = 0.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
62.03	0.00	3	0.00	0.00	100.0
		0.75	0.00	0.00	100.0
		#4	9.15	0.00	85.2
		#10	6.48	0.00	74.8
		#40	23.65	0.00	36.7
		#60	12.70	0.00	16.2
		#200	8.60	0.00	2.3

Serial\_No:02081915:06

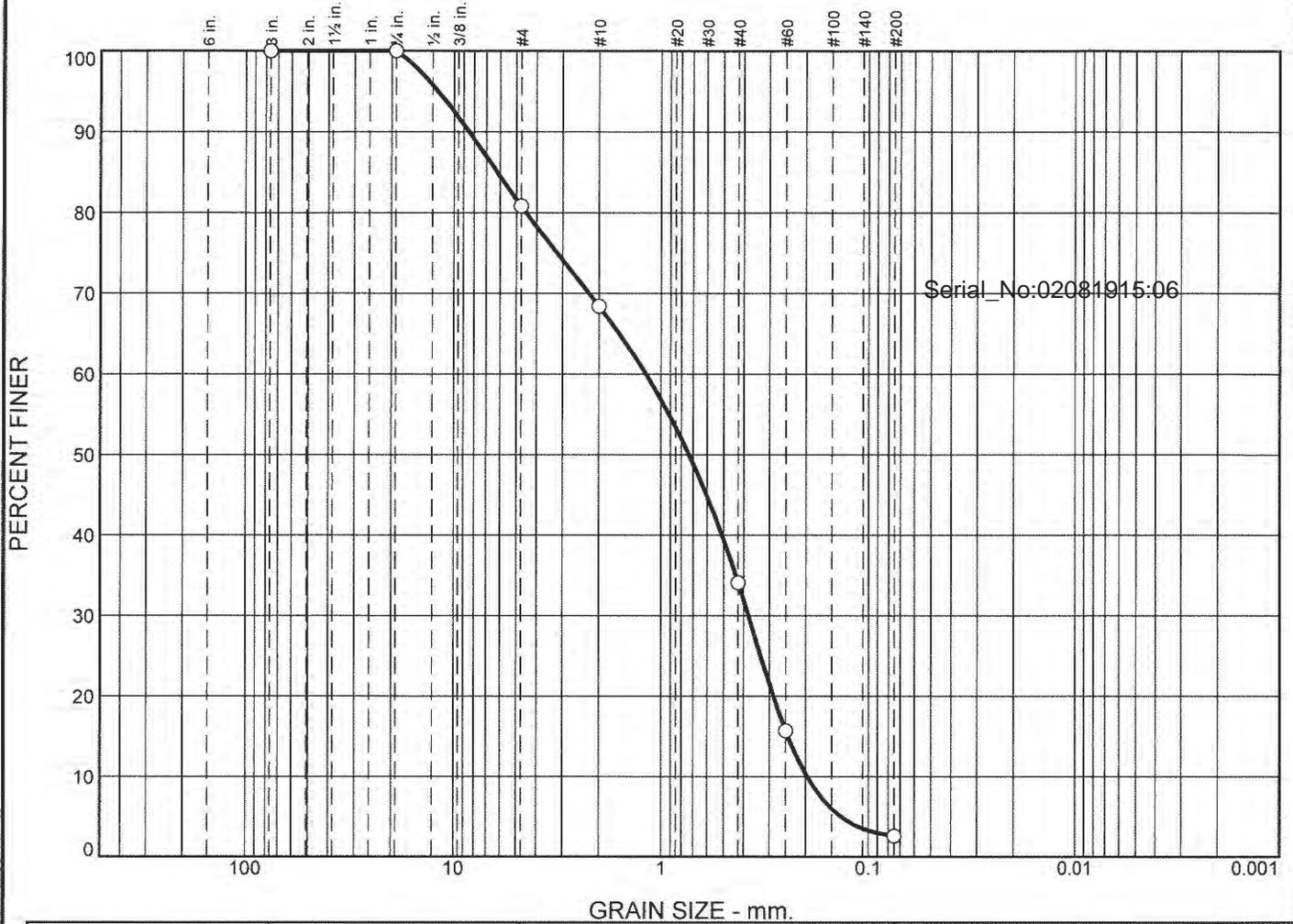
**Fractional Components**

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	14.8	14.8	10.4	38.1	34.4	82.9			2.3

D <sub>5</sub>	D <sub>10</sub>	D <sub>15</sub>	D <sub>20</sub>	D <sub>30</sub>	D <sub>40</sub>	D <sub>50</sub>	D <sub>60</sub>	D <sub>80</sub>	D <sub>85</sub>	D <sub>90</sub>	D <sub>95</sub>
0.1413	0.1972	0.2404	0.2793	0.3600	0.4640	0.6242	0.9011	3.0121	4.6508	7.0023	10.6882

Fineness Modulus	C <sub>u</sub>	C <sub>c</sub>
3.01	4.57	0.73

# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines				
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay			
<input type="radio"/>	0.0	0.0	19.2	12.4	34.3	31.5	2.6				
<input checked="" type="checkbox"/>	Colloids	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
<input type="radio"/>				6.1941	1.1839	0.7334	0.3787	0.2439	0.1969	0.62	6.01

<b>Material Description</b>	<b>USCS</b>	<b>AASHTO</b>
<input type="radio"/>	SP	

<b>Project No.</b> <b>Client:</b> <b>Project:</b> <input type="radio"/> <b>Source of Sample:</b> 1801408-SS4 <b>Sample Number:</b> WG1204174-1  <b>Date:</b> <input type="radio"/>	<b>Remarks:</b>
<b>Alpha Analytical</b>  <b>Mansfield, MA</b>	<b>Figure</b>

**GRAIN SIZE DISTRIBUTION TEST DATA**

2/6/2019

Location: 1801408-SS4

Sample Number: WG1204174-1

USCS Classification: SP

**Sieve Test Data**

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 69.39  
 Tare Wt. = 0.00  
 Minus #200 from wash = 0.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
69.39	0.00	3	0.00	0.00	100.0
		0.75	0.00	0.00	100.0
		#4	13.31	0.00	80.8
		#10	8.61	0.00	68.4
		#40	23.80	0.00	34.1
		#60	12.78	0.00	15.7
		#200	9.10	0.00	2.6

Serial\_No:02081915:06

**Fractional Components**

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	19.2	19.2	12.4	34.3	31.5	78.2			2.6

D <sub>5</sub>	D <sub>10</sub>	D <sub>15</sub>	D <sub>20</sub>	D <sub>30</sub>	D <sub>40</sub>	D <sub>50</sub>	D <sub>60</sub>	D <sub>80</sub>	D <sub>85</sub>	D <sub>90</sub>	D <sub>95</sub>
0.1355	0.1969	0.2439	0.2867	0.3787	0.5089	0.7334	1.1839	4.5002	6.1941	8.4769	11.9339

Fineness Modulus	C <sub>u</sub>	C <sub>c</sub>
3.24	6.01	0.62

## Certification Information

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The following analytes are not included in our Primary NELAP Scope of Accreditation:

### Westborough Facility

**EPA 624/624.1:** m/p-xylene, o-xylene

**EPA 8260C:** NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), Methyl methacrylate, 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.

**EPA 8270D:** NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.

**EPA 6860:** SCM: Perchlorate

**SM4500:** NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

### Mansfield Facility

**SM 2540D:** TSS

**EPA 8082A:** NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.

**EPA TO-15:** Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene,

3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

**Biological Tissue Matrix:** EPA 3050B

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The following analytes are included in our Massachusetts DEP Scope of Accreditation

### Westborough Facility:

#### Drinking Water

**EPA 300.0:** Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE,**

**EPA 180.1, SM2130B, SM4500CI-D, SM2320B, SM2540C, SM4500H-B**

**EPA 332:** Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.

**Microbiology:** **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D.**

#### Non-Potable Water

**SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH:** Ammonia-N and Kjeldahl-N, **EPA 350.1:** Ammonia-N, **LACHAT 10-107-06-1-B:** Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2:** Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300:** Chloride, Sulfate, Nitrate.

**EPA 624.1:** Volatile Halocarbons & Aromatics,

**EPA 608.3:** Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs

**EPA 625.1:** SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045:** PCB-Oil.

**Microbiology:** **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603.**

### Mansfield Facility:

#### Drinking Water

**EPA 200.7:** Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1 Hg.**  
**EPA 522.**

#### Non-Potable Water

**EPA 200.7:** Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.

**EPA 200.8:** Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.

**EPA 245.1 Hg.**

**SM2340B**

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For a complete listing of analytes and methods, please contact your Alpha Project Manager.





## Continuing Calibration Form 7

Client : GEI Consultants  
 Project Name : ROSEMONT ST OVER LITTLE RIVER  
 Instrument ID : VOA117  
 Lab File ID : V17190201A01  
 Sample No : WG1203203-2  
 Channel :

Lab Number : L1903327  
 Project Number : 1801408  
 Calibration Date : 02/01/19 06:35  
 Init. Calib. Date(s) : 01/04/19 01/05/19  
 Init. Calib. Times : 21:09 00:37

Compound	Ave. RRF	RRF	Min RRF	%D	Max %D	Area%	Dev(min)
Fluorobenzene	1	1	-	0	20	148	0
Dichlorodifluoromethane	0.263	0.229	-	12.9	20	131	0
Chloromethane	0.234	0.248	-	-6	20	164	0
Vinyl chloride	0.296	0.299	-	-1	20	151	0
Bromomethane	0.21	0.229	-	-9	20	176	0
Chloroethane	0.191	0.235	-	-23*	20	185	0
Trichlorofluoromethane	0.496	0.525	-	-5.8	20	158	0
Ethyl ether	0.121	0.136	-	-12.4	20	168	0
1,1-Dichloroethene	0.222	0.213	-	4.1	20	146	0
Carbon disulfide	0.65	0.708	-	-8.9	20	171	0
Freon-113	0.223	0.222	-	0.4	20	148	0
Acrolein	0.018	0.017*	-	5.6	20	138	0
Methylene chloride	0.247	0.231	-	6.5	20	148	0
Acetone	20	20.511	-	-2.6	20	149	0
trans-1,2-Dichloroethene	0.254	0.238	-	6.3	20	144	0
Methyl acetate	0.079	0.079*	-	0	20	154	0
Methyl tert-butyl ether	0.512	0.473	-	7.6	20	141	0
tert-Butyl alcohol	0.015	0.012*	-	20	20	115	-.01
Diisopropyl ether	0.591	0.588	-	0.5	20	150	0
1,1-Dichloroethane	0.422	0.425	-	-0.7	20	154	0
Halothane	0.191	0.185	-	3.1	20	146	0
Acrylonitrile	0.037	0.042*	-	-13.5	20	165	0
Ethyl tert-butyl ether	0.613	0.569	-	7.2	20	141	0
Vinyl acetate	0.345	0.376	-	-9	20	172	0
cis-1,2-Dichloroethene	0.268	0.256	-	4.5	20	146	0
2,2-Dichloropropane	0.38	0.377	-	0.8	20	151	0
Bromochloromethane	0.11	0.109	-	0.9	20	144	0
Cyclohexane	0.352	0.359	-	-2	20	154	0
Chloroform	0.441	0.45	-	-2	20	152	0
Ethyl acetate	0.118	0.119	-	-0.8	20	150	0
Carbon tetrachloride	0.372	0.362	-	2.7	20	146	0
Tetrahydrofuran	20	20.494	-	-2.5	20	155	0
Dibromofluoromethane	0.259	0.253	-	2.3	20	145	0
1,1,1-Trichloroethane	0.406	0.402	-	1	20	149	0
2-Butanone	20	20.171	-	-0.9	20	147	0
1,1-Dichloropropene	0.313	0.307	-	1.9	20	147	0
Benzene	0.95	0.936	-	1.5	20	150	0
tert-Amyl methyl ether	0.57	0.499	-	12.5	20	131	0
1,2-Dichloroethane-d4	0.235	0.237	-	-0.9	20	153	0
1,2-Dichloroethane	0.262	0.271	-	-3.4	20	158	0
Methyl cyclohexane	0.413	0.392	-	5.1	20	145	0
Trichloroethene	0.262	0.259	-	1.1	20	150	0
Dibromomethane	0.123	0.121	-	1.6	20	149	0
1,2-Dichloropropane	0.221	0.223	-	-0.9	20	152	-.01
2-Chloroethyl vinyl ether	0.096	0.093	-	3.1	20	141	0

\* Value outside of QC limits.



## Continuing Calibration Form 7

Client : GEI Consultants  
 Project Name : ROSEMONT ST OVER LITTLE RIVER  
 Instrument ID : VOA117  
 Lab File ID : V17190201A01  
 Sample No : WG1203203-2  
 Channel :

Lab Number : L1903327  
 Project Number : 1801408  
 Calibration Date : 02/01/19 06:35  
 Init. Calib. Date(s) : 01/04/19 01/05/19  
 Init. Calib. Times : 21:09 00:37

Compound	Ave. RRF	RRF	Min RRF	%D	Max %D	Area%	Dev(min)
Bromodichloromethane	0.323	0.312	-	3.4	20	146	0
1,4-Dioxane	0.00159	0.00119*	-	25.2*	20	124	0
cis-1,3-Dichloropropene	0.365	0.348	-	4.7	20	143	0
Chlorobenzene-d5	1	1	-	0	20	148	0
Toluene-d8	1.282	1.267	-	1.2	20	145	0
Toluene	0.779	0.761	-	2.3	20	149	0
4-Methyl-2-pentanone	20	16.67	-	16.6	20	124	0
Tetrachloroethene	0.342	0.335	-	2	20	146	0
trans-1,3-Dichloropropene	0.387	0.376	-	2.8	20	146	0
Ethyl methacrylate	0.27	0.224	-	17	20	122	0
1,1,2-Trichloroethane	0.182	0.18	-	1.1	20	147	0
Chlorodibromomethane	0.286	0.27	-	5.6	20	140	0
1,3-Dichloropropane	0.366	0.362	-	1.1	20	148	0
1,2-Dibromoethane	0.215	0.203	-	5.6	20	142	0
2-Hexanone	20	17.546	-	12.3	20	127	0
Chlorobenzene	0.89	0.847	-	4.8	20	146	0
Ethylbenzene	1.513	1.477	-	2.4	20	147	0
1,1,1,2-Tetrachloroethane	0.322	0.305	-	5.3	20	141	0
p/m Xylene	0.594	0.569	-	4.2	20	146	0
o Xylene	0.576	0.541	-	6.1	20	143	0
Styrene	0.925	0.851	-	8	20	138	0
1,4-Dichlorobenzene-d4	1	1	-	0	20	151	0
Bromoform	0.319	0.303	-	5	20	137	0
Isopropylbenzene	2.908	2.718	-	6.5	20	142	0
4-Bromofluorobenzene	0.946	0.889	-	6	20	142	0
Bromobenzene	0.687	0.641	-	6.7	20	140	0
n-Propylbenzene	3.444	3.362	-	2.4	20	150	0
1,4-Dichlorobutane	0.618	0.638	-	-3.2	20	156	0
1,1,2,2-Tetrachloroethane	0.524	0.493	-	5.9	20	139	0
4-Ethyltoluene	2.877	2.741	-	4.7	20	144	0
2-Chlorotoluene	2.026	1.915	-	5.5	20	144	0
1,3,5-Trimethylbenzene	2.454	2.338	-	4.7	20	144	0
1,2,3-Trichloropropane	0.384	0.373	-	2.9	20	142	0
trans-1,4-Dichloro-2-buten	0.125	0.141	-	-12.8	20	166	0
4-Chlorotoluene	2.062	1.961	-	4.9	20	145	0
tert-Butylbenzene	2.13	1.963	-	7.8	20	140	0
1,2,4-Trimethylbenzene	2.443	2.329	-	4.7	20	143	0
sec-Butylbenzene	3.19	3.092	-	3.1	20	147	0
p-Isopropyltoluene	2.702	2.56	-	5.3	20	143	0
1,3-Dichlorobenzene	1.375	1.318	-	4.1	20	144	0
1,4-Dichlorobenzene	1.384	1.316	-	4.9	20	142	0
p-Diethylbenzene	1.615	1.525	-	5.6	20	143	0
n-Butylbenzene	2.534	2.551	-	-0.7	20	153	0
1,2-Dichlorobenzene	1.242	1.169	-	5.9	20	138	0
1,2,4,5-Tetramethylbenzene	2.478	2.203	-	11.1	20	131	0

\* Value outside of QC limits.



## Continuing Calibration Form 7

Client	: GEI Consultants	Lab Number	: L1903327
Project Name	: ROSEMONT ST OVER LITTLE RIVER	Project Number	: 1801408
Instrument ID	: VOA117	Calibration Date	: 02/01/19 06:35
Lab File ID	: V17190201A01	Init. Calib. Date(s)	: 01/04/19      01/05/19
Sample No	: WG1203203-2	Init. Calib. Times	: 21:09      00:37
Channel	:		

Compound	Ave. RRF	RRF	Min RRF	%D	Max %D	Area%	Dev(min)
1,2-Dibromo-3-chloropropan	0.076	0.064	-	15.8	20	119	0
1,3,5-Trichlorobenzene	1.002	0.949	-	5.3	20	141	0
Hexachlorobutadiene	0.477	0.447	-	6.3	20	142	0
1,2,4-Trichlorobenzene	0.86	0.79	-	8.1	20	134	0
Naphthalene	1.664	1.396	-	16.1	20	121	0
1,2,3-Trichlorobenzene	0.761	0.699	-	8.1	20	134	0

\* Value outside of QC limits.



# Appendix E

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## Geotechnical Calculations

- Recommended Soil and Rock Properties
- Earth Pressure Coefficients
- Seismic Site Class Evaluation
- Bearing Resistance on Rock
- Micropile Bond Length Calculation
- Group Analyses Calculation



**Client:** BETA Group, Inc.  
**Project:** Rosemont St. Bridge  
**Project No.:** 1801408

**Prepared By:** W. Lukas  
**Date:** February 2019  
**Checked By:** M. Paster  
**Date:** Dec 2022

## ***Recommended Soil Properties***

### **Purpose:**

The purpose of this evaluation is to select representative soil properties for the Rosemont St. Bridge over the Little River. The soil properties will be used in our engineering analyses.

### **Approach:**

We selected values for unit weight and angle of internal friction of soils. Values were selected for the general soil layers observed in the borings and for proposed fills to be used during construction.

### **Unit Weight**

We selected a saturated (total) unit weight in pounds per cubic foot (pcf). The buoyant unit weight can then be determined by subtracting the unit weight of water (62.4 pcf).

### **Angle of Internal Friction**

We selected an angle of internal friction ( $\phi$ ) in degrees. We used Mohr-Coulomb drained properties for each soil.

### **Proposed Fills**

We selected properties for gravel borrow and gravel borrow for bridge foundations based on the required material gradations and compaction requirements per MassDOT.

### **Subsurface Investigation and SPT Correlations for Observed Soil Layers:**

We reviewed Standard Penetration Test (SPT) N-Values collected during our subsurface investigation. We estimated angles of internal friction for the soils above based on N-Values corrected for overburden and hammer efficiency ( $N_{1,60}$ ). All SPTs were performed using an automatic hammer. We assumed an efficiency of 80 percent based on published data on automatic hammers.

A summary of corrected N-Values based on general soil type is shown below. Our N-Value correction calculations are attached. We did not include refusals due to cobbles or boulders, and we limited the uncorrected (field) N-value to a maximum of 120 blows per foot, which MassDOT considers "practical refusal."

<b>Soil Layer</b>	<b>Average <math>N_{60}</math></b>	<b>Average <math>N_{1,60}</math></b>
Fill	>50	>50
Clay	3	3



**Client:** BETA Group, Inc.  
**Project:** Rosemont St. Bridge  
**Project No.:** 1801408

**Prepared By:** W. Lukas  
**Date:** February 2019  
**Checked By:** M. Paster  
**Date:** Dec 2022

**Results:**

We selected the following soil properties for each layer/soil type based on the references provided in the following pages and our engineering judgment:

Layer/Soil Type	Total Unit Weight, $\gamma$ (pcf)	Friction Angle, $\phi$ (deg)	Nominal Grout to Ground Bond Stress	For LPILE or GROUP Analysis	
				Soil Model	p-y Modulus, K (pci)
Existing Fill	125	35	not used	Sand	86
Clay (drained)	110	30	not used	Sand	35
Weathered Bedrock	140	38	not used	Sand	120
Bedrock (note 1)	170	[1]	104 psi (15 ksf) [2]	Vuggy Limestone	$q_u = 7$ ksi (1,000 ksf)
Gravel Borrow	130	35	not used	not used	not used
Gravel Borrow for Bridge Found'ns	135	37	not used	not used	not used

Notes:

1. For bedrock strength properties, refer to calculation for "Bearing Resistance on Rock."
2. For grout to ground bond stress refer to calculation for "Micropile Bond Length."



**References:**

- AASHTO LRFD Bridge Design Specifications, Ninth Edition, 2020.
- Terzaghi, K., Peck, R.B., 1968. Soil Mechanics in Engineering Practice, 2<sup>nd</sup> Edition, John Wiley & Sons, New York.
- Caltrans Geotechnical Manual, March 2014.
- NAVFAC Design Manual 7.01 Soil Mechanics, Naval Facilities Engineering Command, September 1986.
- Technical Manual for L-Pile 2018, Ensoft, Inc.

AASHTO LRFD Bridge Design Specifications, Ninth Edition, 2020

Table 10.4.6.2.4-1 recommends using the following correlation to select friction angles of granular soils:

**Table 10.4.6.2.4-1—Correlation of  $SPT N_{60}$  Values to Drained Friction Angle of Granular Soils (modified after Bowles, 1977)**

$N_{60}$	$\phi_f$
<4	25–30
4	27–32
10	30–35
30	35–40
50	38–43

Soil Mechanics in Engineering Practice

Karl Terzaghi and Ralph Peck compiled various parameters of soils into the tables below:

**Table 6.3**  
*Porosity, Void Ratio, and Unit Weight of Typical Soils in Natural State*

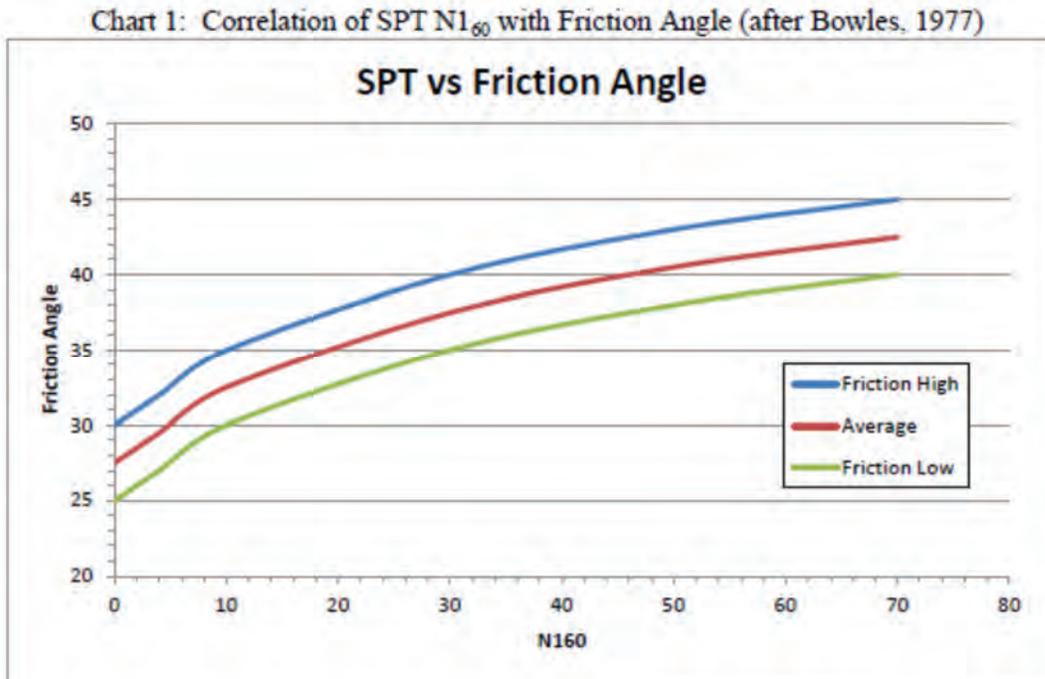
Description	Porosity, n (%)	Void ratio, e	Water content, w (%)	Unit weight			
				$\gamma_d$	$\gamma$	$\gamma_d$	$\gamma$
1. Uniform sand, loose	46	0.85	32	1.43	1.89	90	118
2. Uniform sand, dense	34	0.51	19	1.75	2.09	109	130
3. Mixed-grained sand, loose	40	0.67	25	1.59	1.99	99	124
4. Mixed-grained sand, dense	30	0.43	16	1.86	2.16	116	135
5. Glacial till, very mixed-grained	29	0.25	9	2.12	2.32	132	145
6. Soft glacial clay	55	1.2	45	—	1.77	—	110
7. Stiff glacial clay	37	0.6	22	—	2.07	—	129
8. Soft slightly organic clay	66	1.9	70	—	1.58	—	98
9. Soft very organic clay	75	3.0	110	—	1.42	—	89
10. Soft bentonite	84	5.2	194	—	1.27	—	80

$w$  = water content when saturated, in per cent of dry weight.  
 $\gamma_d$  = unit weight in dry state.  
 $\gamma$  = unit weight in saturated state.

**Table 17.1**  
*Representative Values of  $\phi$  for Sands and Silts*

Material	Degrees	
	Loose	Dense
Sand, round grains, uniform	27–5	34
Sand, angular grains, well graded	33	45
Sandy gravels	35	50
Silty sand	27–33	30–34
Inorganic silt	27–30	30–35

Caltrans Geotechnical Manual (March 2014)



Choose the friction angle (expressed to the nearest degree) based upon the soil type, particle size(s), and rounding or angularity. Experience should be used to select specific values within the ranges. In general, finer materials or materials with significant (about 30+ %) silt-sized material will fall in the lower portion of the range. Coarser materials with less than 5% fines will fall in the upper portion of the range. The extreme range of phi angles for any  $N_{160}$  is five degrees, so the adjustment factors for particle size and roundness should be only a degree or two. The following bullets provide help in determining which value to select for a given  $N_{160}$  and soil type:

- Use the maximum value for GW
- Use the average for GM and SP
- Use the minimum for SC
- Use the minimum + 0.5 for ML
- Use the average +1 for SW
- Use the average -1 for GC
- Use the Maximum -1 for GP

Values may also be increased with increasing grain size and/or particle angularity, and decreased with decreasing grain size and/or increasing roundness. For example, an SP with  $N_{160} = 30$  could be assigned phi angles of 37, 38 or 39 degrees for fine, medium and coarse grain sizes respectively.



NAVFAC Design Manual 7.01 Soil Mechanics

TABLE 6  
 Typical Values of Soil Index Properties

	Particle Size and Gradation				Voids <sup>(1)</sup>						Unit Weight <sup>(2)</sup> (lb./cu.ft.)						
	Approximate Size Range (mm)		Approx. D <sub>10</sub> (mm)	Approx. Range Uniform Coefficient C <sub>u</sub>	Void Ratio			Porosity (%)			Dry Weight			Net Weight		Submerged Weight	
	D <sub>max</sub>	D <sub>min</sub>			e <sub>max</sub> loose	e <sub>cr</sub>	e <sub>min</sub> dense	n <sub>max</sub> loose	n <sub>min</sub> dense	n <sub>min</sub> loose	100% Mod. AASHTO	Max dense	Min loose	Max dense	Min loose	Max dense	
<b>GRANULAR MATERIALS</b>																	
<b>Uniform Materials</b>																	
a. Equal spheres (theoretical values)	-	-	-	1.0	0.92	-	0.35	47.6	26	-	-	-	-	-	-	-	
b. Standard Ottawa SAND	0.84	0.59	0.67	1.1	0.80	0.75	0.50	44	33	92	-	110	93	131	57	69	
c. Clean, uniform SAND (fine or medium)	-	-	-	1.2 to 2.0	1.0	0.80	0.40	50	29	83	115	118	84	136	52	73	
d. Uniform, inorganic SILT	0.05	0.005	0.012	1.2 to 2.0	1.1	-	0.40	52	29	80	-	118	81	136	51	73	
<b>Well-graded Materials</b>																	
a. Silty SAND	2.0	0.005	0.02	5 to 10	0.90	-	0.30	47	23	87	122	127	88	142	54	79	
b. Clean, fine to coarse SAND	2.0	0.05	0.09	4 to 6	0.95	0.70	0.20	49	17	85	132	138	86	148	53	86	
c. Micaceous SAND	-	-	-	-	1.2	-	0.40	55	29	76	-	120	77	138	48	76	
d. Silty SAND & GRAVEL	100	0.005	0.02	15 to 300	0.85	-	0.14	46	12	89	-	146 <sup>(3)</sup>	90	155 <sup>(3)</sup>	56	92	
<b>MIXED SOILS</b>																	
Sandy or Silty CLAY	2.0	0.001	0.003	10 to 30	1.8	-	0.25	64	20	60	130	135	100	147	38	85	
Skip-graded Silty CLAY with stones or rk frags	250	0.001	-	-	1.0	-	0.20	50	17	84	-	140	115	151	53	89	
Well-graded GRAVEL, SAND, SILT & CLAY mixture	250	0.001	0.002	25 to 1000	0.70	-	0.13	41	11	100	140	148 <sup>(4)</sup>	125	156 <sup>(4)</sup>	62	94	
<b>CLAY SOILS</b>																	
CLAY (30%-50% clay sizes)	0.05	0.5 $\mu$	0.001	-	2.4	-	0.50	71	33	50	105	112	94	133	31	71	
Colloidal CLAY (-0.002 mm: 50%)	0.01	10 $\text{\AA}$	-	-	12	-	0.60	92	37	13	90	106	71	128	8	66	
<b>ORGANIC SOILS</b>																	
Organic SILT	-	-	-	-	3.0	-	0.55	75	35	40	-	110	87	131	25	69	
Organic CLAY (30% - 50% clay sizes)	-	-	-	-	4.4	-	0.70	81	41	30	-	100	81	125	18	62	

Representative Range of Dry Unit Weights (after FHWA-HI-97-021)	
Rock Type	Unit Weight Range (kcf)
Shale	0.140 - 0.159
Sandstone	0.108 - 0.172
Limestone	0.121 - 0.178
Schist	0.159 - 0.185
Gneiss	0.159 - 0.185
Granite	0.153 - 0.185
Basalt	0.127 - 0.191

1. Dry unit weights are for moderately weathered to unweathered rock.  
 2. Wide range in unit weights for shale, sandstone, and limestone represents effect of variations in porosity, cementation, grain size, etc.  
 3. Specimens with unit weights falling outside these ranges may be encountered.

**From LPile Technical Manual:**

As discussed in this excerpt, using  $k$  values for fine sand is considered conservative for coarse or widely graded materials.

Chapter 3 – Lateral Load-Transfer Curves for Soil and Rock

LPile will assign a default value for  $k$  if the user enters a value of zero. The value of  $k$  is determined from the angle of friction and it is assumed that the sand is fine. The equations used by LPile to determine  $k$  as a function of friction angle for fine sand are shown in Figure 3-34. Whether the sand is above or below the water table will be determined from the input value of effective unit weight. If the effective unit weight is less than 77.76 pcf (12.225 kN/m<sup>3</sup>) the sand is considered to be below the water table. If the input value of  $\phi$  is greater than 45 degrees, a  $k$  value corresponding to 45 degrees is used by LPile. The two correlation lines intersect at a friction angle value of 27.6423 degrees and a  $k$  value of 10.2068 pci. If the input value of  $\phi$  is less than 27.6423 degrees, the value of  $k$  linearly varies from a value of zero at zero degrees to a value of 10.2068 pci at 27.6423 degrees.

If the sand profile is coarse or well-graded sand, the user may consider using a higher value of  $k$  than those suggested in the Figure 3-34. While experimental data for  $k$  in well-graded sands is sparse, use of  $k$  values 10 to 50 percent higher may be appropriate in dense and very dense well-graded sands that do not contain any compressible minerals such as mica.

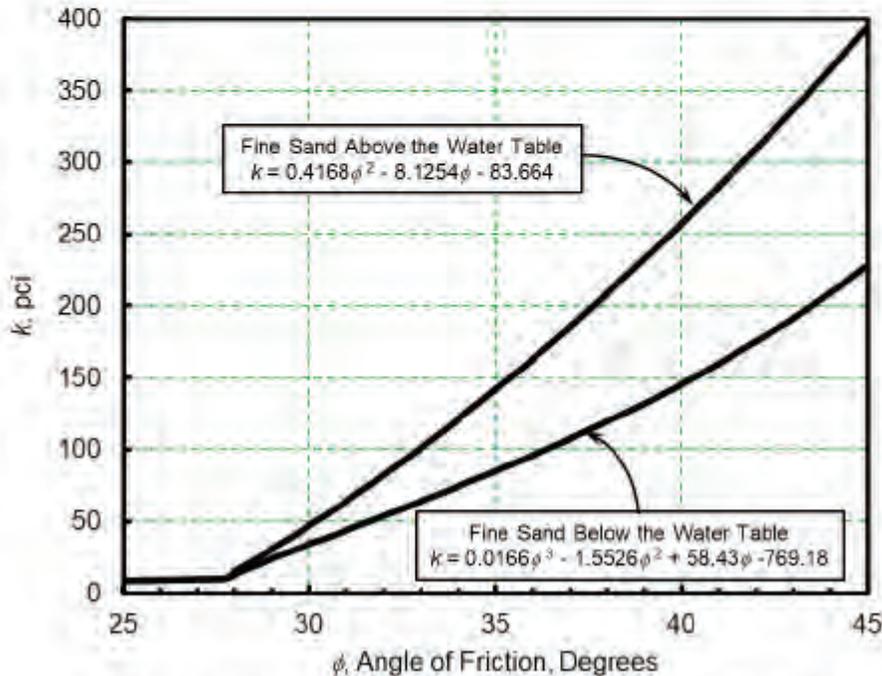


Figure 3-34 Value of  $k$  versus Friction Angle for Fine Sand Used in LPile



Client: BETA Group, Inc.  
 Project: Rosemont St. Bridge  
 Project No.: 1801408  
 Subject: Lateral Earth Pressures

Prepared By: W. Lukas  
 Date: Feb 2019  
 Checked By: M. Paster  
 Date: Dec 2022

**Purpose:** Calculate lateral earth pressure coefficients

**Reference:** American Association of State Highway and Transportation Officials (AASHTO)  
 "AASHTO LRFD Bridge Design Specifications, Ninth Edition, 2020"

**Equations:** See attached

**Calculations:**

	Fill	Clay (drained)	Weathered Rock	Gravel Borrow	Gravel Borrow for Bridge Foundations
Effective Friction Angle of Soil, $\phi'_f$ (deg)	35	30	38	35	37
Friction Angle Between Fill and Wall, $\delta$ (deg)	17.5	15.0	19.0	17.5	18.5
Angle of Fill to the Horizontal, $\beta$ (deg)	0	0	0	0	0
Angle of Back Face of Wall to the Horizontal, $\theta$ (deg)	90	90	90	90	90
<b>At-Rest Lateral Earth Pressure Coefficient, <math>k_o</math> (Eq. 3.11.5.2-1)</b>	<b>0.43</b>	<b>0.50</b>	<b>0.38</b>	<b>0.43</b>	<b>0.40</b>
$\Gamma$ (Eq. 3.11.5.3-2)	2.86	2.58	3.02	2.86	2.97
<b>Active Lateral Earth Pressure Coefficient, <math>k_a</math> (Eq. 3.11.5.3-1)</b>	<b>0.25</b>	<b>0.30</b>	<b>0.22</b>	<b>0.25</b>	<b>0.23</b>
$-\delta/\phi_f$	-0.5	-0.5	-0.5	-0.5	-0.5
$\beta/\phi_f$	0.0	0.0	0.0	0.0	0.0
Coefficient of Passive Pressure for $\theta = 0$ , $k_p$ (Figure 3.11.5.4-1)	10.5	6.0	14.1	10.5	13.0
Reduction Factor of $k_p$ , R (Figure 3.11.5.4-1)	0.674	0.746	0.608	0.674	0.641
<b>Coefficient of Passive Pressure, <math>k_p</math></b>	<b>7.08</b>	<b>4.48</b>	<b>8.57</b>	<b>7.08</b>	<b>8.34</b>

**Reference:** American Association of State Highway and Transportation Officials (AASHTO)  
 "AASHTO LRFD Bridge Design Specifications, Seventh Edition, 2014"

**Equations:** At-Rest Lateral Earth Pressure Coefficient,  $k_o$

**3.11.5.2—At-Rest Lateral Earth Pressure Coefficient,  $k_o$**

For normally consolidated soils, vertical wall, and level ground, the coefficient of at-rest lateral earth pressure may be taken as:

$$k_o = 1 - \sin \phi'_f \quad (3.11.5.2-1)$$

where:

$\phi'_f$  = effective friction angle of soil  
 $k_o$  = coefficient of at-rest lateral earth pressure

**Active Lateral Earth Pressure Coefficient,  $k_a$**

**3.11.5.3—Active Lateral Earth Pressure Coefficient,  $k_a$**

Values for the coefficient of active lateral earth pressure may be taken as:

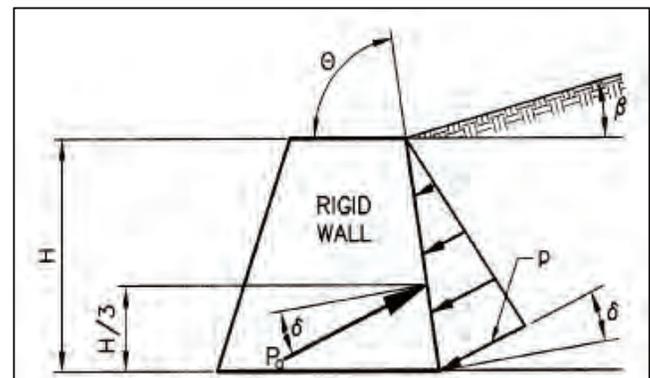
$$k_a = \frac{\sin^2(\theta + \phi'_f)}{\Gamma [\sin^2 \theta \sin(\theta - \delta)]} \quad (3.11.5.3-1)$$

in which:

$$\Gamma = \left[ 1 + \frac{\sin(\phi'_f + \delta) \sin(\phi'_f - \beta)}{\sin(\theta - \delta) \sin(\theta + \beta)} \right]^2 \quad (3.11.5.3-2)$$

where:

$\delta$  = friction angle between fill and wall taken as specified in Table 3.11.5.3-1 (degrees)  
 $\beta$  = angle of fill to the horizontal as shown in Figure 3.11.5.3-1 (degrees)  
 $\theta$  = angle of back face of wall to the horizontal as shown in Figure 3.11.5.3-1 (degrees)  
 $\phi'_f$  = effective angle of internal friction (degrees)



**Figure 3.11.5.3-1—Notation for Coulomb Active Earth Pressure**



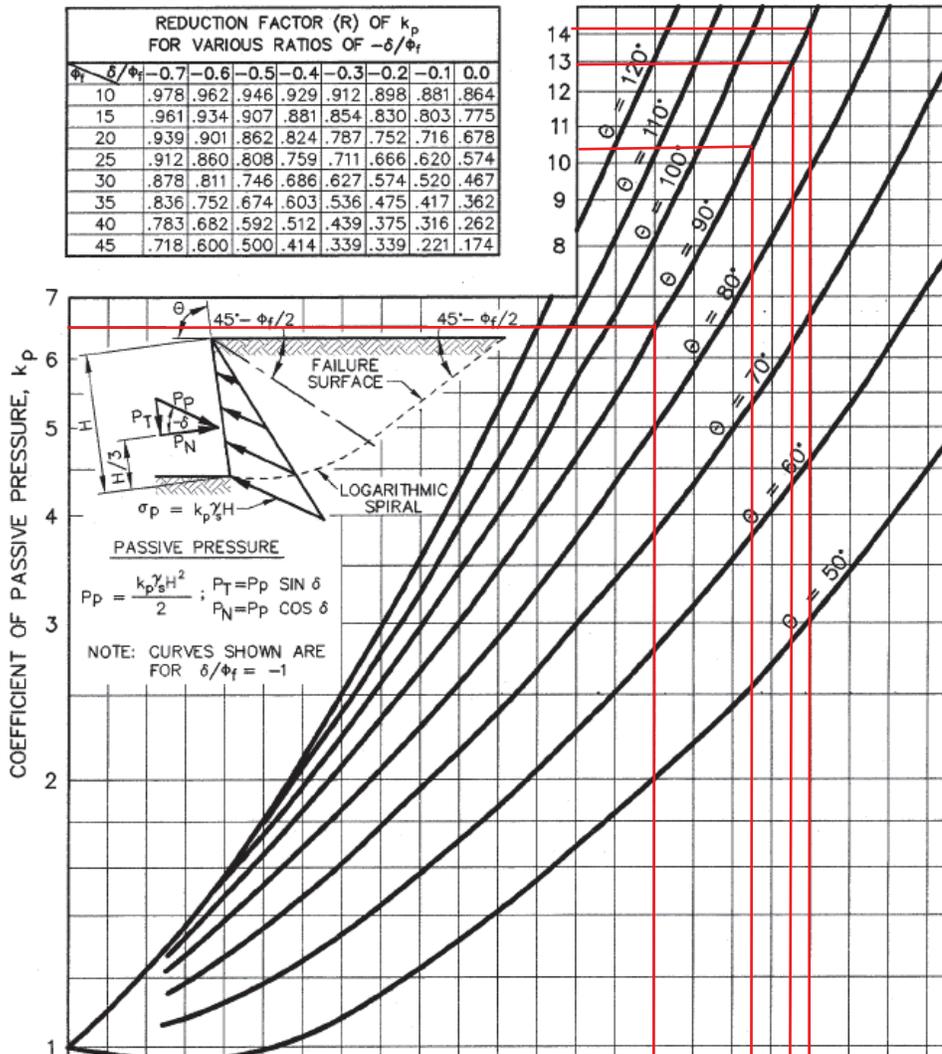
**Table 3.11.5.3-1—Friction Angle for Dissimilar Materials (U.S. Department of the Navy, 1982a)**

Interface Materials	Friction Angle, $\delta$ (degrees)	Coefficient of Friction, $\tan \delta$ (dim.)
Mass concrete on the following foundation materials: <ul style="list-style-type: none"> <li>• Clean sound rock</li> <li>• Clean gravel, gravel-sand mixtures, coarse sand</li> <li>• Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel</li> <li>• Clean fine sand, silty or clayey fine to medium sand</li> <li>• Fine sandy silt, nonplastic silt</li> <li>• Very stiff and hard residual or preconsolidated clay</li> <li>• Medium stiff and stiff clay and silty clay</li> </ul>	35 29 to 31 24 to 29 19 to 24 17 to 19 22 to 26 17 to 19	0.70 0.55 to 0.60 0.45 to 0.55 0.34 to 0.45 0.31 to 0.34 0.40 to 0.49 0.31 to 0.34
Masonry on foundation materials has same friction factors.		
Steel sheet piles against the following soils: <ul style="list-style-type: none"> <li>• Clean gravel, gravel-sand mixtures, well-graded rock fill with spalls</li> <li>• Clean sand, silty sand-gravel mixture, single-size hard rock fill</li> <li>• Silty sand, gravel or sand mixed with silt or clay</li> <li>• Fine sandy silt, nonplastic silt</li> </ul>	22 17 14 11	0.40 0.31 0.25 0.19
Formed or precast concrete or concrete sheet piling against the following soils: <ul style="list-style-type: none"> <li>• Clean gravel, gravel-sand mixture, well-graded rock fill with spalls</li> <li>• Clean sand, silty sand-gravel mixture, single-size hard rock fill</li> <li>• Silty sand, gravel or sand mixed with silt or clay</li> <li>• Fine sandy silt, nonplastic silt</li> </ul>	22 to 26 17 to 22 17 14	0.40 to 0.49 0.31 to 0.40 0.31 0.25
Various structural materials: <ul style="list-style-type: none"> <li>• Masonry on masonry, igneous and metamorphic rocks:               <ul style="list-style-type: none"> <li>○ dressed soft rock on dressed soft rock</li> <li>○ dressed hard rock on dressed soft rock</li> <li>○ dressed hard rock on dressed hard rock</li> </ul> </li> <li>• Masonry on wood in direction of cross grain</li> <li>• Steel on steel at sheet pile interlocks</li> </ul>	35 33 29 26 17	0.70 0.65 0.55 0.49 0.31

### Passive Lateral Earth Pressure Coefficient, $k_p$

#### 3.11.5.4—Passive Lateral Earth Pressure Coefficient, $k_p$

For noncohesive soils, values of the coefficient of passive lateral earth pressure may be taken from [Figure 3.11.5.4-1](#) for the case of a sloping or vertical wall with a horizontal backfill or from [Figure 3.11.5.4-2](#) for the case of a vertical wall and sloping backfill. For conditions that deviate from those described in [Figures 3.11.5.4-1](#) and [3.11.5.4-2](#), the passive pressure may be calculated by using a trial procedure based on wedge theory, e.g., see Terzaghi et al. (1996). When wedge theory is used, the limiting value of the wall friction angle should not be taken larger than one-half the angle of internal friction,  $\phi_f$ .





Client: BETA Group, Inc.  
Project: Rosemont St. Bridge  
Project No.: 1801408  
Subject: Lateral Earth Pressures

Prepared By: W. Lukas  
Date: Feb 2019  
Checked By: M. Paster  
Date: Dec 2022

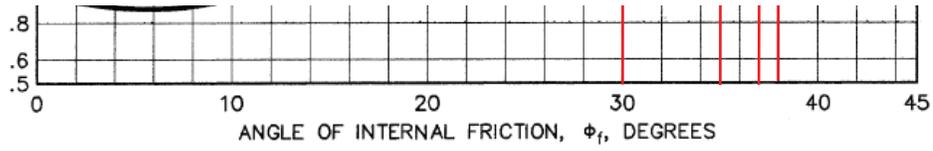


Figure 3.11.5.4-1—Computational Procedures for Passive Earth Pressures for Vertical and Sloping Walls with Horizontal Backfill (U.S. Department of the Navy, 1982a)



**Seismic Site Class Evaluation - Rosemont Street Bridge**

Purpose: Evaluate seismic design criteria in accordance with 2011 AASHTO LRFD Seismic Bridge Design. Evaluate borings based on N60 values (Assuming CE=1.33 for automatic hammer.)

Layer	BB-1		
	N <sub>i</sub>	Layer (D <sub>i</sub> )	D <sub>i</sub> /N <sub>i</sub>
1	82	13	0.16
2	100	87	0.87

$$\Sigma = 100 \quad 1.0$$

$$\bar{N} = 97.2$$

Layer	BB-2		
	N <sub>i</sub>	Layer (D <sub>i</sub> )	D <sub>i</sub> /N <sub>i</sub>
1	26	19	0.73
2	3	3	1.00
3	100	78	0.78

$$\Sigma = 100 \quad 2.5$$

$$\bar{N} = 39.8$$

Layer	Composite		
	N <sub>i</sub>	Layer (D <sub>i</sub> )	D <sub>i</sub> /N <sub>i</sub>
1	54	16	0.30
2	3	3	1.00
3	100	78	0.78

$$\Sigma = 97 \quad 2.1$$

$$\bar{N} = 46.7$$

$$\bar{N} = \frac{\sum d_i}{\sum d_i/N_i} \quad \text{From AASHTO Eq. 3.4.2.2-3}$$

**From AASHTO Table 3.4.2.1-1 15 < N < 50**  
**Site Class D**

However, we recommend using Site Class C for seismic design. While the calculations in above indicate Site Class D, it is our judgement that Site Class D is overly conservative considering the presence of shallow bedrock and the overall site conditions.

**Site Seismic Coefficients (for Site Class C)**

Horizontal Peak Ground Acceleration, PGA = 0.090  
 Horizontal Response Spectral Acceleration S<sub>s</sub> = 0.180 AASHTO Figs. 3.4.1-2b, -3b, and -4b  
 Horizontal Response Spectral Acceleration S<sub>1</sub> = 0.041

F<sub>PGA</sub> = F<sub>A</sub> = 1.2 AASHTO Table 3.4.2.3-1  
 F<sub>V</sub> = 1.7 AASHTO Table 3.4.2.3-2

**Design Response Spectra (for Site Class C)**

Acceleration Coefficient, A<sub>s</sub> = PGA × F<sub>PGA</sub> A<sub>s</sub> = 0.108 AASHTO Eq. 3.4.1-1  
 Design Spectral Acceleration (0.2 sec), S<sub>DS</sub> = S<sub>s</sub> × F<sub>A</sub> S<sub>DS</sub> = 0.216 AASHTO Eq. 3.4.1-2  
 Design Spectral Acceleration (1 sec), S<sub>D1</sub> = S<sub>1</sub> × F<sub>V</sub> S<sub>D1</sub> = 0.070 AASHTO Eq. 3.4.1-3

**From AASHTO Table 3.5.1**  
**Seismic Design Category A**



AASHTO Tables:

Table 3.4.2.1-1—Site Class Definitions

Site Class	Soil Type and Profile
A	Hard rock with measured shear wave velocity, $\bar{v}_s > 5000$ ft/sec
B	Rock with $2500$ ft/sec $< \bar{v}_s < 5000$ ft/sec
C	Very dense soil and soil rock with $1200$ ft/sec $< \bar{v}_s < 2500$ ft/sec, or with either $\bar{N} > 50$ blows/ft or $\bar{s}_u > 2.0$ ksf
D	Stiff soil with $600$ ft/sec $< \bar{v}_s < 1200$ ft/sec, or with either $15$ blows/ft $< N < 50$ blows/ft or $1.0$ ksf $< \bar{s}_u < 2.0$ ksf
E	Soil profile with $\bar{v}_s < 600$ ft/sec, or with either $\bar{N} < 15$ blows/ft or $\bar{s}_u < 1.0$ ksf, or any profile with more than 10 ft of soft clay defined as soil with $PI > 20$ , $w > 40\%$ , and $\bar{s}_u < 0.5$ ksf
F	Soils requiring site-specific ground motion response evaluations, such as: <ul style="list-style-type: none"> <li>• Peats or highly organic clays (<math>H &gt; 10</math> ft of peat or highly organic clay, where <math>H</math> = thickness of soil)</li> <li>• Very high plasticity clays (<math>H &gt; 25</math> ft with <math>PI &gt; 75</math>)</li> <li>• Very thick soft/medium stiff clays (<math>H &gt; 120</math> ft)</li> </ul>
<p>Exceptions:</p> <p>Where the soil properties are not known in sufficient detail to determine the site class, a site investigation shall be undertaken sufficient to determine the site class. Site Class E or F should not be assumed unless the authority having jurisdiction determines that Site Class E or F could be present at the site or in the event that Site Class E or F is established by geotechnical data.</p> <p>where:</p> <p><math>\bar{v}_s</math> = average shear wave velocity for the upper 100 ft of the soil profile as defined in Article 3.4.2.2</p> <p><math>\bar{N}</math> = average standard penetration test (SPT) blow count (blows/ft) (ASTM D 1586) for the upper 100 ft of the soil profile as defined in Article 3.4.2.2</p> <p><math>\bar{s}_u</math> = average undrained shear strength in ksf (ASTM D 2166 or D 2850) for the upper 100 ft of the soil profile as defined in Article 3.4.2.2</p> <p><math>PI</math> = plasticity index (ASTM D 4318)</p> <p><math>w</math> = moisture content (ASTM D 2216)</p>	

**Table 3.4.2.3-1—Values of  $F_{pga}$  and  $F_a$  as a Function of Site Class and Mapped Peak Ground Acceleration or Short-Period Spectral Acceleration Coefficient**

Site Class	Mapped Peak Ground Acceleration or Spectral Response Acceleration Coefficient at Short Periods				
	$PGA \leq 0.10$ $S_s \leq 0.25$	$PGA = 0.20$ $S_s = 0.50$	$PGA = 0.30$ $S_s = 0.75$	$PGA = 0.40$ $S_s = 1.00$	$PGA \geq 0.50$ $S_s \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	a	a	a	a	a

Note: Use straight line interpolation for intermediate values of  $PGA$  and  $S_s$ , where  $PGA$  is the peak ground acceleration and  $S_s$  is the spectral acceleration coefficient at 0.2 sec obtained from the ground motion maps.

<sup>a</sup> Site-specific response geotechnical investigation and dynamic site response analyses should be considered (Article 3.4.3).

**Table 3.4.2.3-2—Values of  $F_v$  as a Function of Site Class and Mapped 1-sec Period Spectral Acceleration Coefficient**

Site Class	Mapped Spectral Response Acceleration Coefficient at 1-sec Periods				
	$S_1 \leq 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \geq 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	a	a	a	a	a

Note: Use straight line interpolation for intermediate values of  $S_1$ , where  $S_1$  is the spectral acceleration coefficient at 1.0 sec obtained from the ground motion maps.

<sup>a</sup> Site-specific response geotechnical investigation and dynamic site response analyses should be considered (Article 3.4.3).

**Table 3.5-1—Partitions for Seismic Design Categories A, B, C, and D**

Value of $S_{D1} = F_v S_1$	SDC
$S_{D1} < 0.15$	A
$0.15 \leq S_{D1} < 0.30$	B
$0.30 \leq S_{D1} < 0.50$	C
$0.50 \leq S_{D1}$	D



**Client:** BETA Group, Inc.  
**Project:** Rosemont Street Bridge  
**Project No.:** 1801408

**Prepared By:** W. Lukas  
**Date:** Feb 2019  
**Checked By:** M. Paster  
**Date:** Dec 2022

## ***Bearing Resistance on Rock***

### **Purpose:**

Evaluate the bearing resistance for abutments bearing on bedrock at the Rosemont Street Bridge over the Little River.

### **References:**

- AASHTO LRFD Bridge Design Specification, 9<sup>th</sup> Edition, 2020.
- AASHTO LRFD Bridge Design Specification, 2012.
- AASHTO LRFD Bridge Design Specification, 2002.
- Sabbatini et al. 2002:

Sabatini, P. J., R. C. Bachus, P. W. Mayne, J. A. Schneider, and T. E. Zettler. *Geotechnical Engineering Circular 5 (GEC5)—Evaluation of Soil and Rock Properties*. FHWA-IF-02-034. Federal Highway Administration, U.S. Department of Transportation, Washington, DC, 2002.

- Carter and Kulhawy, 1988:

Carter, J. P., and F. H. Kulhawy. *Analysis and Design of Foundations Socketed into Rock*, Report No. EL-5918. Empire State Electric Engineering Research Corporation and Electric Power Research Institute, New York, NY, 1988. p. 158.

### **Sampled Rock:**

Rock core samples were collected in each of the 2 borings performed at the site. At least 10 feet of bedrock was cored in each boring and we evaluated the rock samples to determine rock type and quality.

According to the USGS Bedrock Geologic Map of Massachusetts, the rock observed at the site was part of the Berwick formation, which is described as thin- to thick-bedded metamorphosed calcareous sandstone, siltstone, and minor muscovite schist. The observed rock in BB-1 was a hard, black, fine-grained, lineated metamorphic rock that showed minimal weathering and moderate fracturing. Joint spacing varied between core samples, ranging from 1 to 9 inches. The rock was generally fresh, with no to slight weathering visible in the joints. The observed rock in BB-2 was a very hard, black, coarse-grained, metamorphic rock with angular white crystals and some small micaceous crystals. The rock showed minimal weathering and moderate fracturing. Joint spacing varied between core samples, ranging from 2 to 16 inches. The rock was generally fresh, with no to slight weathering visible in the joints.

Rock Quality Designation (RQD) values of 56, 80, 92, 92, and 100. The RQD value of 56 was from the first 3 feet of BB-1.

### **Calculations:**

1. Uniaxial Compressive Strength,  $q_u$ : No testing was performed on the rock cores. Unconfined uniaxial compressive strength for intact cores,  $q_u$ , was selected from Table 4.4.8.1.2B in AASHTO 2002 (attached). Table 4.4.8.1.2B indicates typical compressive strength for siltstone and schist ranging from 200 to 3,000 ksf. We selected  $q_u = 1,000$  ksf for the rock encountered in the borings.
2. Rock Mass Strength: Per AASHTO 2020, Section C10.6.3.2.1, the Rock Mass Strength was estimated using the Rock Mass Rating (RMR) system described in Table 40 (attached) of Sabbatini et al. (2002). The relative ratings were conservatively selected from the table as:



- a. Strength of Intact Rock = 7
- b. RQD = 17
- c. Spacing of Joints = 10
- d. Condition of Joints = 12
- e. Groundwater Conditions = 4
- f. Adjustment for footings for joint orientation = -7

The sum of the relative ratings is the RMR.

$$RMR = 7 + 17 + 10 + 12 + 4 - 7 = 43$$

3. Bearing Resistance at Strength Limit State: For bearing resistance at the strength limit, AASHTO 2020, Sections 10.6.3.2.2 and C10.6.3.2.2 indicate that the semi-empirical procedure by Carter and Kulhawy (1988) may be used for jointed rock. The following equation was used to evaluate the nominal bearing resistance:

$$q_{ult} = \left[ \sqrt{s} + \sqrt{m\sqrt{s} + s} \right] q_u \quad \text{Carter and Kulhawy (1988) Equation 3-6 (attached)}$$

Material constants s and m were selected from AASHTO (2012) Table 10.4.6.4-4 (attached). Values for 's' and 'm' were selected for Rock Type C and Fair Quality Rock Mass (RMR of ~44).

$$m = 0.275$$

$$s = 0.00009, S^{0.5} = 0.0095$$

Nominal bearing resistance  $q_{ult} = [0.0095 + \text{SQR}(0.275 \times 0.0095 + 0.00009)] \times q_u = [0.0615] \times 1,000 \text{ ksf} = 61 \text{ ksf}$ .

Using a resistance factor of 0.45 per AASHTO (2020) Table 10.5.5.2.2-1, the factored bearing resistance = 27 ksf.

4. Bearing Resistance at Service Limit State: The value of 40 ksf (277 psi) was selected from AASHTO 2020, Table C10.6.2.5.1-1 (attached).

**Results:**

	<b>Bearing Resistance</b>
<b>Strength Limit State</b>	61 ksf (nominal) 27 ksf (factored)
<b>Service Limit State</b>	40 ksf



From AASHTO (2002)

2002 AASHTO

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HIGHWAY BRIDGES

4.4.8.2.2

TABLE 44.8.1.2B Typical Range of Uniaxial Compressive Strength ( $C_u$ ) as a Function of Rock Category and Rock Type

Rock Category	General Description	Rock Type	$C_u^{(1)}$	
			(ksf)	(psi)
A	Carbonate rocks with well-developed crystal cleavage	Dolostone	700- 6,500	4,800-45,000
		Limestone	500- 6,000	3,500-42,000
		Carbonatite	800- 1,500	5,500-10,000
		Marble	800- 5,000	5,500-35,000
		Tactite-Skarn	2,700- 7,000	19,000-49,000
B	Lithified argillaceous rock	Argillite	600- 3,000	4,200-21,000
		Claystone	30- 170	200- 1,200
		Marlstone	1,000- 4,000	7,600-28,000
		Phyllite	500- 5,000	3,500-35,000
		Siltstone	200- 2,500	1,400-17,000
		Shale	150- 740	1,000- 5,100
C	Arenaceous rocks with strong crystals and poor cleavage	Slate	3,000- 4,400	21,000-30,000
		Conglomerate	700- 4,600	4,800-32,000
		Sandstone	1,400- 3,600	9,700-25,000
D	Fine-grained igneous crystalline rock	Quartzite	1,300- 8,000	9,000-55,000
		Andesite	2,100- 3,800	14,000-26,000
		Diorite	450-12,000	3,100-83,000
E	Coarse-grained igneous and metamorphic crystalline rock	Amphibolite	2,500- 5,800	17,000-40,000
		Gabbro	2,600- 6,500	18,000-45,000
		Gneiss	500- 6,500	3,500-45,000
		Granite	300- 7,000	2,100-49,000
		Quartzdiorite	200- 2,100	1,400-14,000
		Quartzmonzonite	2,700- 3,300	19,000-23,000
		Schist	200- 3,000	1,400-21,000
Syenite	1,800- 9,000	26,000-62,000		

<sup>(1)</sup>Range of Uniaxial Compressive Strength values reported by various investigations.  
<sup>(2)</sup>Not including oil shale.

From Sabbatini et al. (2002):

Table 40. CSIR classification of jointed rock mass.

**A. CLASSIFICATION PARAMETERS AND THEIR RATINGS**

PARAMETER		RANGES OF VALUES							
1	Strength of intact rock material	Point load strength index	>8 MPa	4 to 8 Mpa	2 to 4 MPa	1 to 2 MPa	For this low range – uniaxial compressive test is preferred		
		Uniaxial compressive strength	>200 MPa	100 to 200 MPa	50 to 100 MPa	25 to 50 MPa	10 to 25 MPa	3 to 10 MPa	1 to 3 MPa
	Relative Rating	15	12	7	4	2	1	0	
2	Drill core quality RQD	90% to 100%	75% to 90%	50% to 75%	25% to 50%	<25%			
	Relative Rating	20	17	13	8	3			
3	Spacing of joints	>3 m	1 to 3m	0.3 to 1 m	50 to 300 mm	<50mm			
	Relative Rating	30	25	20	10	5			
4	Condition of joints	Very rough surfaces Not continuous No separation Hard joint wall rock	Slightly rough surfaces Separation <1mm Hard joint wall rock	Slightly rough surfaces Separation <1mm Soft joint wall rock	Slickensided surfaces or Gouge <5 mm thick or Joints open 1 to 5 mm Continuous joints	Soft gouge >5 mm thick or Joints open >5 mm Continuous joints			
		Relative Rating	25	20	12	6	0		
5	Ground water	Inflow per 10 m tunnel length	None		<25 liters/min	25 to 125 liters/min	>125 liters/min		
		Ratio= joint water pressure/major principal stress	OR	0	OR	0.0 to 0.2	OR	0.2 to 0.5	OR
	General Conditions	OR	Completely Dry	OR	Moist only (interstitial water)	OR	Water under moderate pressure	OR	Severe water problems
	Relative Rating	10		7	4	0			

**B. RATING ADJUSTMENT FOR JOINT ORIENTATIONS**

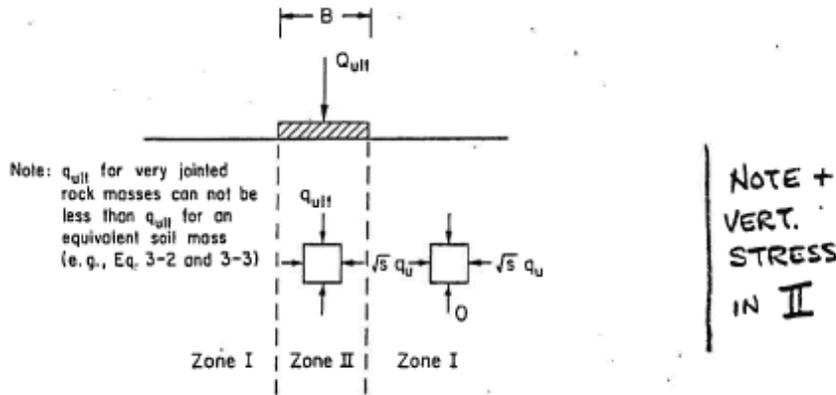
Strike and dip orientations of joints		Very favorable	Favorable	Fair	Unfavorable	Very Unfavorable
Ratings	Tunnels	0	-2	-5	-10	-12
	Foundations	0	-2	-7	-15	-25
	Slopes	0	-5	-25	-50	-60

**C. ROCK MASS CLASSES DETERMINED FROM TOTAL RATINGS**

RMR Rating	100 to 81	80 to 61	60 to 41	40 to 21	<20
Class No.	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock

From Carter and Kulhawy, 1988

ERRATA : CORRECTED PAGES FOR EL-5918 (SEP 88) <sup>1 of 3</sup>



$$\text{Rock Mass Failure Criterion: } \sigma_1 = \sigma_3 + \sqrt{(mq_u \sigma_3 + sq_u^2)}$$

Figure 3-5. Lower Bound Solution for Bearing Capacity

the failure criterion. The rock mass beneath a strip footing may be divided into two zones, with homogeneous stress conditions at failure throughout each, as shown in Figure 3-5. The vertical stress in zone I is assumed to be zero, while the horizontal stress is equal to the uniaxial compressive strength of the rock mass, given by Equation 3-5 as  $s^{1/2}q_u$ . For equilibrium, continuity of the horizontal stress across the interface must be maintained, and therefore the bearing capacity of the strip footing may be evaluated from Equation 3-5 (with  $\sigma_3 = s^{1/2}q_u$ ) as:

$$q_{ult} = \underbrace{[s^{1/2} + (ms^{1/2} + s)^{1/2}]}_{N_{HS}} q_u \quad (3-6) \quad \text{EQN.}$$

For a circular foundation, a similar approach may be used, with the interface between the two zones being a cylindrical surface of the same diameter as the foundation. In this axisymmetric case, the radial stress transmitted across the cylindrical surface, at the point of collapse of the foundation, may be greater than  $s^{1/2}q_u$ , without necessarily violating either radial equilibrium or the failure criterion. However, because of the uncertainty of this value, the radial stress at the interface also is assumed to be  $s^{1/2}q_u$  for the case of a circular foundation. Therefore, the predicted (lower bound) bearing capacity is given by Equation 3-6.

Guidelines for selecting  $s$  and  $m$  for jointed rock masses are given in Table 3-1. The categories in this table are determined by the rock type and the conditions of

Carter & Kulhawy 1988  
 Analysis and Design of Drilled Shaft  
 3-6 Foundations Socketed into Rock



From AASHTO 2012, 6<sup>th</sup> Edition

10-14

AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

Table 10.4.6.4-4—Approximate Relationship between Rock-Mass Quality and Material Constants Used in Defining Nonlinear Strength (Hoek and Brown, 1988)

Rock Quality	Constants	Rock Type				
		A	B	C	D	E
A = Carbonate rocks with well developed crystal cleavage— <i>dolomite, limestone and marble</i> B = Lithified argillaceous rocks— <i>mudstone, siltstone, shale and slate (normal to cleavage)</i> C = Arenaceous rocks with strong crystals and poorly developed crystal cleavage— <i>sandstone and quartzite</i> D = Fine grained polyminerallitic igneous crystalline rocks— <i>andesite, dolerite, diabase and rhyolite</i> E = Coarse grained polyminerallitic igneous & metamorphic crystalline rocks— <i>amphibolite, gabbro gneiss, granite, norite, quartz-diorite</i>						
INTACT ROCK SAMPLES						
Laboratory size specimens free from discontinuities.	<i>m</i>	7.00	10.00	15.00	17.00	25.00
CSIR rating: <i>RMR</i> = 100	<i>s</i>	1.00	1.00	1.00	1.00	1.00
VERY GOOD QUALITY ROCK MASS						
Tightly interlocking undisturbed rock with unweathered joints at 3–10 ft	<i>m</i>	2.40	3.43	5.14	5.82	8.567
CSIR rating: <i>RMR</i> = 85	<i>s</i>	0.082	0.082	0.082	0.082	0.082
GOOD QUALITY ROCK MASS						
Fresh to slightly weathered rock, slightly disturbed with joints at 3–10 ft	<i>m</i>	0.575	0.821	1.231	1.395	2.052
CSIR rating: <i>RMR</i> = 65	<i>s</i>	0.00293	0.00293	0.00293	0.00293	0.00293
FAIR QUALITY ROCK MASS						
Several sets of moderately weathered joints spaced at 1–3 ft	<i>m</i>	0.128	0.183	0.275	0.311	0.458
CSIR rating: <i>RMR</i> = 44	<i>s</i>	0.00009	0.00009	0.00009	0.00009	0.00009
POOR QUALITY ROCK MASS						
Numerous weathered joints at 2 to 12 in.; some gouge. Clean compacted waste rock.	<i>m</i>	0.029	0.041	0.061	0.069	0.102
CSIR rating: <i>RMR</i> = 23	<i>s</i>	$3 \times 10^{-5}$	$3 \times 10^{-6}$	$3 \times 10^{-6}$	$3 \times 10^{-6}$	$3 \times 10^{-6}$
VERY POOR QUALITY ROCK MASS						
Numerous heavily weathered joints spaced <2 in. with gouge. Waste rock with fines.	<i>m</i>	0.007	0.010	0.015	0.017	0.025
CSIR rating: <i>RMR</i> = 3	<i>s</i>	$1 \times 10^{-7}$				



Client: BETA Group, Inc.  
 Project: Rosemont Street Bridge  
 Project No.: 1801408

Prepared By: W. Lukas  
 Date: Feb 2019  
 Checked By: M. Paster  
 Date: Dec 2022

10-68

AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, NINTH EDITION, 2020

Table C10.6.2.5.1-1—Presumptive Bearing Resistance for Spread Footing Foundations at the Service Limit State Modified after U.S. Department of the Navy (1982)

Type of Bearing Material	Consistency in Place	Bearing Resistance (ksf)	
		Ordinary Range	Recommended Value of Use
Massive crystalline igneous and metamorphic rock: granite, diorite, basalt, gneiss, thoroughly cemented conglomerate (sound condition allows minor cracks)	Very hard, sound rock	120-200	160
Foliated metamorphic rock: slate, schist (sound condition allows minor cracks)	Hard sound rock	60-80	70
Sedimentary rock: hard cemented shales, siltstone, sandstone, limestone without cavities	Hard sound rock	30-50	40
Weathered or broken bedrock of any kind, except highly argillaceous rock (shale)	Medium hard rock	16-24	20
Compaction shale or other highly argillaceous rock in sound condition	Medium hard rock	16-24	20
Well-graded mixture of fine- and coarse-grained soil: glacial till, hardpan, boulder clay (GW-GC, GC, SC)	Very dense	16-24	20
Gravel, gravel-sand mixture, boulder-gravel mixtures (GW, GP, SW, SP)	Very dense	12-20	14
	Medium dense to dense	8-14	10
	Loose	4-12	6
Coarse to medium sand, and with little gravel (SW, SP)	Very dense	8-12	8
	Medium dense to dense	4-8	6
	Loose	2-6	3
Fine to medium sand, silty or clayey medium to coarse sand (SW, SM, SC)	Very dense	6-10	6
	Medium dense to dense	4-8	5
	Loose	2-4	3
Fine sand, silty or clayey medium to fine sand (SP, SM, SC)	Very dense	6-10	6
	Medium dense to dense	4-8	5
	Loose	2-4	3
Homogeneous inorganic clay, sandy or silty clay (CL, CH)	Very dense	6-12	8
	Medium dense to dense	2-6	4
	Loose	1-2	1
Inorganic silt, sandy or clayey silt, varved silt-clay-fine sand (ML, MH)	Very stiff to hard	4-8	6
	Medium stiff to stiff	2-6	3
	Soft	1-2	1



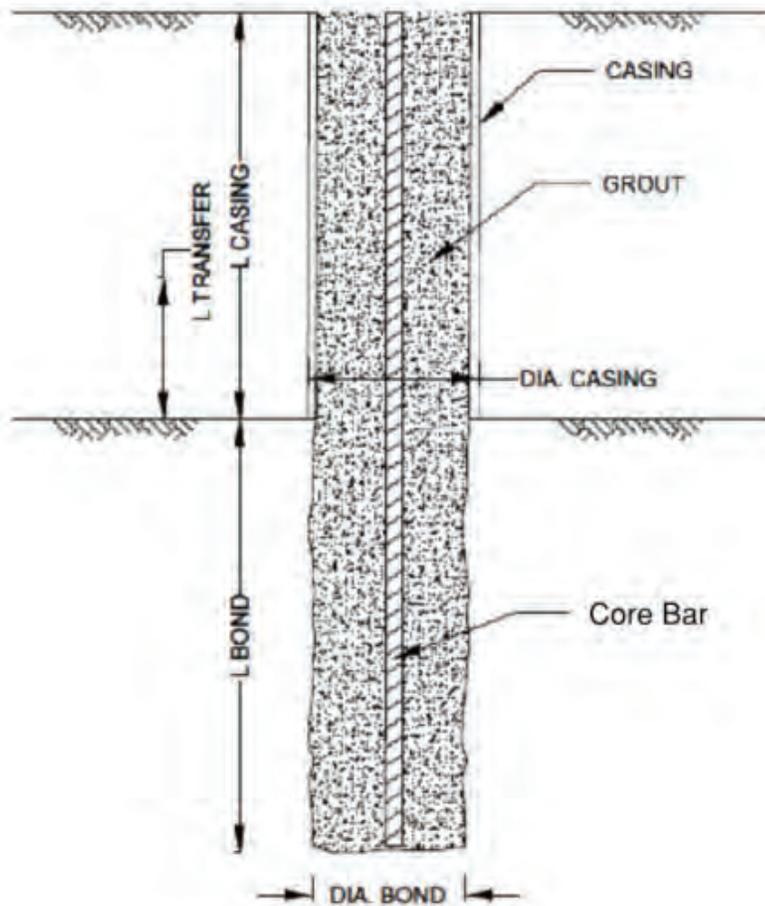
Client	BETA Group			Page	1
Project	Rosemont St. Bridge - Micropiles			Pg. Rev.	
By	J. Giampa	Chk.	M. H-Cabal	App.	
Date	08/12/2024	Date	08/12/2024	Date	

Project No.	1804108	Document No.	N/A
Subject	Minimum Micropile Bond Length		

## MICROPILE DESIGN WORKSHEET

Calculation for the micropile geotechnical capacity assuming:

***9 5/8" OD Casing with #18 Threaded Core Bar***



### References

1. FHWA NHI-05-039 Micropile Design and Construction (2005)
2. ACI318-11 Building Code Requirements for Structural Concrete
3. AISC Steel Construction Manual, 13th Edition
4. International Building Code Council (2015). 2015 International Building Code. Country Club Hills, ILL.
5. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.



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Subject	Minimum Micropile Bond Length				

**GEOTECHNICAL DESIGN:**

**A.) Applied Load**

Maximum factored axial load per pile was based on LRFD Strength I loading. Pile loading was provided by BETA on 01/19/2024 and 01/31/2024.

Maximum Compression Load per Micropile:

$$P_c := 110 \text{ kip} = 110000 \cdot \text{lbf}$$

*Maximum factored axial load per pile. Based on LRFD Strength I load case.*

**B.) Calculate Minimum Uncased Length**

*Assumed that micropiles will be advanced into competent bedrock.*

Ultimate Bond Strength:

$$\alpha_{\text{bond}} := 15 \text{ ksf} = 104 \cdot \text{psi}$$

*FHWA Table 5-3  
AASHTO Table  
C10.9.3.5.2-1*

Resistance Factor for Bond:

$$\text{RF} := 0.55$$

*Based on AASHTO  
Table 10.5.5.2.5-1,  
assuming presumptive  
values*

Assumed Nominal Bond Diameter:

$$\text{DIA}_{\text{bond}} := 8 \text{ in}$$

Circumference of Uncased Section:

$$C_{\text{UC}} := \pi \cdot \text{DIA}_{\text{bond}} = 25.1 \cdot \text{in}$$

Minimum Uncased Length:

$$L_{\text{min}} := \frac{P_c}{C_{\text{UC}} \cdot \alpha_{\text{bond}} \cdot \text{RF}} = 6.4 \text{ ft}$$

*To account for  
potential  
variability in the  
bedrock, use 10 ft*

$$L_{\text{min\_round}} := 10 \text{ ft}$$



	<b>CALCULATION COVER PAGE</b>			Page	i
				Rev. No.	2
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<b>Project</b>	Rosemont Street Bridge Micropiles				
<b>Project No.</b>	1804108	<b>Document No.</b>	N/A		
<b>Title</b>	Group Analysis for Rosemont Street Micropiles				
<b>Summary</b>					
<p>This calculation package presents the results of our lateral micropile analysis for the proposed west abutment and wingwalls supporting the Rosemont St. Bridge in Haverhill, MA. Our lateral analysis is based on the pile layout and loading provided by BETA Group on January 19 and January 31, 2024, respectively.</p>					
<b>Methodology</b>					
<p>We performed our preliminary evaluation of the lateral behavior of the proposed rock-socketed micropiles as described below:</p>					
<ol style="list-style-type: none"> <li>1. Developed a soil profile representative of the soils below the proposed west abutment and wingwalls. In our soil profile, we accounted for a total scour depth of about 7.93 ft (El. 12.47; contraction and abutment scour) based on the results presented in the Hydraulic and Scour Report at Rosemont Street Bridge Over Little River, Haverhill, MA, prepared by BETA Group, Inc., and dated April 2024.</li> <li>2. Assigned unit weights and strength properties to the soils and rock based on site-specific explorations and our engineering judgement.</li> <li>3. Assumed micropile section properties to input into software GROUP. We compared different sizes of micropiles.</li> <li>4. Modeled the updated micropile layout at the proposed west abutment and wingwalls based on information provided by BETA Group on January 19 and 31, 2024.</li> <li>5. Applied LRFD load cases to the micropile group provided by BETA to evaluate the lateral response of the rock socketed micropiles.</li> <li>6. Obtained lateral deflection, bending moment and shear force along the depth of the micropiles from GROUP.</li> </ol>					
<b>Results</b>					
The lateral behavior of the micropile sections is provided in this calculation.					
<b>Signature Block &amp; Record of Revisions</b>					
Rev.	Description	Code	Pages/Sections	Name	Date
0	Submitted for Approval	P	All	M. H-Cabal	12/23/2022
		C	All	J. Giampa	12/23/2022
		A	All	M. Paster	12/23/2022
1	Updated model based on updated loads and micropiles layout	P	All	M. H-Cabal	03/15/2024
		C	All	J. Giampa	03/15/2024
		A	All		
2	Revised model with updated scour information	P	All	M. H-Cabal	8/7/2024
		C	All	J. Giampa	8/8/2024
		A			
Codes: P = Prepared; C = Checked; A = Approved					



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Project No.	1804108	Document No.	N/A
Subject	GROUP Analysis for Rosemont Street Micropiles		

## GROUP Analysis for Rosemont Street Micropiles

### Purpose:

- Perform lateral pile analysis at the proposed west abutment and wingwalls supported on rock-socketed micropiles. Our lateral analysis is based on the pile layout and loading provided by BETA Group on January 19 and January 31, 2024, respectively.

### Assumptions and Input

- Conservatively ignore any shear resistance along bottom of the west abutment and wingwalls, passive resistance in front of the abutment/pile caps.
- Assume pinned-head connection at proposed abutment.
- The bottom of the pile cap elevation is 16 ft.
- Scour elevation at approximately El. 12.47 (or scour depth of 7.93 ft considering contraction and abutment scour) based on the results presented in the Hydraulic and Scour Report at Rosemont Street Bridge Over Little River, Haverhill, MA, prepared by BETA Group, Inc., and dated April 2024.

### Soil Properties and Layering for Analysis:

See recommended soil properties sheet of GEI's Geotechnical Report  
**Clay (2 to 5 ft)**

LPILE soil type for p-y curve: Sand (Reese) (Assumed drained condition)

Unit Weight: 110 *pcf*  
 Friction Angle: 30 *deg*  
 Effective Unit Weight Below Water Table: 47.6 *pcf*  
 k: 35 *pci*

### Weathered Rock (5 to 10 ft)

LPILE soil type for p-y curve: Sand (Reese)

Unit Weight: 140 *pcf*  
 Friction Angle: 38 *deg*  
 Effective Unit Weight Below Water Table: 77.6 *pcf*  
 k: 120 *pci*

### Bedrock (over depth of 10 ft)

LPILE soil type for p-y curve: Vuggy Limestone

Unit Weight: 170 *pcf*  
 Unconfined Compressive Strength: 7,000 *psi* (AASHTO 2002 Table 4.4.8.1.2B)  
 Effective Unit Weight Below Water Table: 107.6 *pcf*

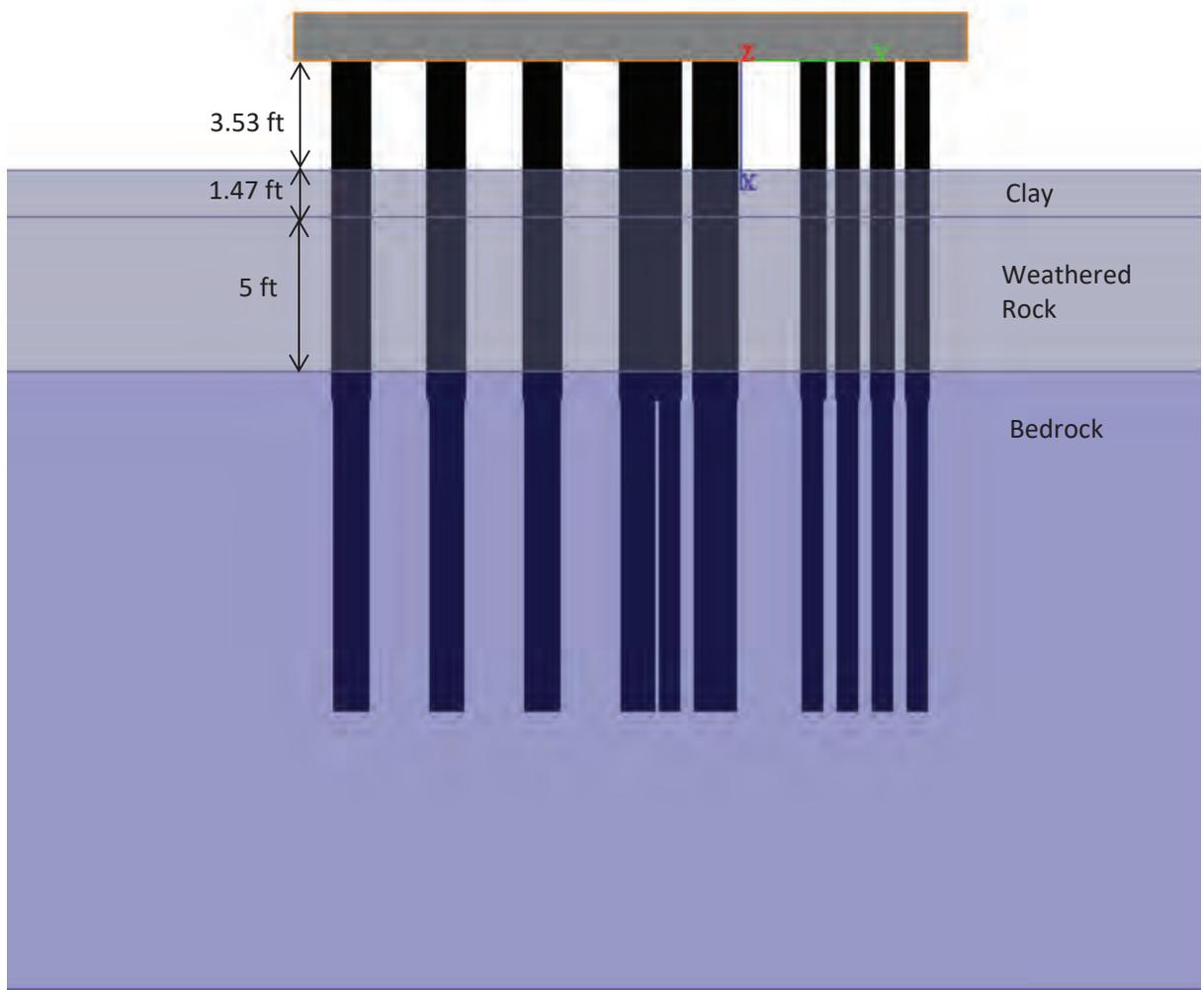


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**Soil Profile:**

We modeled scour to an El. of 12.47 based on the check contraction and abutment scour provided in the Hydraulic and Scour Report at Rosemont Street Bridge Over Little River, Haverhill, MA, prepared by BETA Group, Inc., and dated April 2024.

Below the scour elevation, the soil profile was based on GEI's 2018 boring BB-2.





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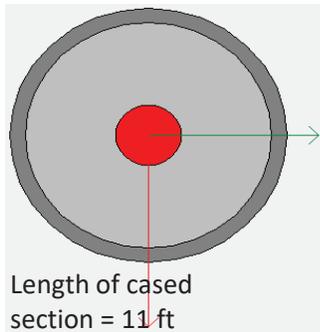
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**Pile Properties:**

We compared two sizes of micropile outside diameter and we considered permanent steel casing (with 1/16" corrosion loss) through the overburden, extending a minimum of 12 inches into competent rock. A rock socket was modeled beyond the tip of the casing a minimum of 10 feet into competent rock.

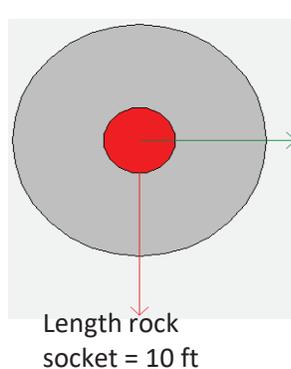
	Nominal Micropile Outside Diameter	
	9+5/8"	10+3/4"
Nominal Casing OD (in):	9.625	10.75
Corroded Casing OD (in):	9.5	10.625
Corrosion loss (in): 1/16=	0.0625	0.0625
Nominal Casing Thickness (in):	0.545	0.5
Casing ID (in):	8.535	9.75
Corroded Casing area (in <sup>2</sup> ):	13.67	14.00
Casing Yield Stress (ksi)	52	
Rock Socket Diameter (in):	8	9
Reinforcement Bar:	#18	
Area of bar (in <sup>2</sup> ):	4	
Concrete Strength (psi):	4000	
Rebar Modulus (ksi):	29000	
Rebar Yield Stress (ksi)	60	

**Cased Section**



Casing embedment in rock: 12 inches per AASHTO Bridge

**Rock Socket**



(Not to Scale)

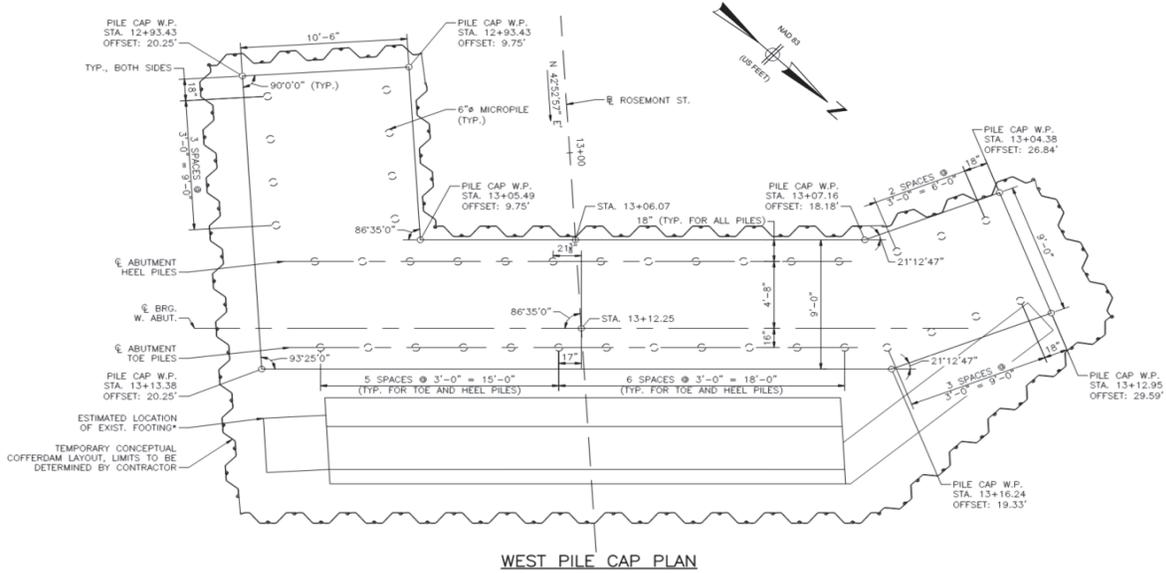


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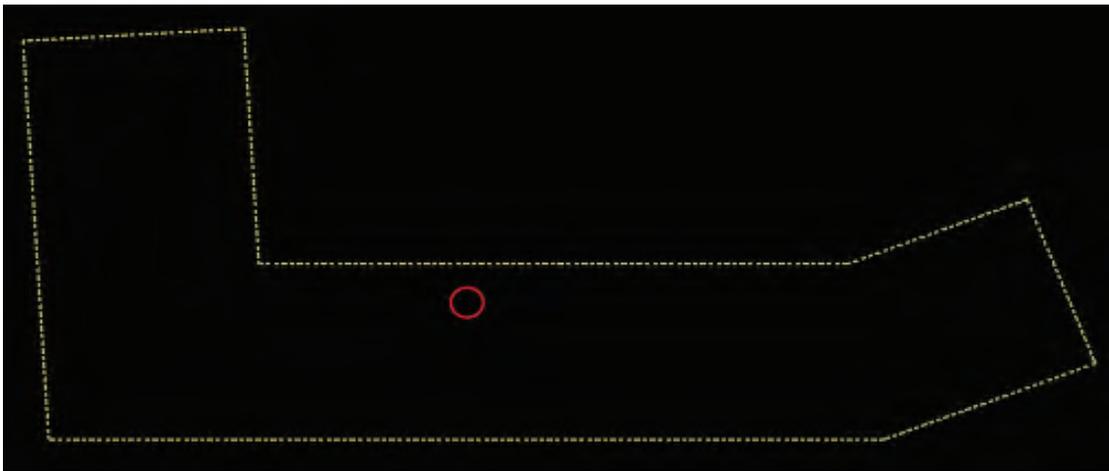
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**Pile Layout:**

Layout provided by BETA on 1/19/2024.



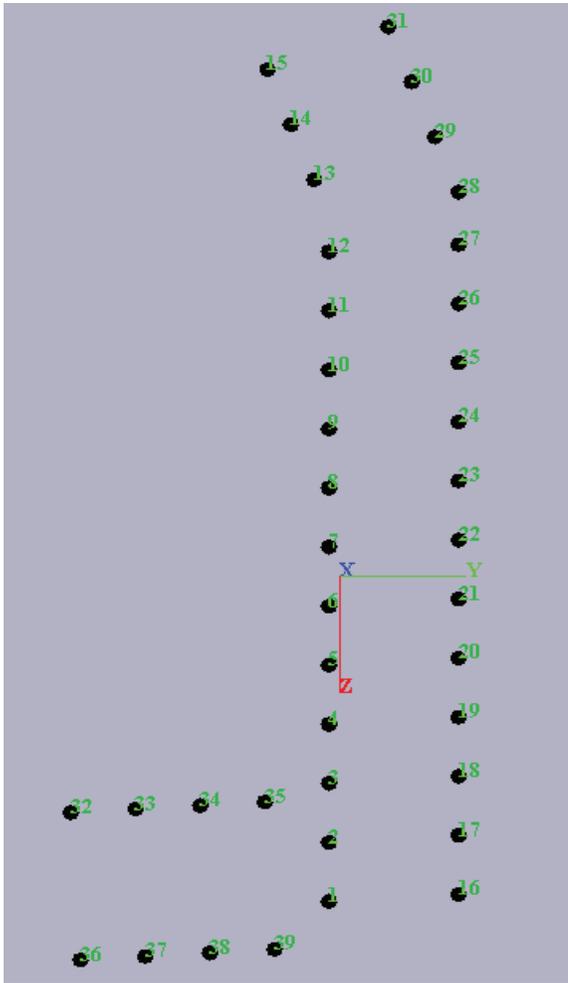
The geometric center of the pile cap was estimated using AutoCAD.



(Not to scale)



Pile numbering in GROUP



(Not to scale)

**P-Y Multipliers:**

Laterally loaded pile groups result in higher deflections than a single pile loaded with the same lateral load, due to overlapping stress zones (i.e. shadowing effects) of individual piles in the group. These shadowing effects occur in the trailing rows of pile groups and result in an apparent reduction of soil stiffness and strength. For this reason, reduction factors must be applied to the soil stiffness or coefficient of subgrade reaction to reasonably estimate the deflection of the pile groups. The reduction factors were applied to each pile in the pile group and were calculated by GROUP.



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**P-Y Multipliers (cont'd):**

The center-to-center spacing in the longitudinal direction was at least 5B and the spacing in the transverse direction ranged from about 4B to at least 5B. Therefore, the P-multipliers ranged from 0.95 to 1.0 and is generally consistent with AASHTO Section 10.7.2.4. for piles spaced 5B.

**Loads:**

The following load cases were analyzed in our model. The load cases were provided by BETA in document titled "Pile Cap Load Summary" and provided to us on 1/31/2024. All loads are applied to the geometric center of the pile cap.

1. **Strength I**

Px	1938	kips
Py	586	kips
Pz	198	kips
My	1067	kip-ft
Mz	4399	kip-ft

2. **Strength III**

Px	1649	kips
Py	555	kips
Pz	148	kips
My	617	kip-ft
Mz	3429	kip-ft

3. **Strength IV**

Px	1858	kips
Py	545	kips
Pz	141	kips
My	522	kip-ft
Mz	3513	kip-ft

4. **Strength V**

Px	1872	kips
Py	569	kips
Pz	190	kips
My	999	kip-ft
Mz	4229	kip-ft

5. **Service I**

Px	1446	kips
Py	399	kips
Pz	141	kips
My	655	kip-ft
Mz	2906	kip-ft

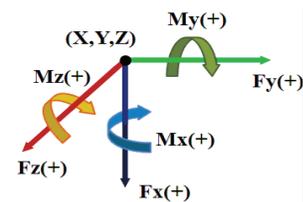
6. **Extreme I**

Px	1282	kips
Py	369	kips
Pz	104	kips
My	286	kip-ft
Mz	2076	kip-ft

7. **Extreme II**

Px	478	kips
Py	97	kips
Pz	130	kips
My	650	kip-ft
Mz	451	kip-ft

Load legend in GROUP:





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Subject	GROUP Analysis for Rosemont Street Micropiles
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**Results (with scour to El. 12.47)**

**9+5/8" PILE, 8" ROCK SOCKET**

Resultant		Axial (kips)		Max Pile Moment (kip-in)	Max Pile Shear (kip)	Max Pile Deflection (in)
Load Case No.	Load Case	Comp.	Tension			
1	Strength I	109.3	--	1868	177	2.8
2	Strength III	89.5	--	1746	165	2.6
3	Strength IV	96.0	--	1717	161	2.6
4	Strength V	105.3	--	1855	176	2.8
5	Service I	76.8	--	1219	115	1.8
6	Extreme I	61.8	--	1080	101	1.6
7	Extreme II	19.3	--	381	34	0.6

Longitudinal		Axial (kips)		Mz	Vy	dy
Load Case No.	Load Case	Comp.	Tension	Max Pile Moment (kip-in)	Max Pile Shear (kip)	Max Pile Deflection (in)
1	Strength I	109.3	--	1743	166	2.7
2	Strength III	89.5	--	1668	159	2.5
3	Strength IV	96.0	--	1645	156	2.5
4	Strength V	105.3	--	1739	166	2.7
5	Service I	76.8	--	1147	108	1.7
6	Extreme I	61.8	--	1035	97	1.5
7	Extreme II	19.3	--	238	21	0.3

**Pile Cap Displacements**

Load Case No.	Load Case	Longitudinal (in)	Transversal (in)	Resultant (in)
1	Strength I	2.3	0.8	2.5
2	Strength III	2.2	0.6	2.3
3	Strength IV	2.2	0.6	2.3
4	Strength V	2.3	0.8	2.4
5	Service I	1.5	0.5	1.6
6	Extreme I	1.4	0.4	1.4
7	Extreme II	0.3	0.4	0.5



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Project No.	1804108	Document No.	N/A
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Subject	GROUP Analysis for Rosemont Street Micropiles
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Results (with scour to El. 12.47; cont'd)

**10+3/4" PILE, 9" ROCK SOCKET**

**Resultant**

Load Case No.	Load Case	Axial (kips)		Max Pile Moment (kip-in)	Max Pile Shear (kip)	Max Pile Deflection (in)
		Comp.	Tension			
1	Strength I	109.3	--	1877	171	2.1
2	Strength III	89.5	--	1765	160	2.0
3	Strength IV	96.0	--	1734	156	1.9
4	Strength V	105.3	--	1866	170	2.1
5	Service I	76.8	--	1245	112	1.4
6	Extreme I	61.8	--	1108	100	1.2
7	Extreme II	19.3	--	391	33	0.4

**Longitudinal**

Load Case No.	Load Case	Axial (kips)		Mz (kip-in)	Vy (kip)	dy (in)
		Comp.	Tension			
1	Strength I	109.3	--	1754	160	2.0
2	Strength III	89.5	--	1688	153	1.9
3	Strength IV	96.0	--	1661	150	1.8
4	Strength V	105.3	--	1752	160	2.0
5	Service I	76.8	--	1163	105	1.3
6	Extreme I	61.8	--	1057	95	1.2
7	Extreme II	19.3	--	247	21	0.3

**Pile Cap Displacements**

Load Case No.	Load Case	Longitudinal (in)	Transversal (in)	Resultant (in)
1	Strength I	1.7	0.6	1.8
2	Strength III	1.7	0.4	1.7
3	Strength IV	1.6	0.4	1.7
4	Strength V	1.7	0.6	1.8
5	Service I	1.1	0.4	1.2
6	Extreme I	1.0	0.3	1.1
7	Extreme II	0.2	0.3	0.4



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**Results (cont'd)**

The values shown above are the maximum values for any pile at any depth. The maximum deflection occurred at the top of the piles and the maximum shear and moment occurred at depths between 10 and 12 feet, and 8 and 10 feet, respectively. GROUP output plots of  $\sigma$  for each load case are provided in Attachment 2.

**References:**

- 1 AASHTO (2020) LRFD Bridge Design Specifications - 9th Edition.

**Attachments:**

- 1 BETA 2024 Load Summary
- 2 GROUP Output Plots
- 3 GROUP Output Files

## **Beta 2024 Load Summary**



JOB	Haverhill Rosemont St	No.	6155
CALCULATED BY	DW	DATE	1/29/2024
CHECKED BY	PJK	DATE	1/30/2024
DESCRIPTION	Pile Cap Load Summary	SHEET NO.	

**Combined Load Summary**

In which,

L <sub>SW</sub> =	14.67	ft
L <sub>NW</sub> =	11.09	ft
TW =	3.00	ft

Furthermore,

SW Applied Angle =	90.00	deg to Baseline
=	1.57	rad
NW Applied Angle =	342.20	deg to Baseline
=	5.97	rad

Trig. Adjustment Factor

SW Longit. =	0.00
SW Trans =	1.00
NW Longit. =	0.95
NW Trans. =	-0.31

Total Wingwall Lateral Load (k)		
Limit State	SW	NW
Strength I	238.75	137.88
Strength III	182.29	137.88
Strength IV	182.29	137.88
Strength V	225.85	137.88
Service I	167.29	102.13
Extreme I	135.03	102.13
Extreme II	161.16	102.13

Total Wingwall Moment (k-ft)		
Limit State	SW	NW
Strength I	1244.98	709.13
Strength III	730.44	709.13
Strength IV	739.57	727.88
Strength V	1127.37	709.13
Service I	724.19	473.23
Extreme I	430.17	473.23
Extreme II	794.53	473.23

Adjusted Wingwall Lateral Load with Respect to BL (k)				
Limit State	SW <sub>LONG</sub>	SW <sub>TRANS</sub>	NW <sub>LONG</sub>	NW <sub>TRANS</sub>
Strength I	0.00	238.75	131.28	-42.14
Strength III	0.00	182.29	131.28	-42.14
Strength IV	0.00	182.29	131.28	-42.14
Strength V	0.00	225.85	131.28	-42.14
Service I	0.00	167.29	97.25	-31.22
Extreme I	0.00	135.03	97.25	-31.22
Extreme II	0.00	161.16	97.25	-31.22

Adjusted Wingwall Moment with Respect to BL (k-ft)				
Limit State	SW <sub>LONG</sub>	SW <sub>TRANS</sub>	NW <sub>LONG</sub>	NW <sub>TRANS</sub>
Strength I	0.00	1244.98	675.20	-216.74
Strength III	0.00	730.44	675.20	-216.74
Strength IV	0.00	739.57	693.05	-222.47
Strength V	0.00	1127.37	675.20	-216.74
Service I	0.00	724.19	450.58	-144.63
Extreme I	0.00	430.17	450.58	-144.63
Extreme II	0.00	794.53	450.58	-144.63

Total Wingwall Vertical Load (k)		
Limit State	SW	NW
Strength I	357.95	261.31
Strength III	357.95	261.31
Strength IV	396.33	287.89
Strength V	357.95	261.31
Service I	276.62	201.44
Extreme I	276.62	201.44
Extreme II	276.62	201.44

Total Abutment Loads and Moments (k and k-ft)					
	M <sub>long</sub>	M <sub>trans</sub>	F'z	PHoriz <sub>Long</sub>	PHoriz <sub>Trans</sub>
Strength I	3723.71	38.75	1318.35	436.88	1.76
Strength III	2783.84	103.75	1030.06	424.20	8.29
Strength IV	2819.64	5.37	1174.22	413.61	0.36
Strength V	3554.03	88.76	1252.45	437.82	5.88
Service I	2455.22	75.16	968.23	302.10	4.98
Extreme I	1625.59	0.00	803.49	271.67	0.00

\*Abutment loads and moments are already shown with respect to the BL.



JOB	Haverhill Rosemont St	No.	6155
CALCULATED BY	DW	DATE	1/29/2024
CHECKED BY	PJK	DATE	1/30/2024
DESCRIPTION	Pile Cap Load Summary	SHEET NO.	

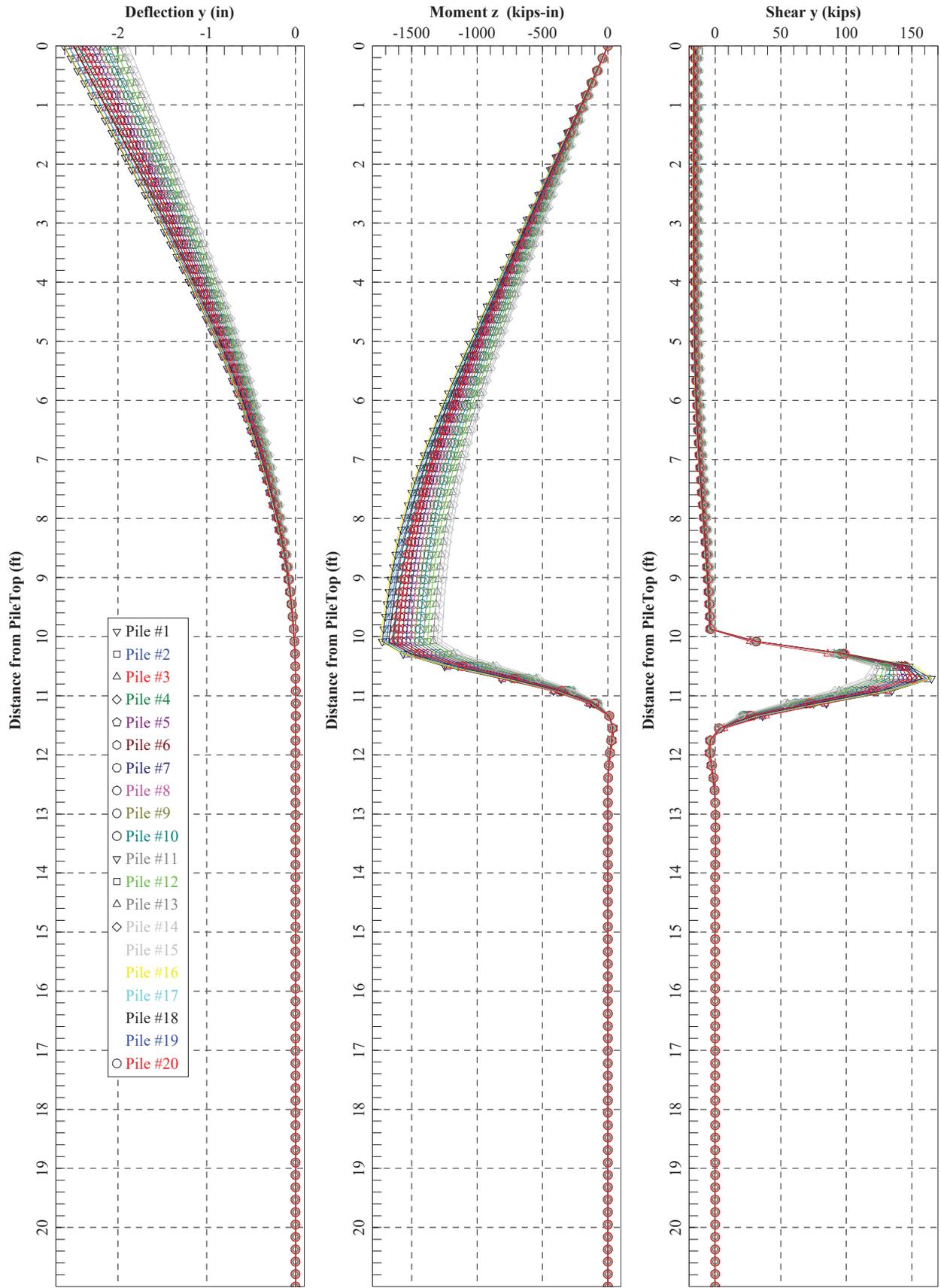
### Combined Load Summary

Total Pile Cap Loads and Moments (k and k-ft)					
	M <sub>long</sub>	M <sub>trans</sub>	F'z	PHoriz <sub>Long</sub>	PHoriz <sub>Trans</sub>
Strength I	4398.91	1066.99	1937.61	568.16	198.37
Strength III	3459.04	617.46	1649.32	555.48	148.44
Strength IV	3512.69	522.48	1858.44	544.89	140.51
Strength V	4229.23	999.39	1871.72	569.10	189.59
Service I	2905.80	654.71	1446.29	399.34	141.05
Extreme I	2076.17	285.53	1281.55	368.92	103.81
Extreme II	450.58	649.90	478.06	97.25	129.94

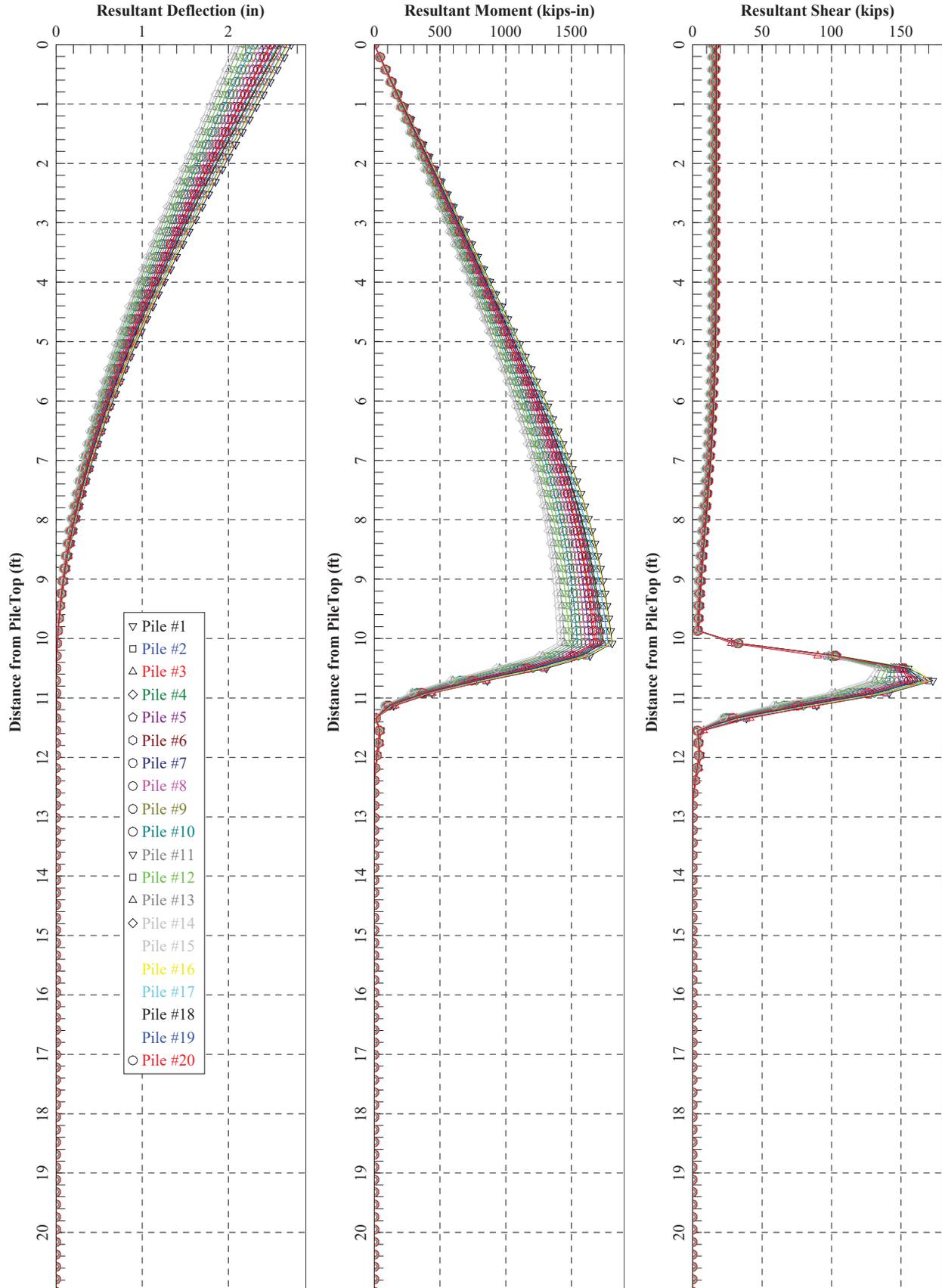
## **GROUP Output Plots**

9.625-inch-diameter Pile  
GROUP Output Plots

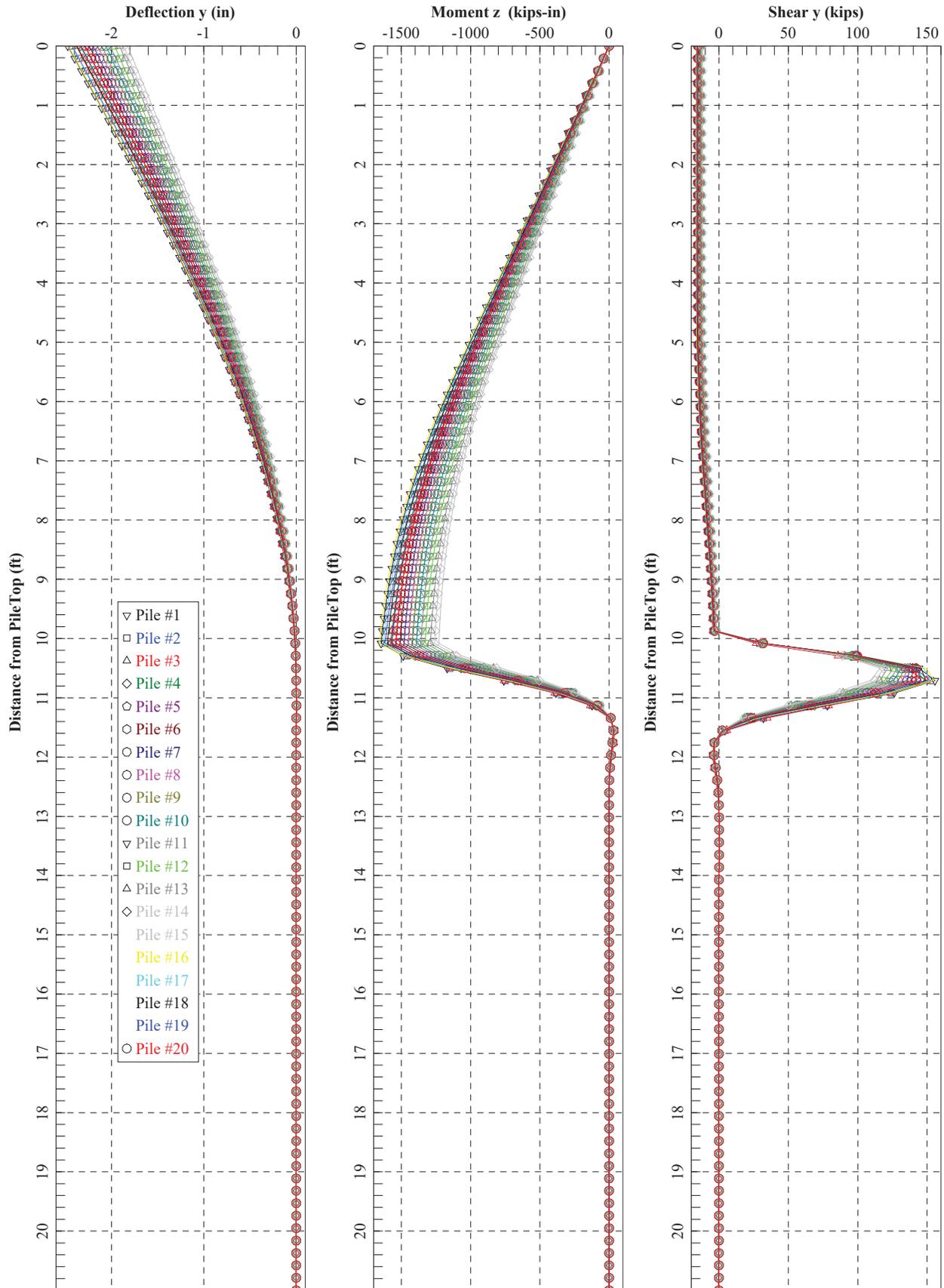
# 9.625-inch-diameter Pile Strength I Longitudinal



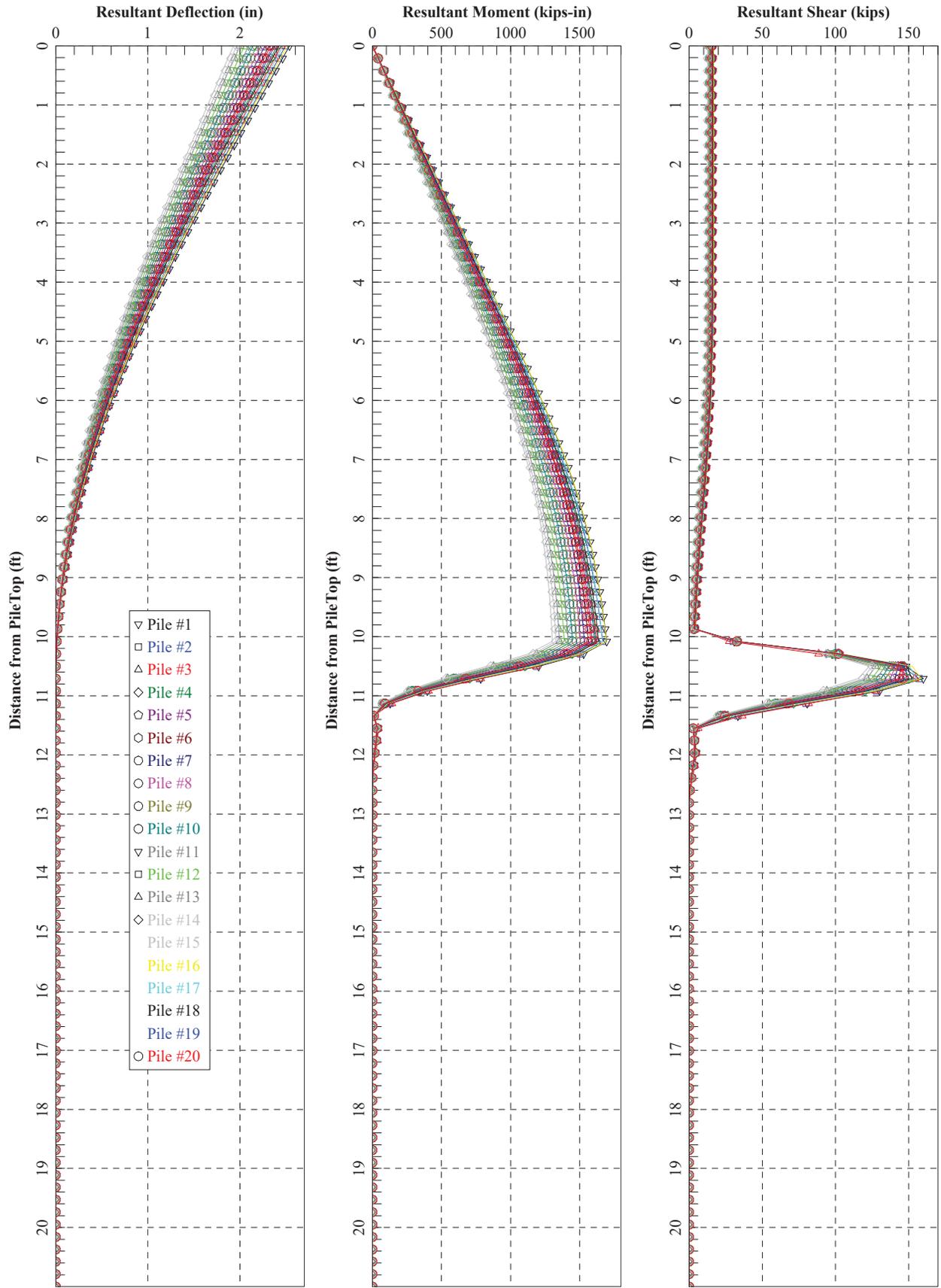
9.625-inch-diameter Pile  
Strength I  
Resultant



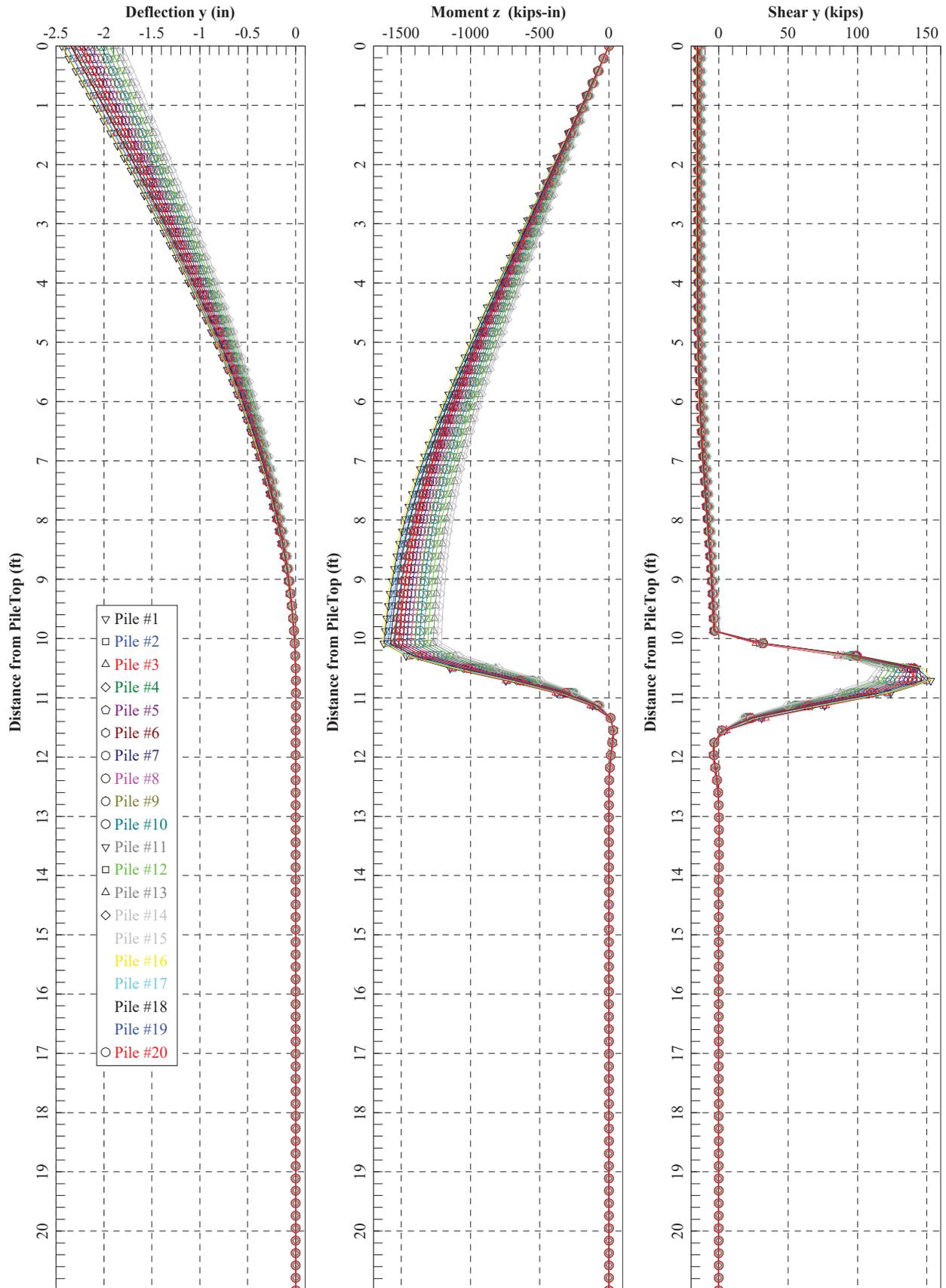
9.625-inch-diameter Pile  
Strength III  
Longitudinal



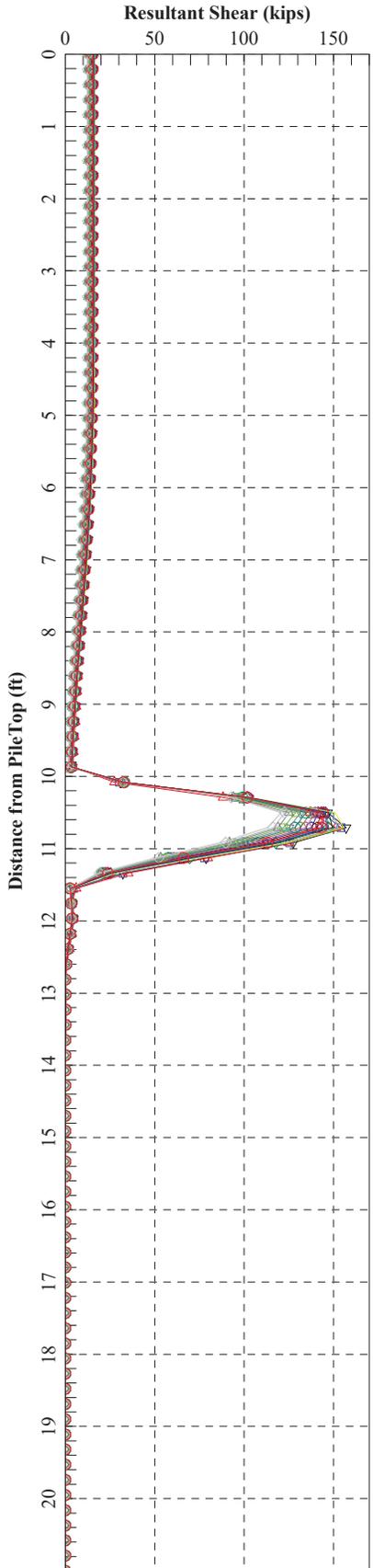
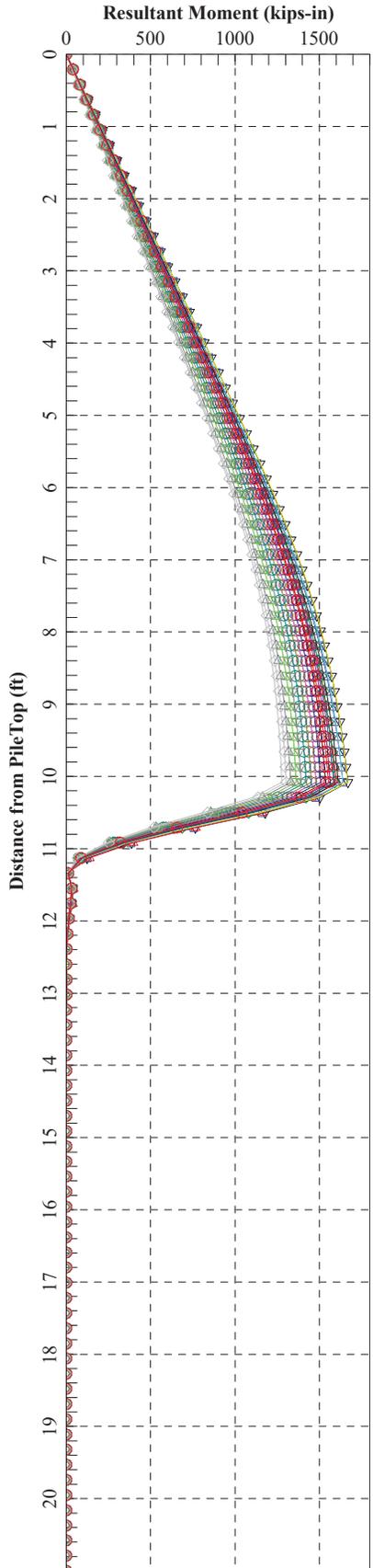
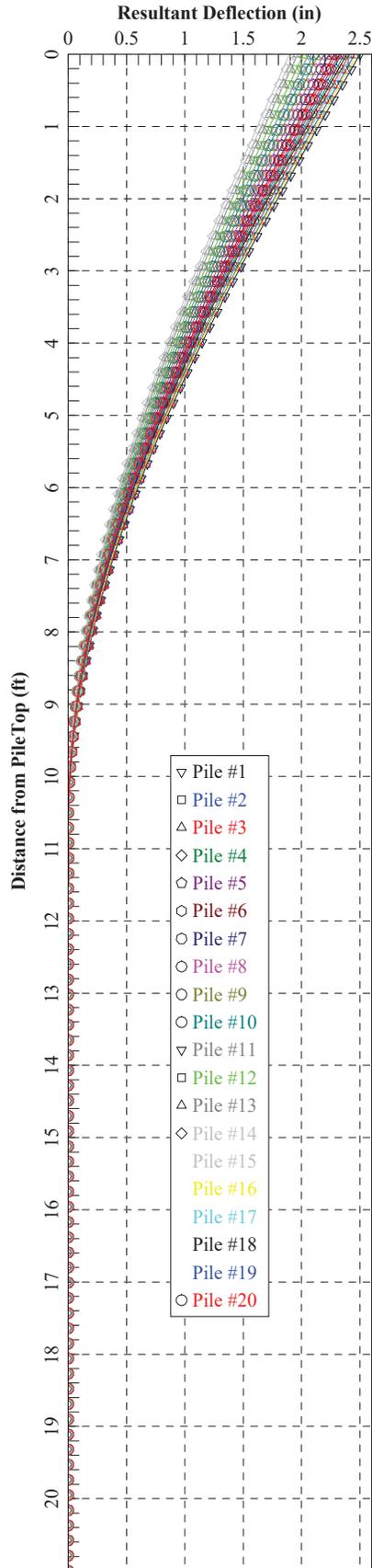
9.625-inch-diameter Pile  
Strength III  
Resultant



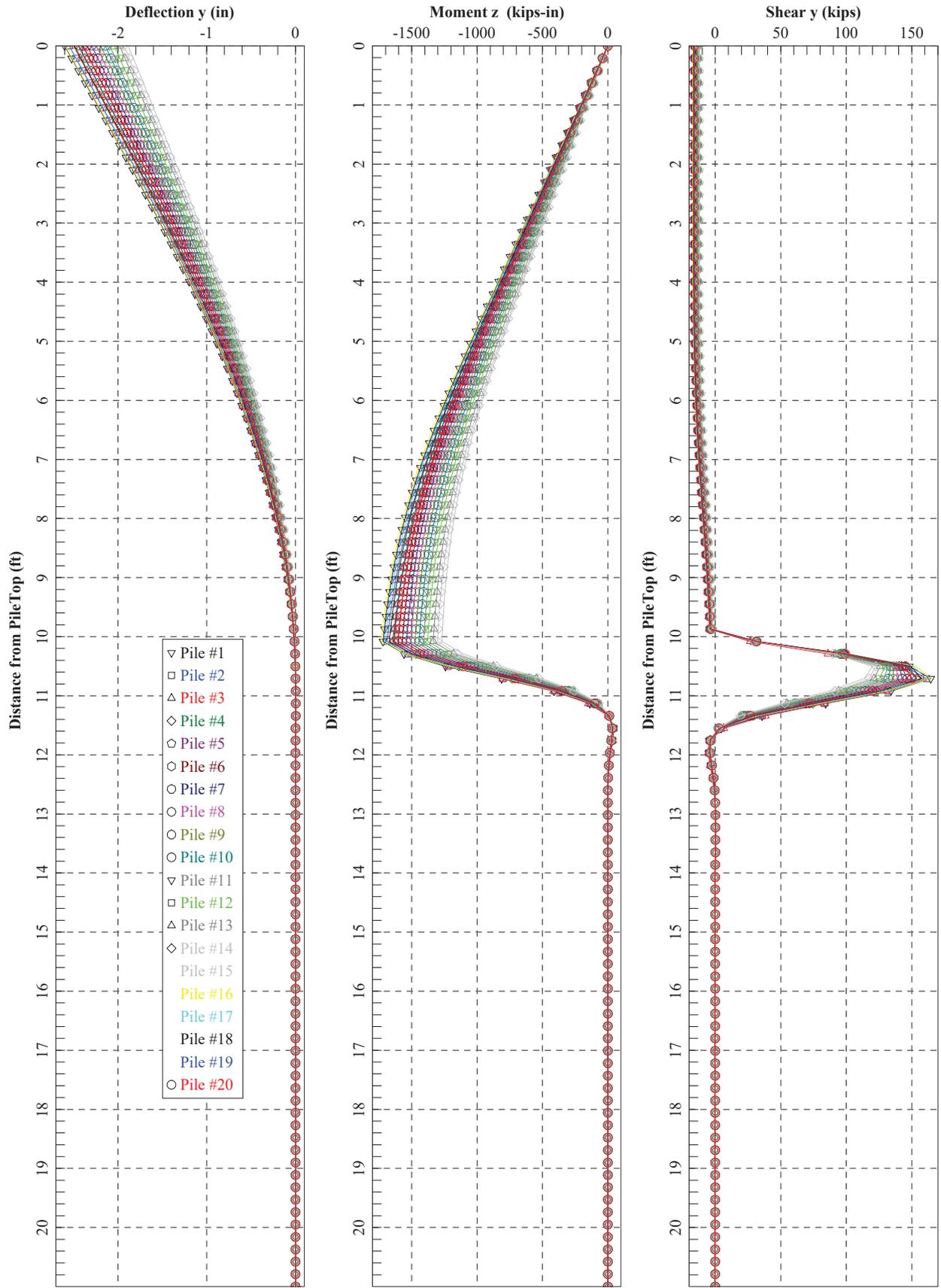
# 9.625-inch-diameter Pile Strength IV Longitudinal



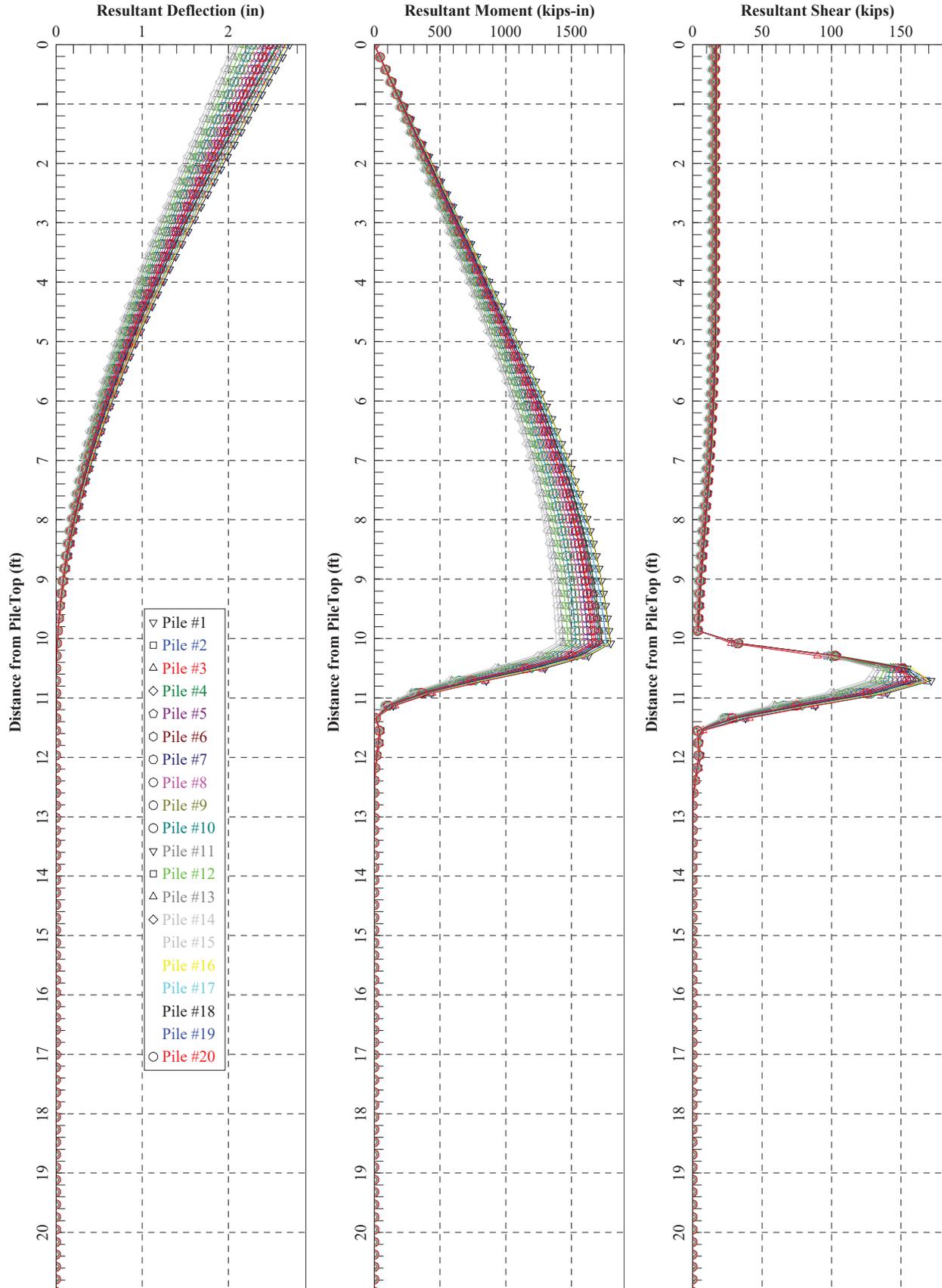
# 9.625-inch-diameter Pile Strength IV Resultant



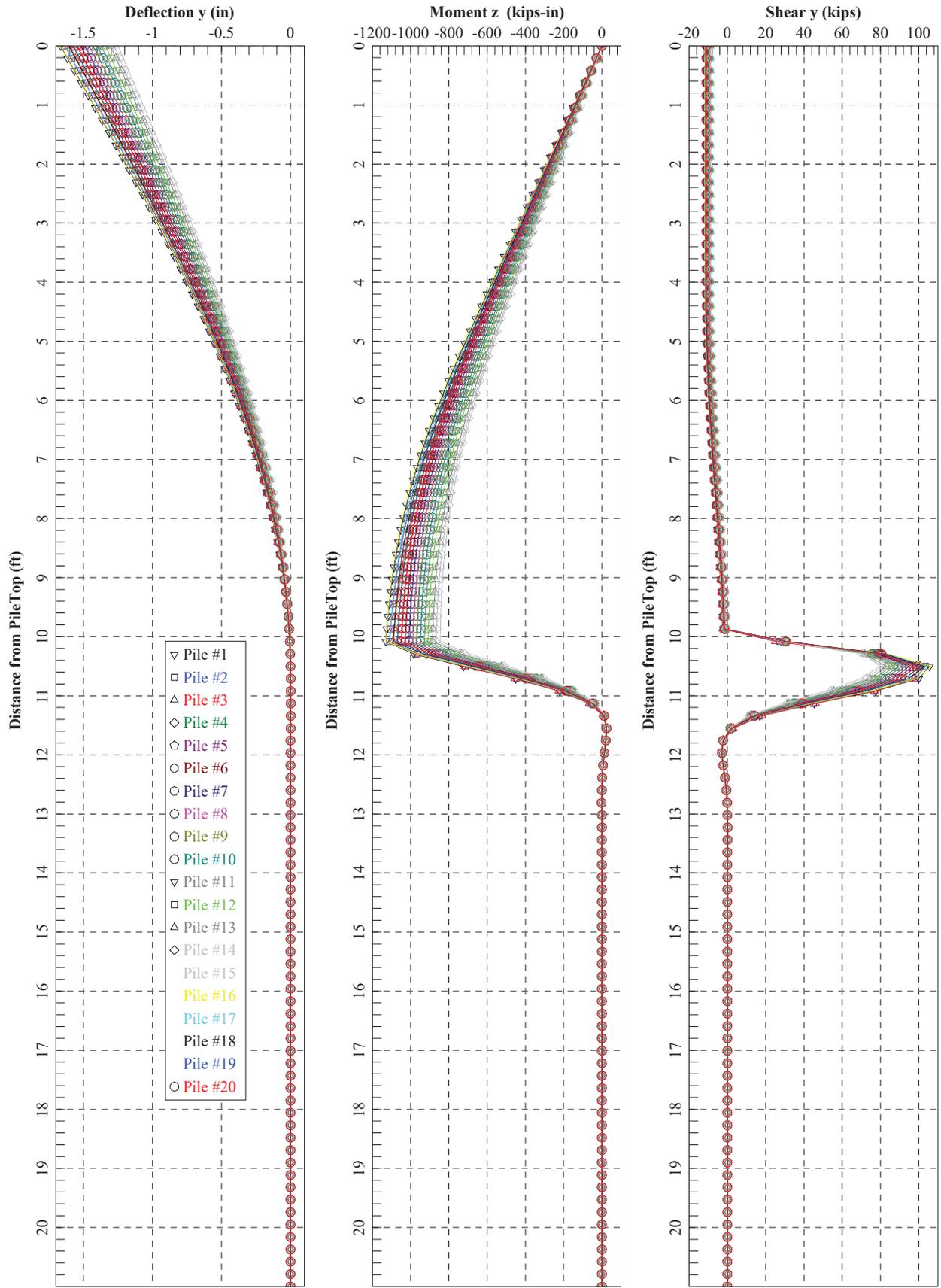
# 9.625-inch-diameter Pile Strength V Longitudinal



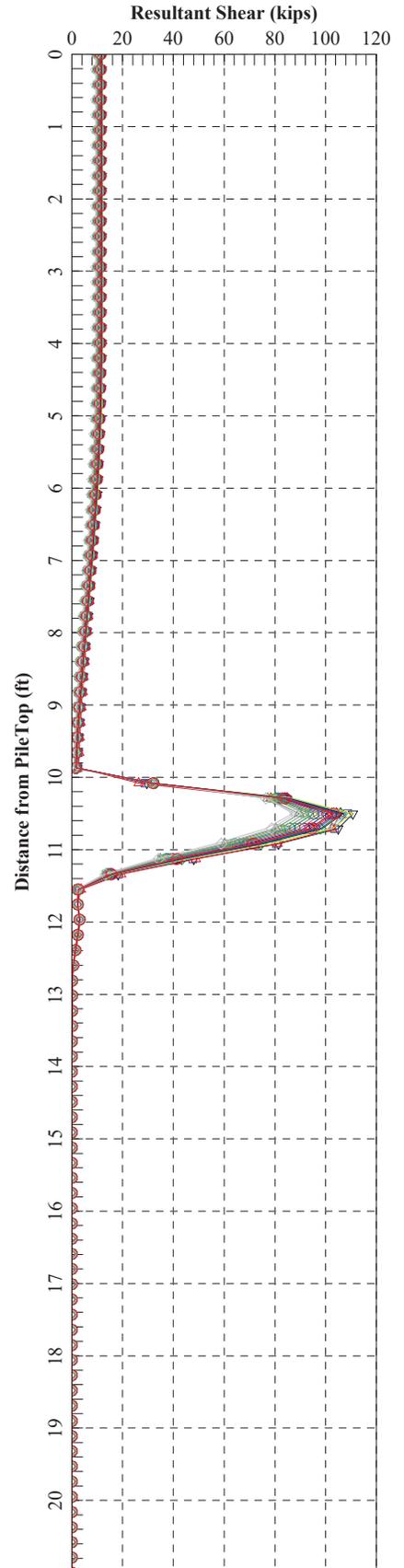
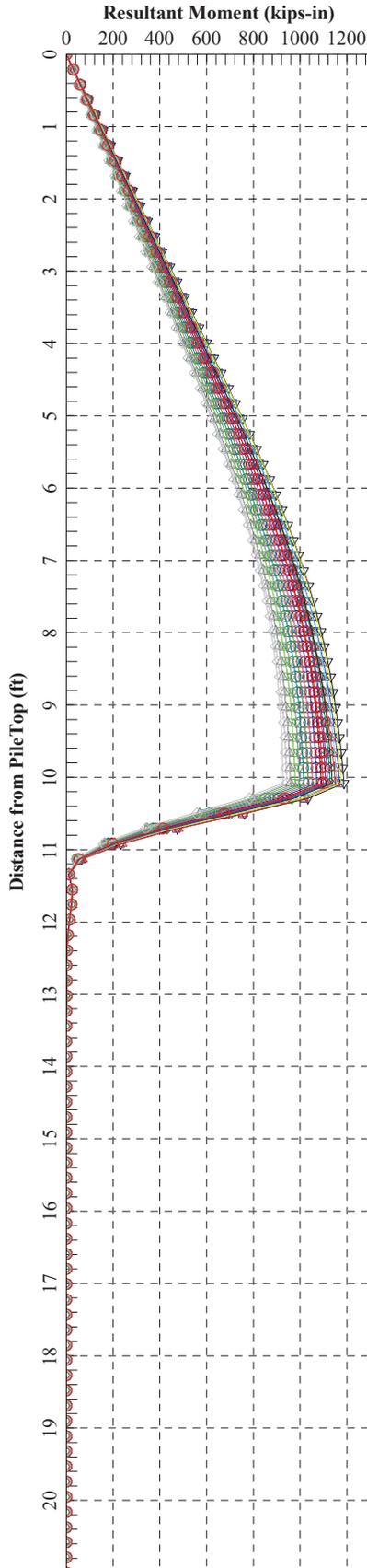
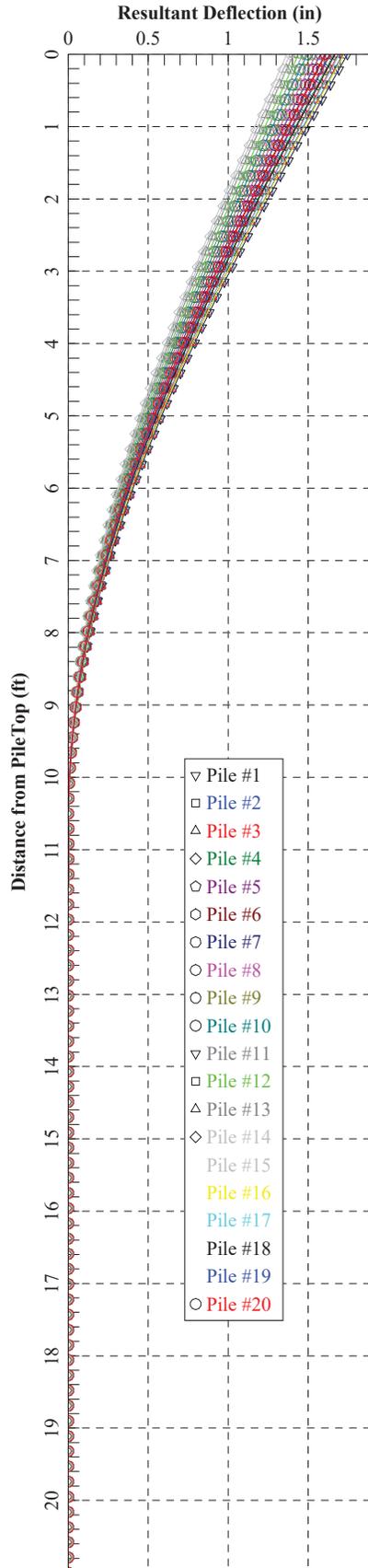
# 9.625-inch-diameter Pile Strength V Resultant



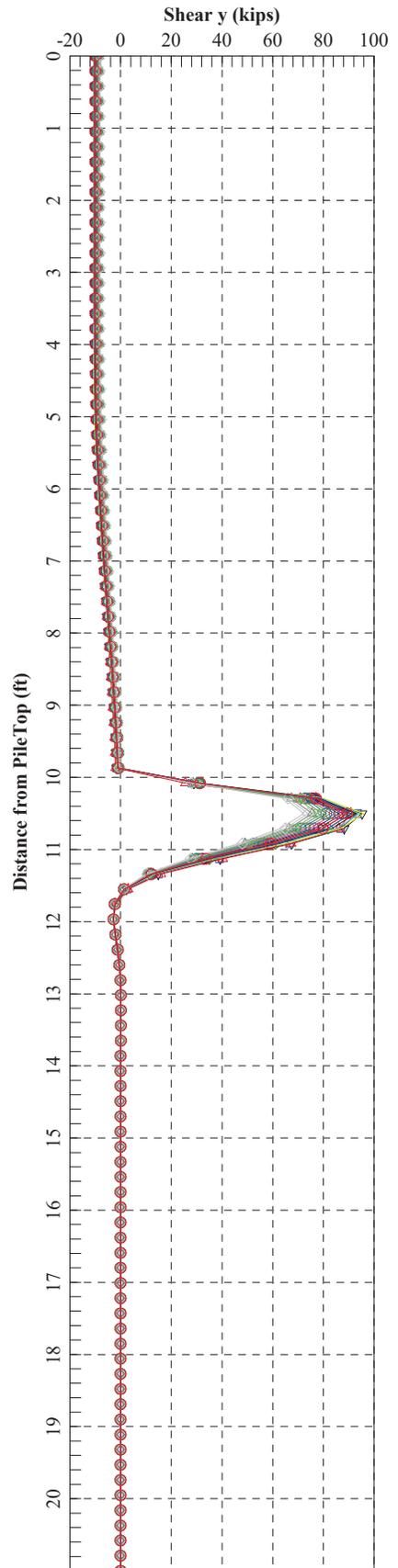
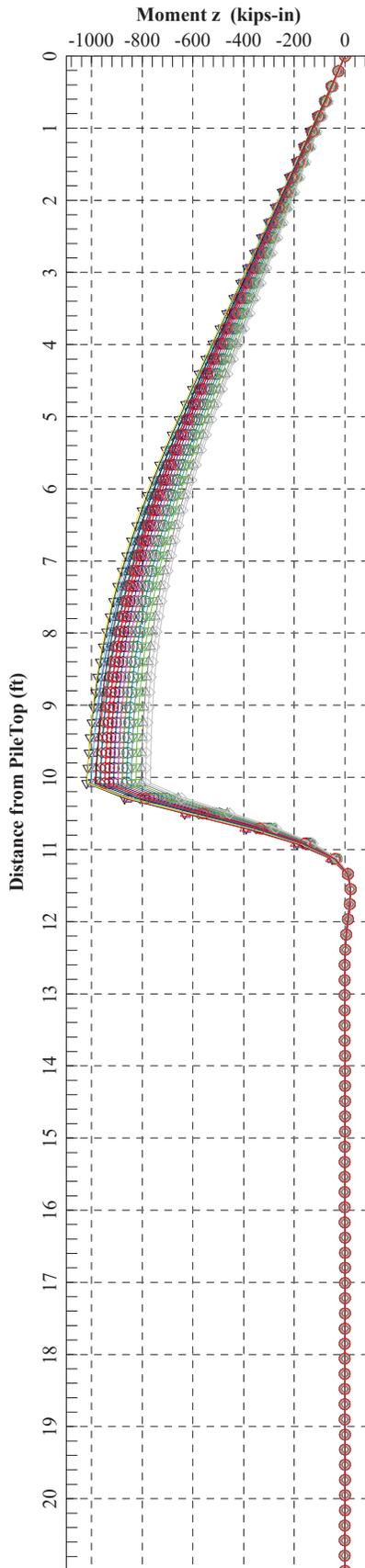
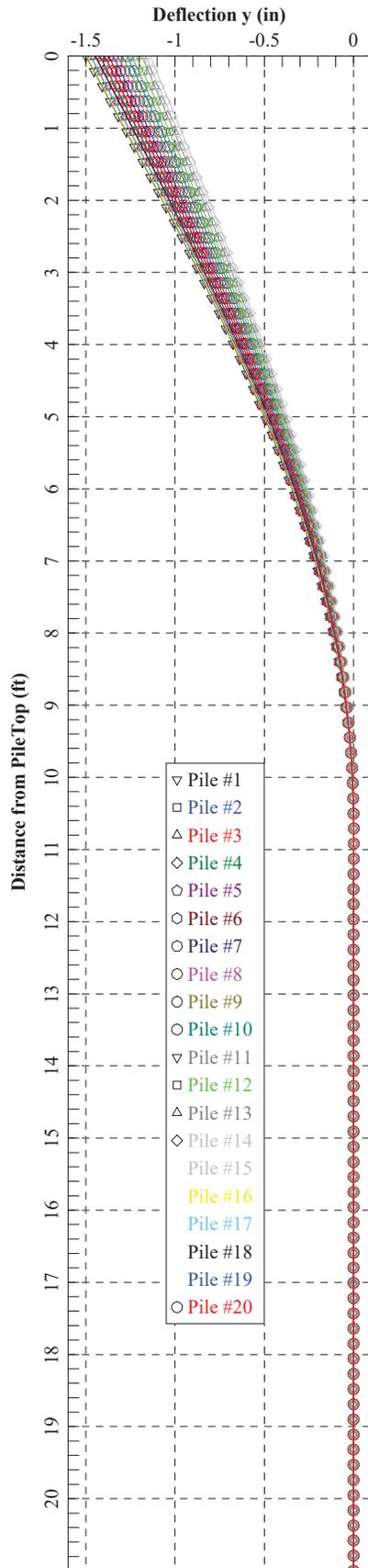
9.625-inch-diameter Pile  
Service I  
Longitudinal



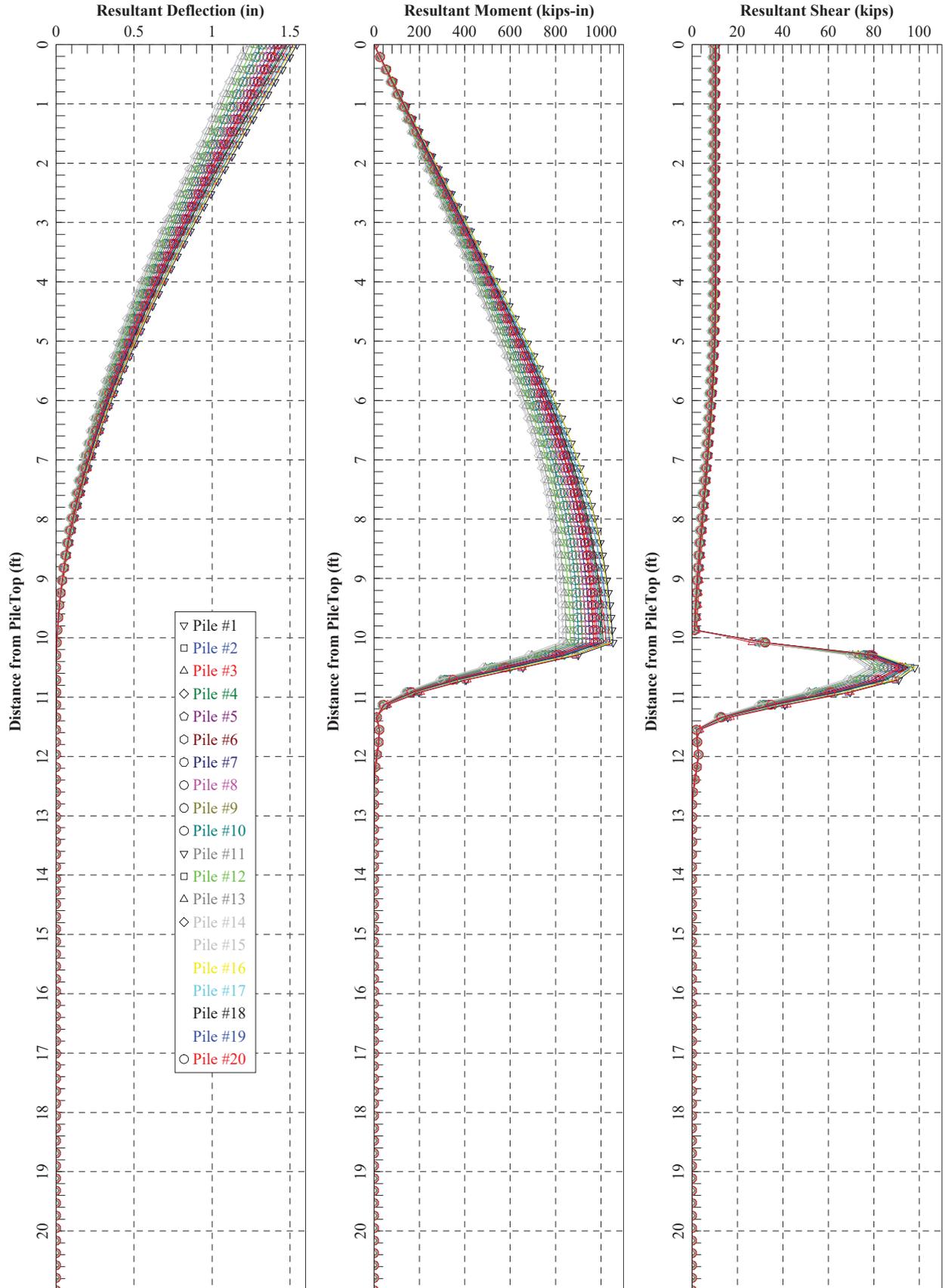
9.625-inch-diameter Pile  
Service I  
Resultant



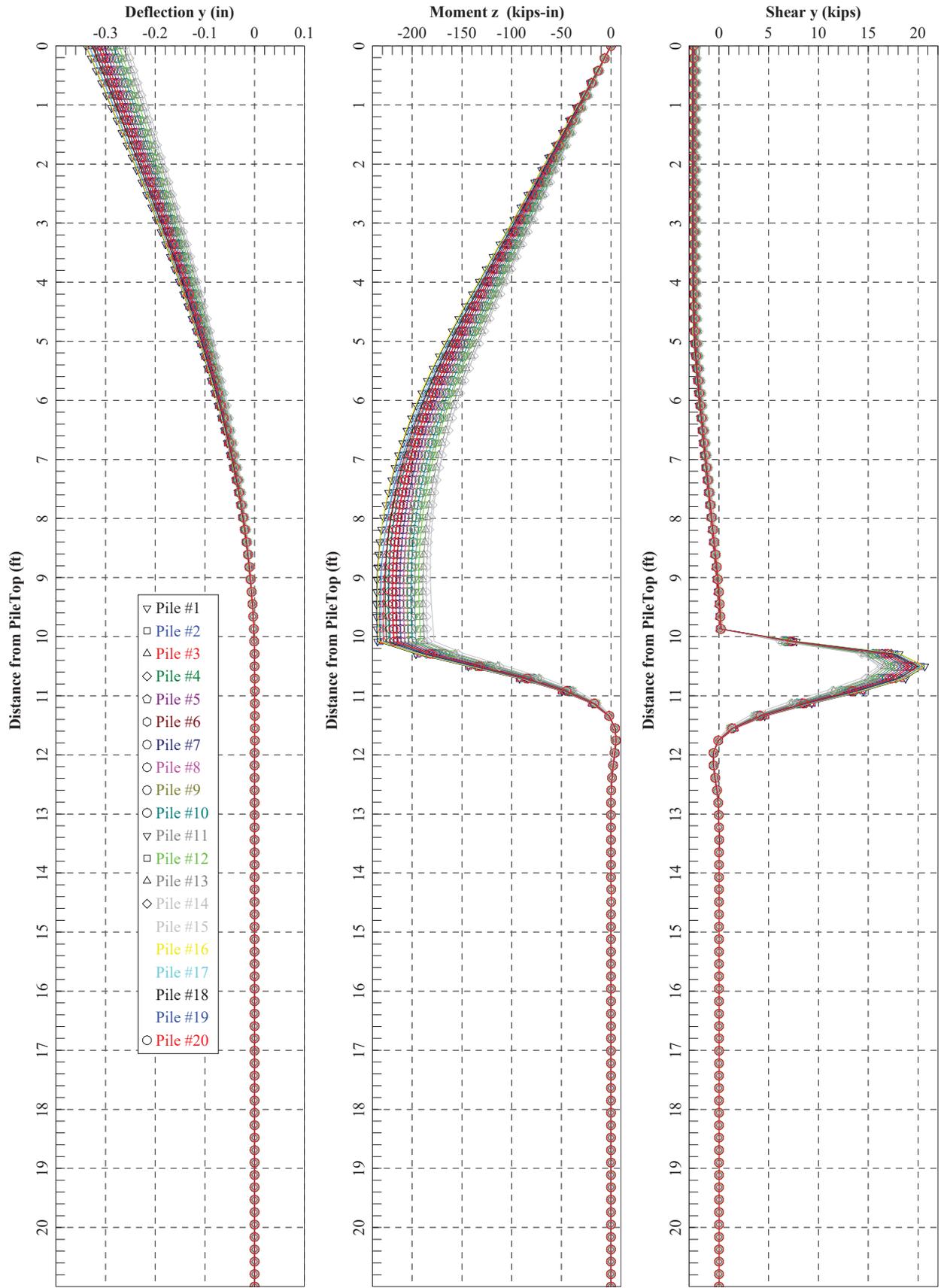
9.625-inch-diameter Pile  
Extreme I  
Longitudinal



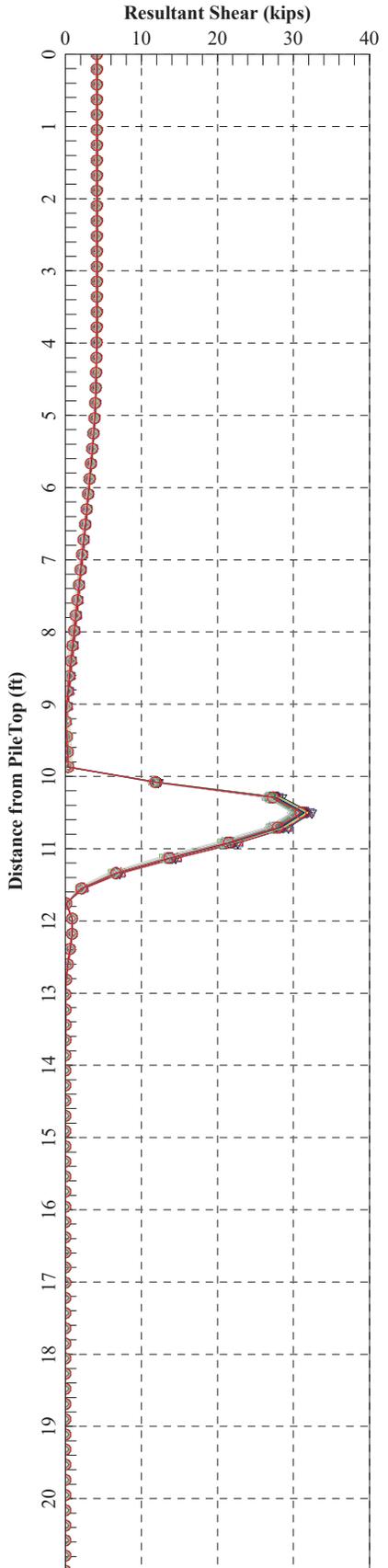
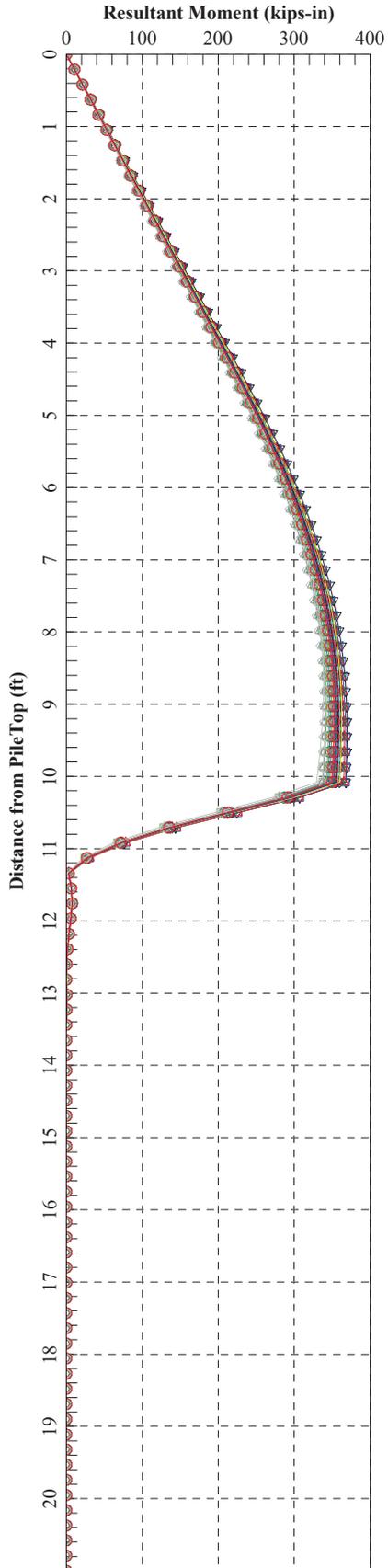
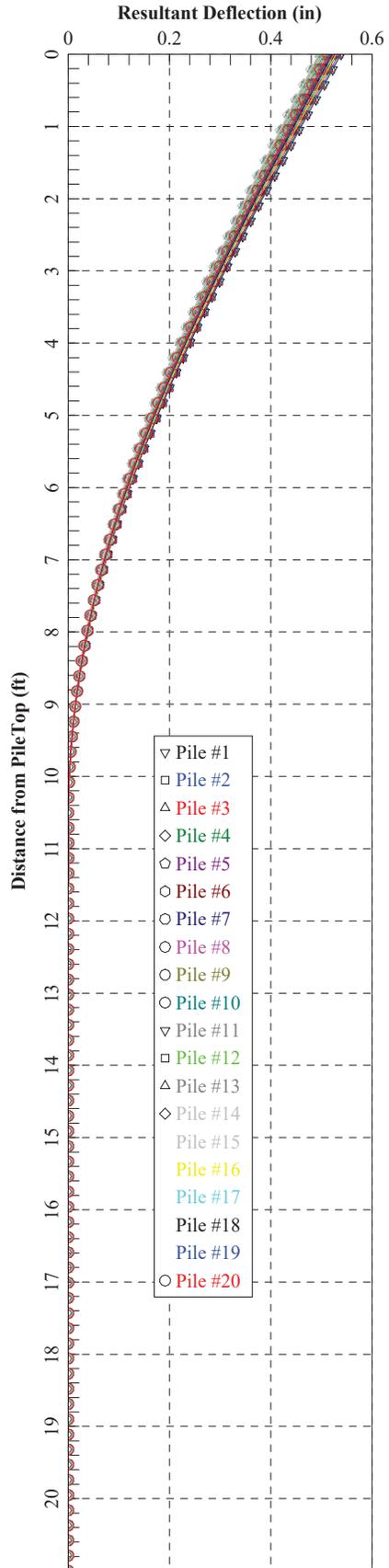
9.625-inch-diameter Pile  
Extreme I  
Resultant



9.625-inch-diameter Pile  
Extreme II  
Longitudinal

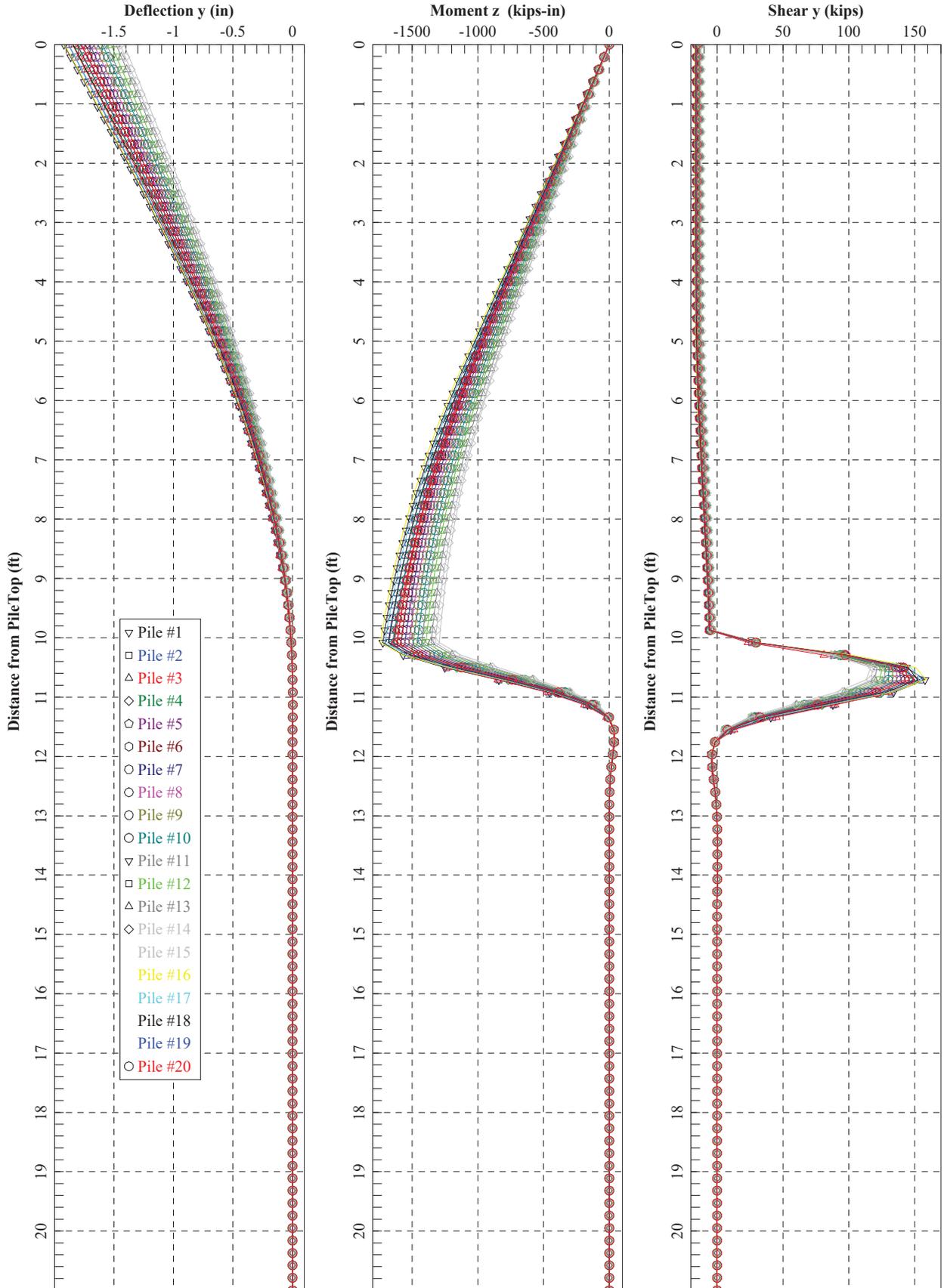


9.625-inch-diameter Pile  
Extreme II  
Resultant

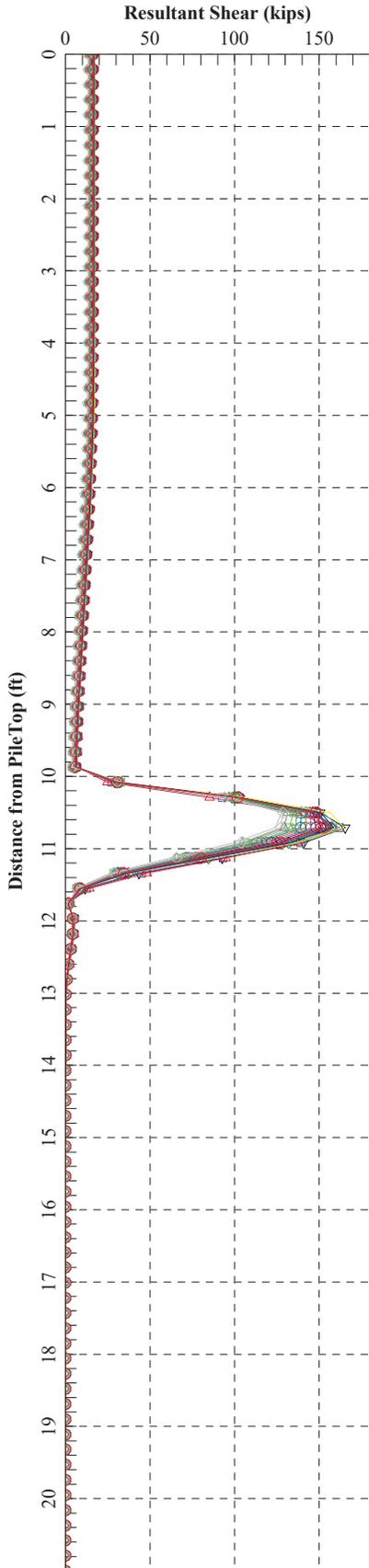
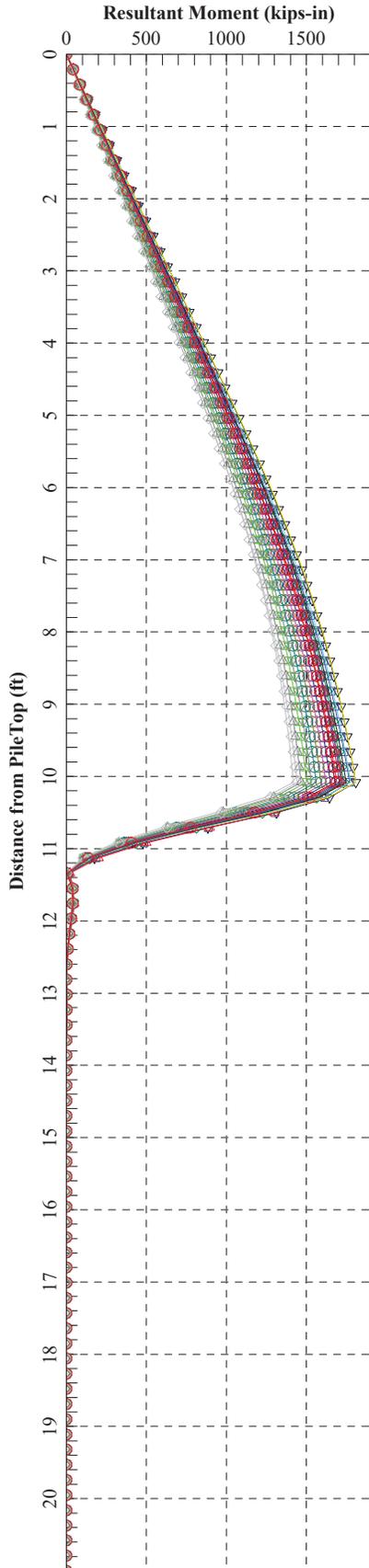
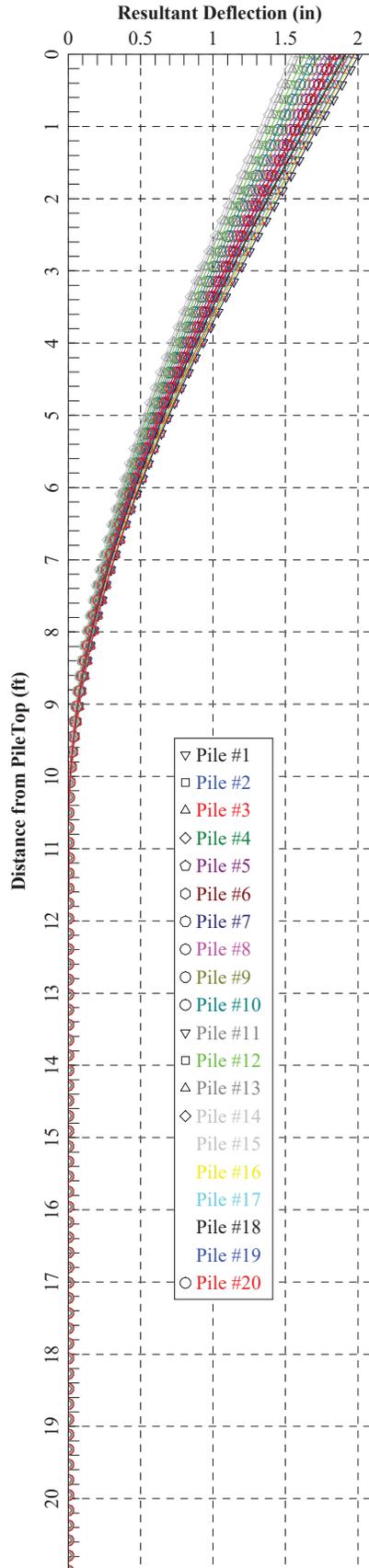


10.75-inch-diameter Pile  
GROUP Output Plots

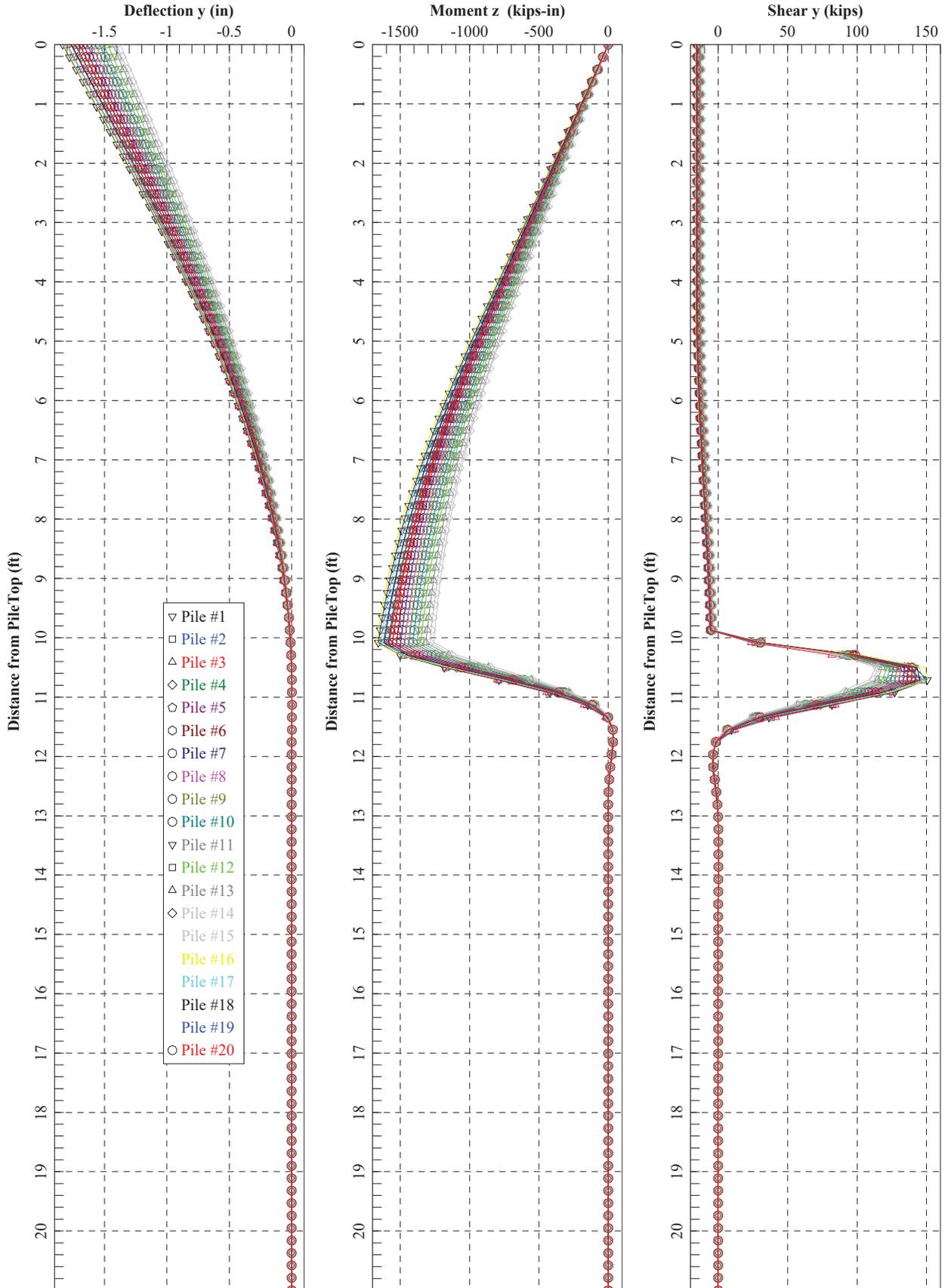
10.75-inch-diameter Pile  
Strength I  
Longitudinal



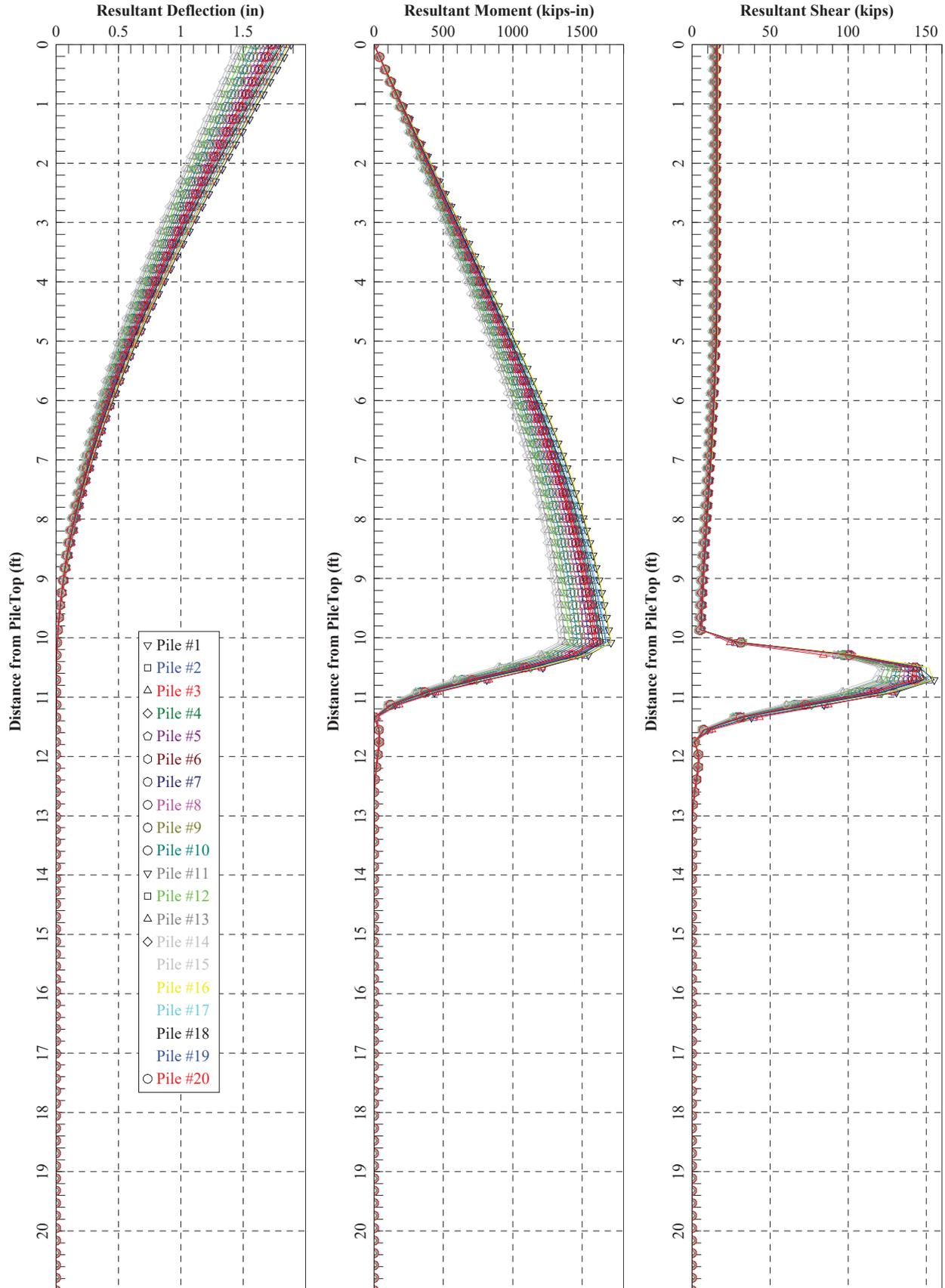
10.75-inch-diameter Pile  
Strength I  
Resultant



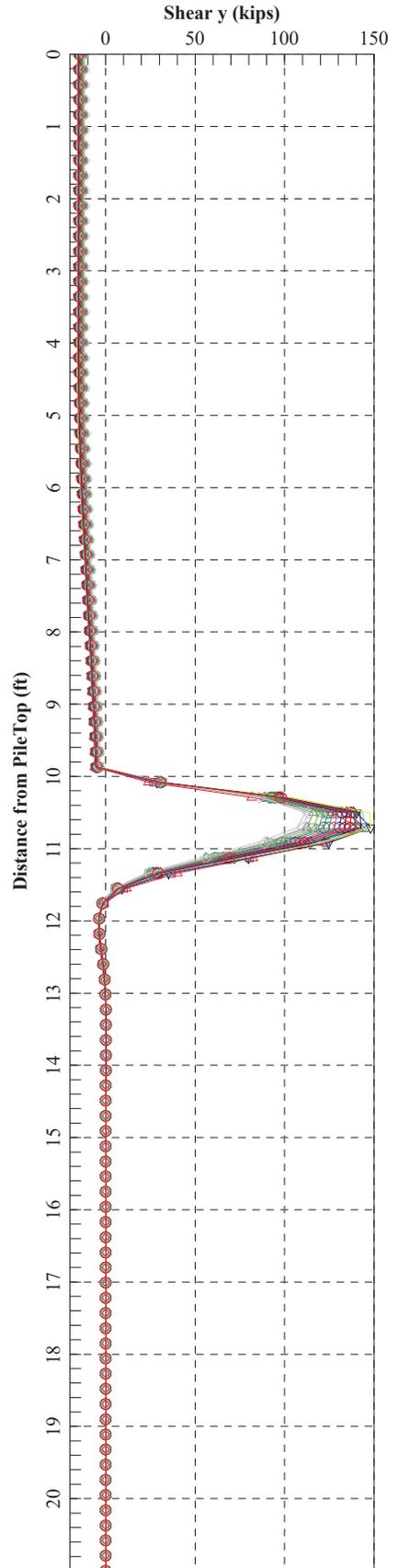
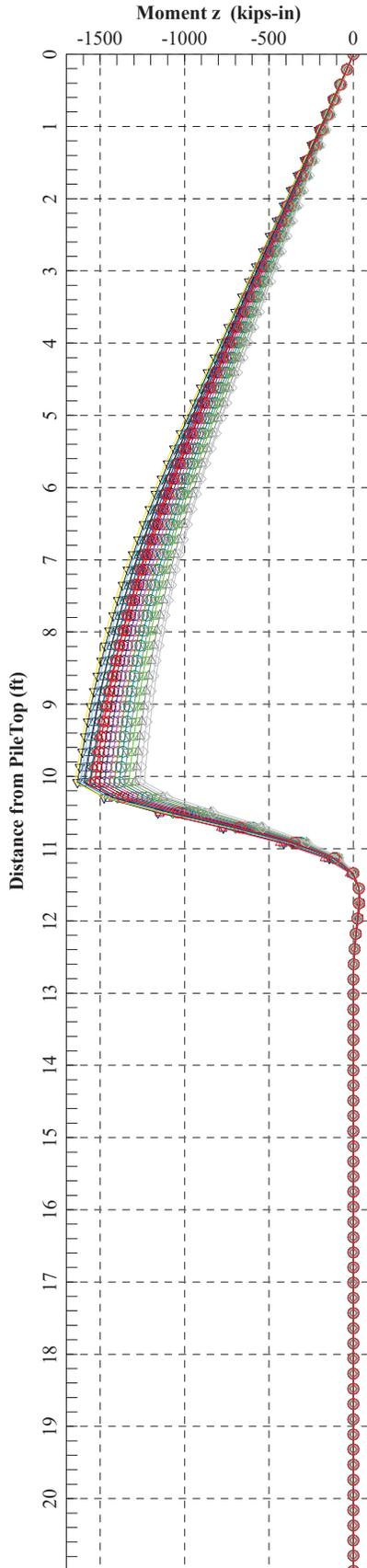
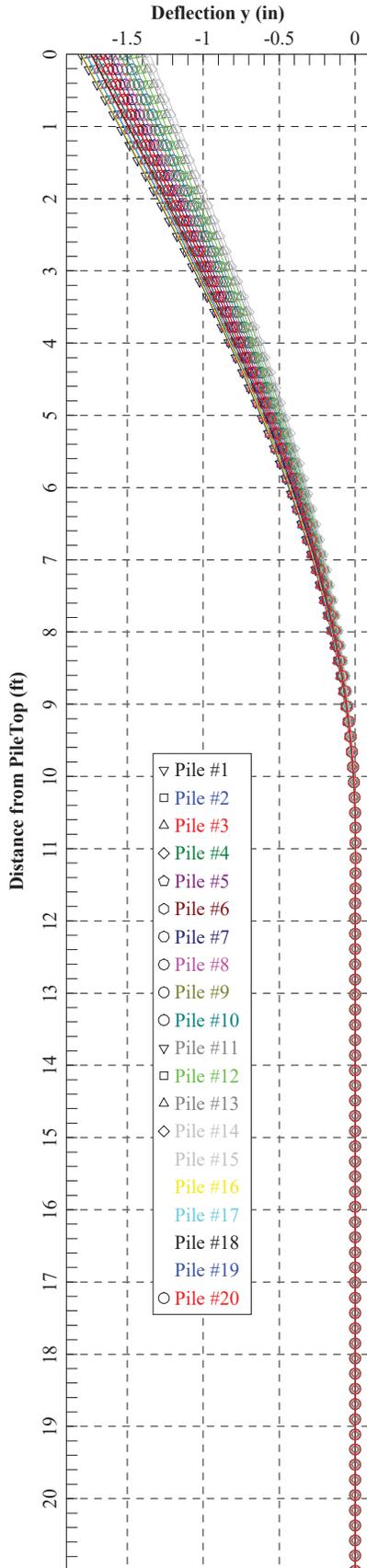
# 10.75-inch-diameter Pile Strength II Longitudinal



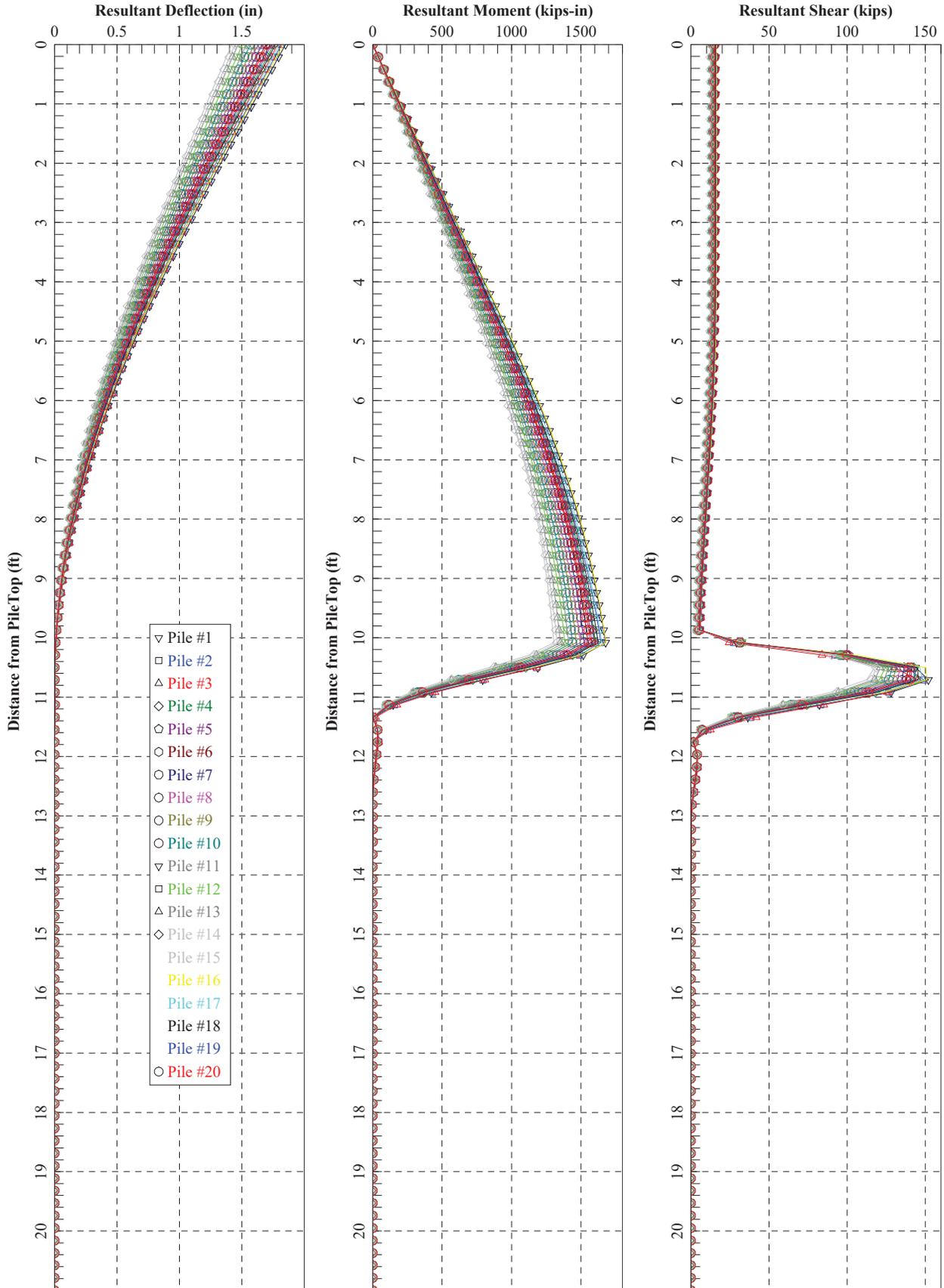
10.75-inch-diameter Pile  
Strength II  
Resultant



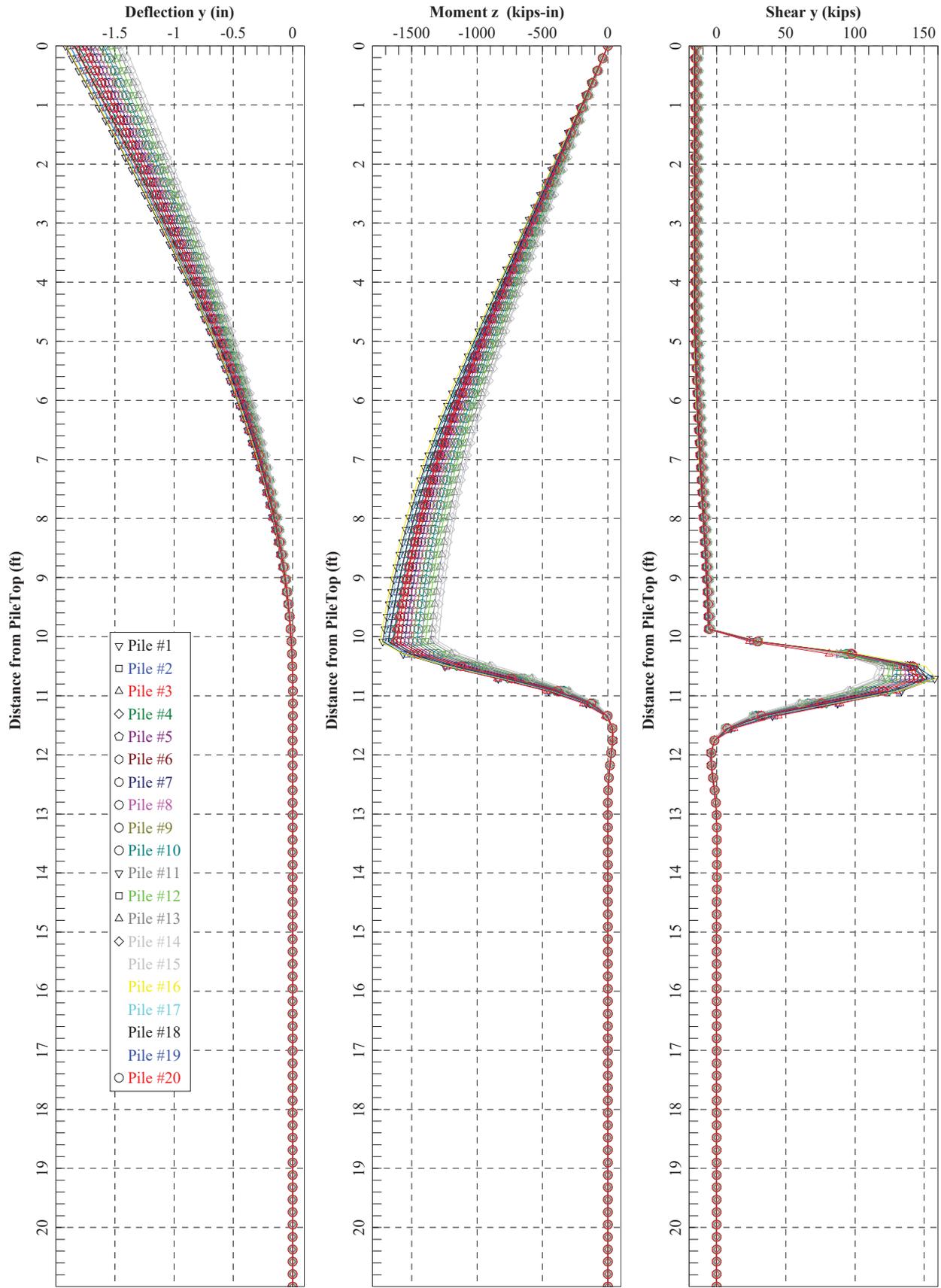
10.75-inch-diameter Pile  
Strength IV  
Longitudinal



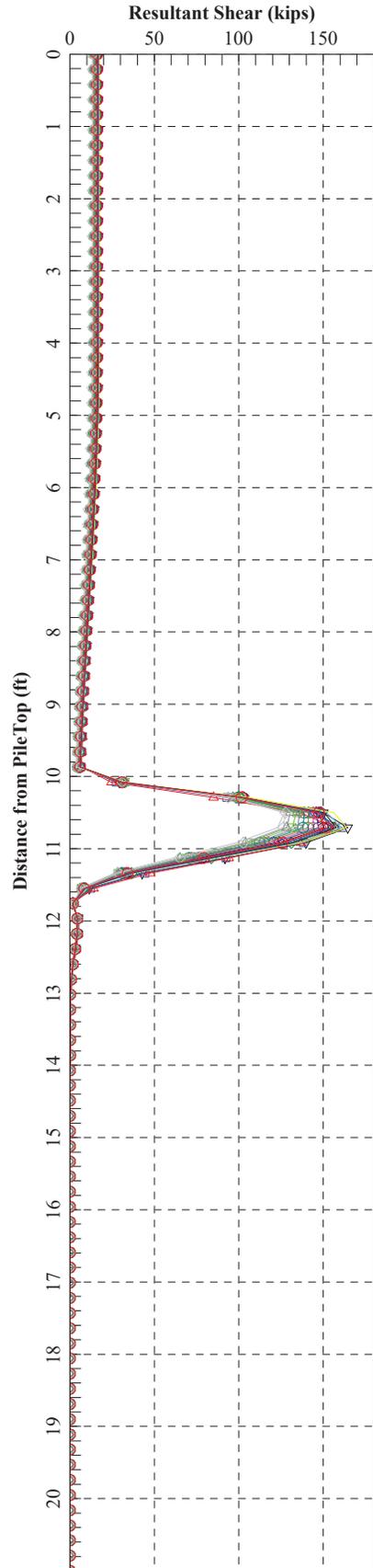
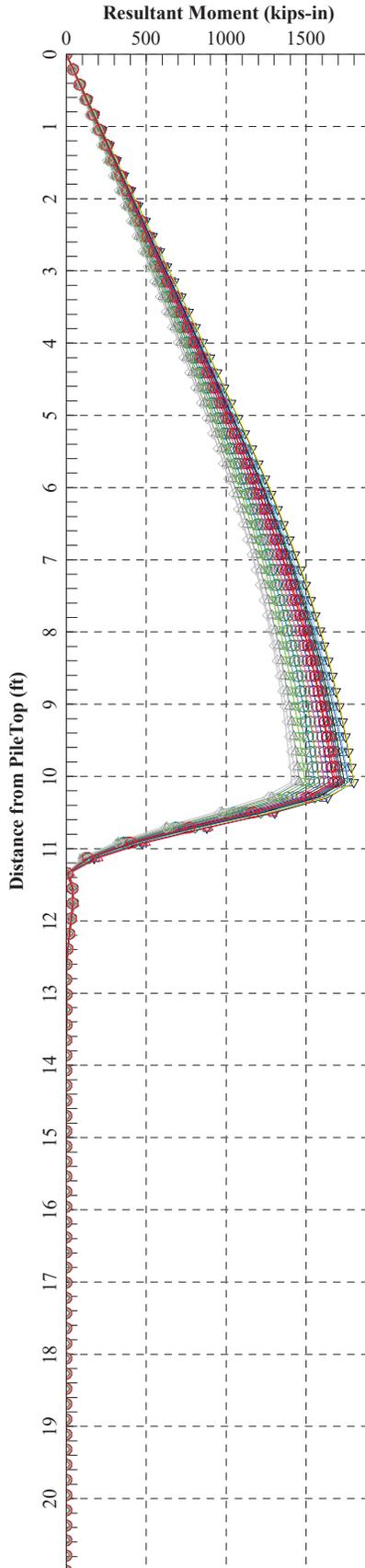
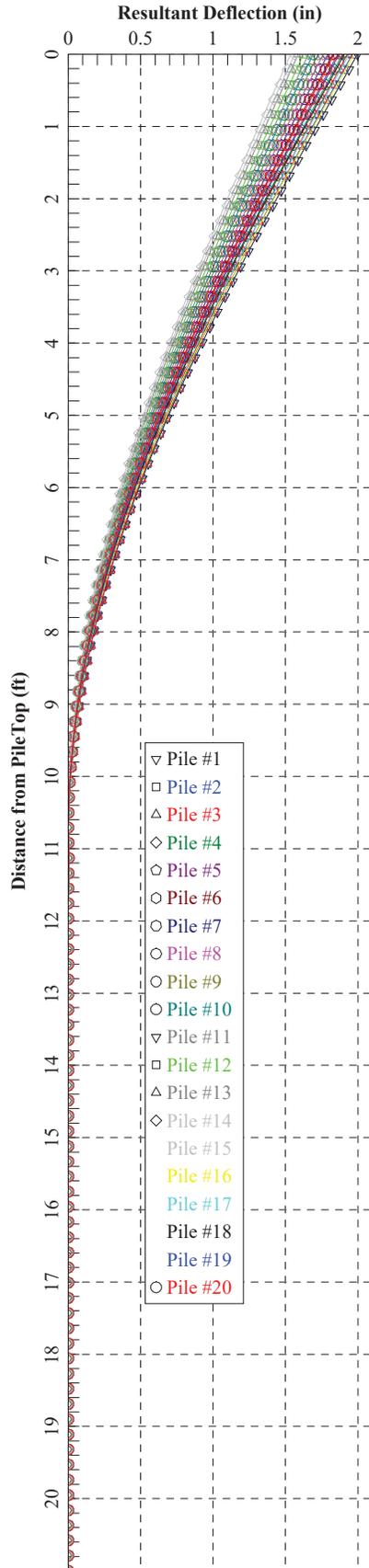
10.75-inch-diameter Pile  
Strength IV  
Resultant



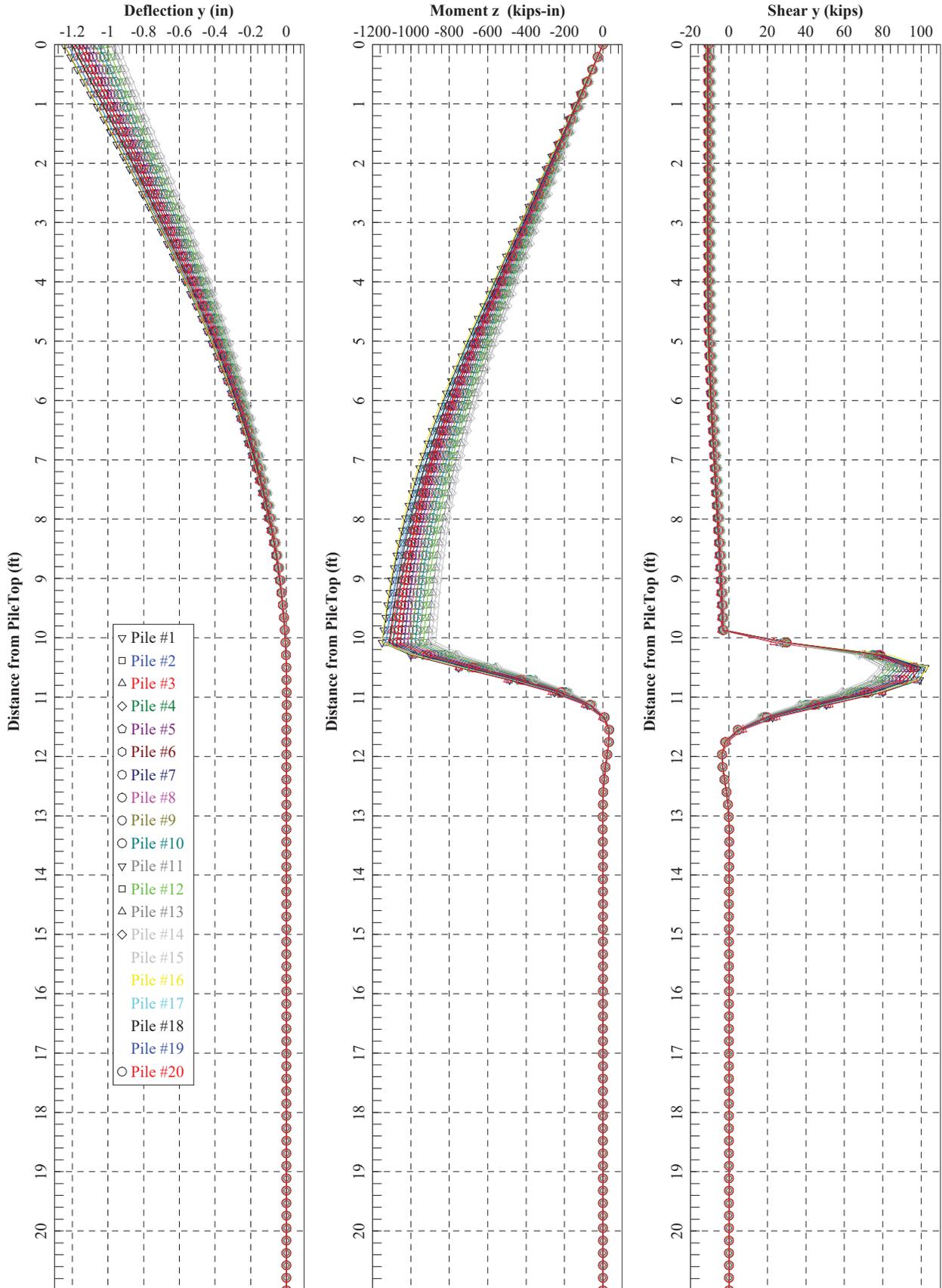
10.75-inch-diameter Pile  
Strength V  
Longitudinal



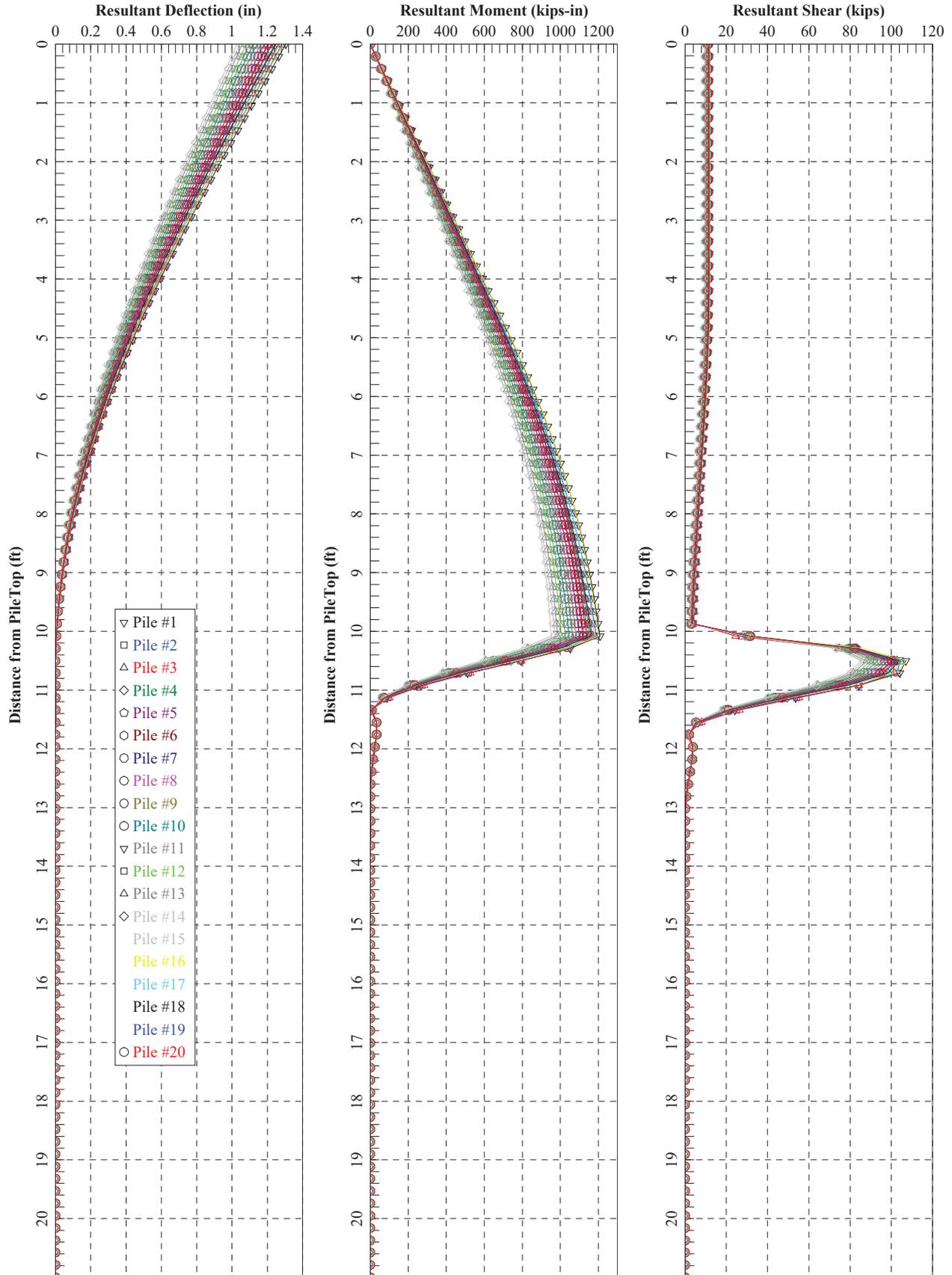
10.75-inch-diameter Pile  
Strength V  
Resultant



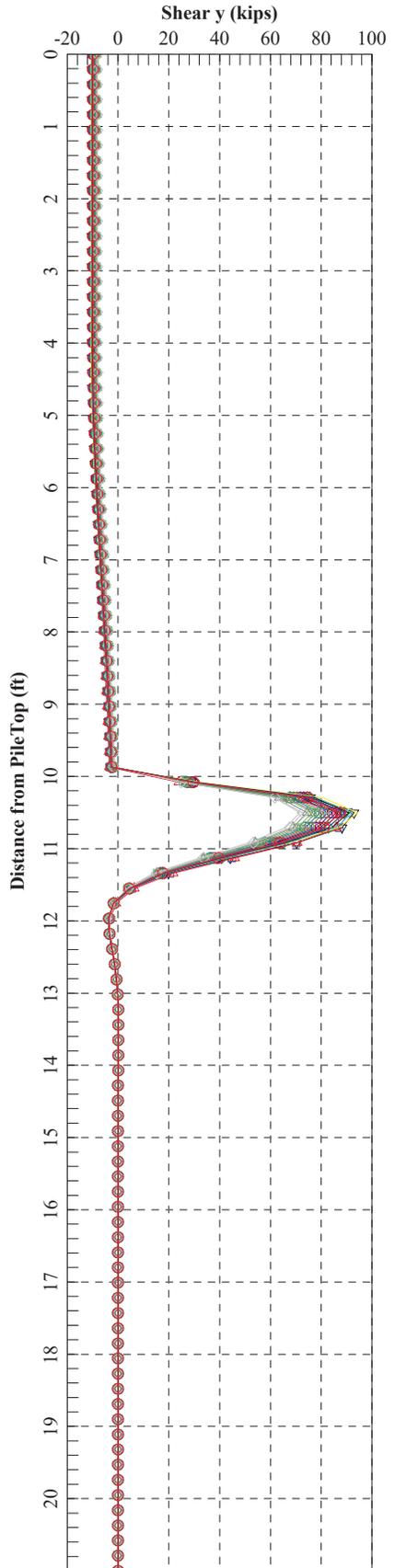
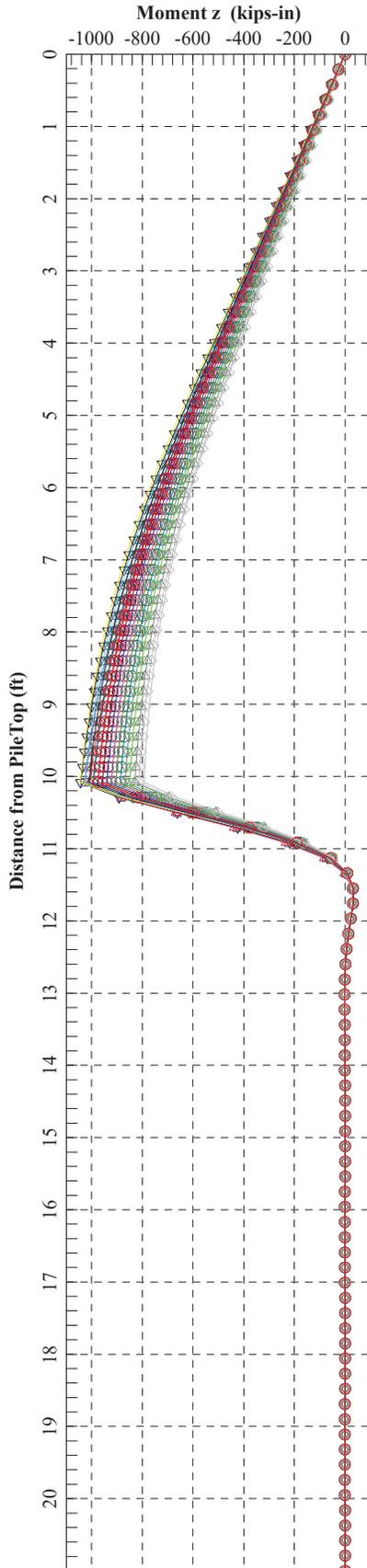
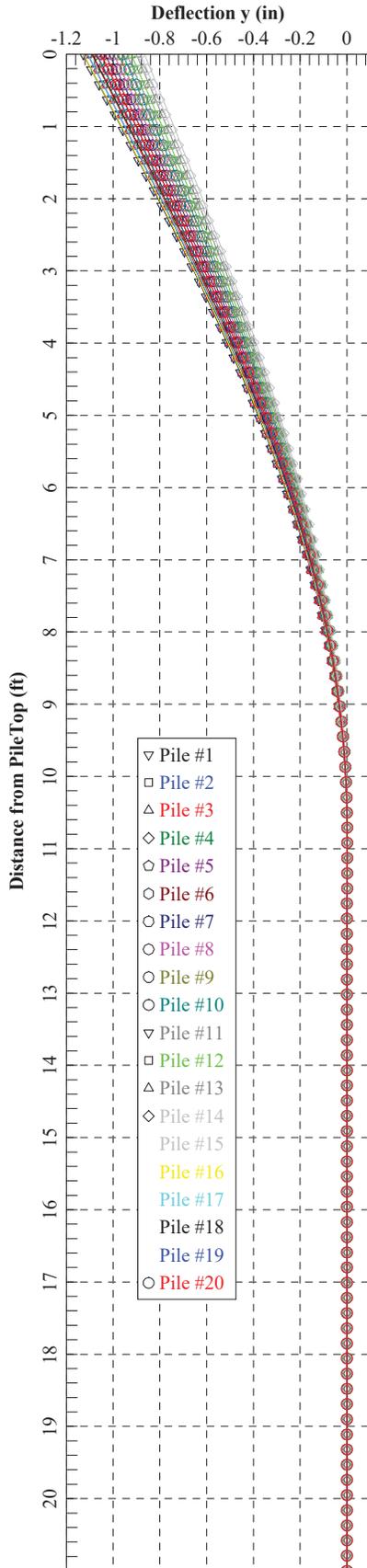
10.75-inch-diameter Pile  
Service I  
Longitudinal



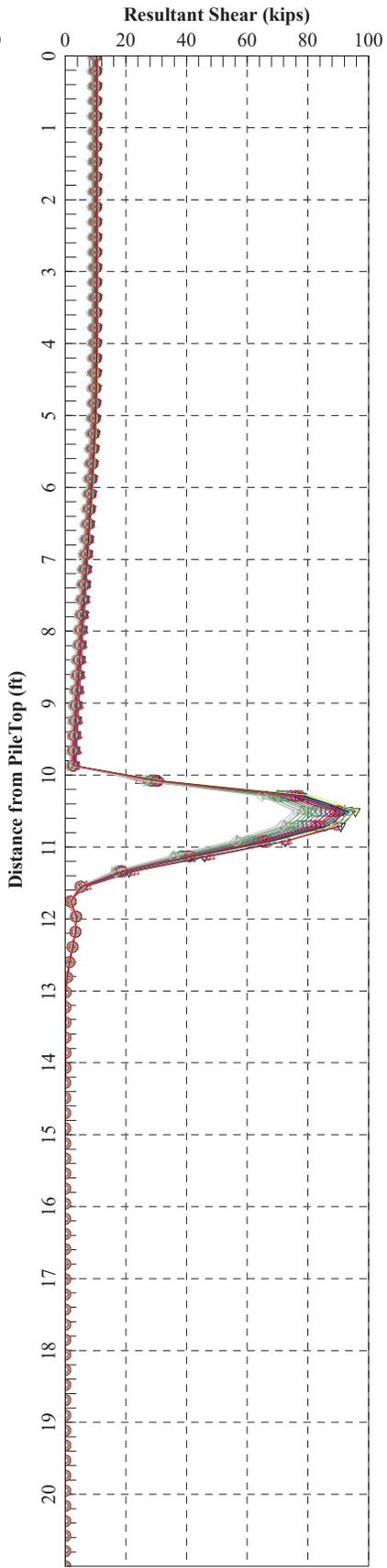
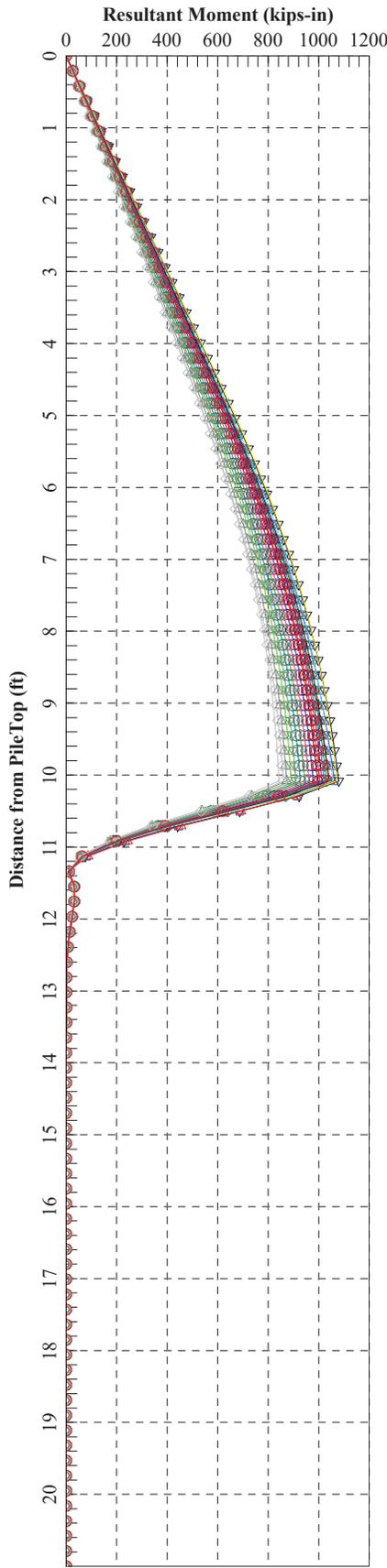
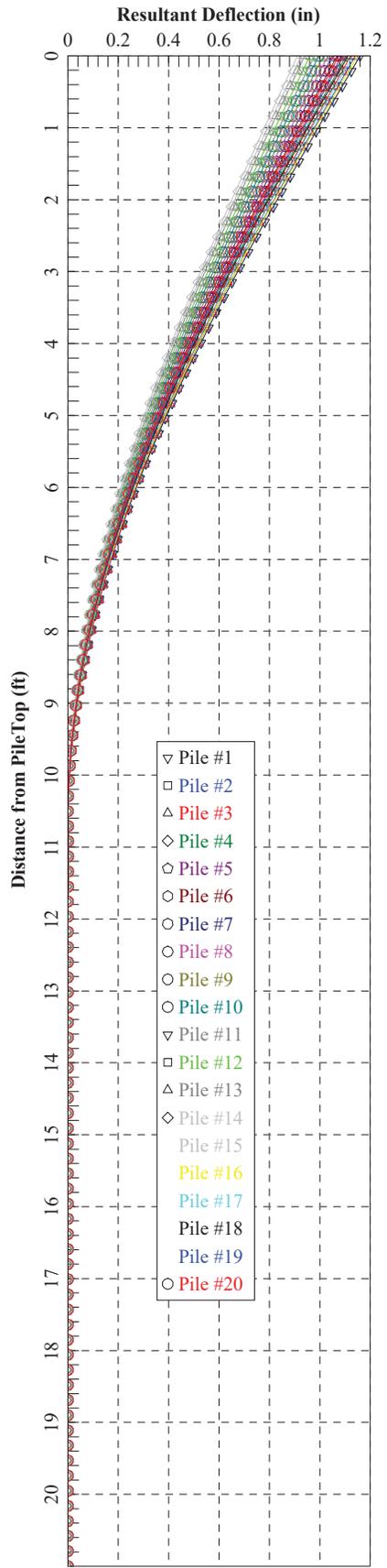
10.75-inch-diameter Pile  
Service I  
Resultant



10.75-inch-diameter Pile  
Extreme I  
Longitudinal

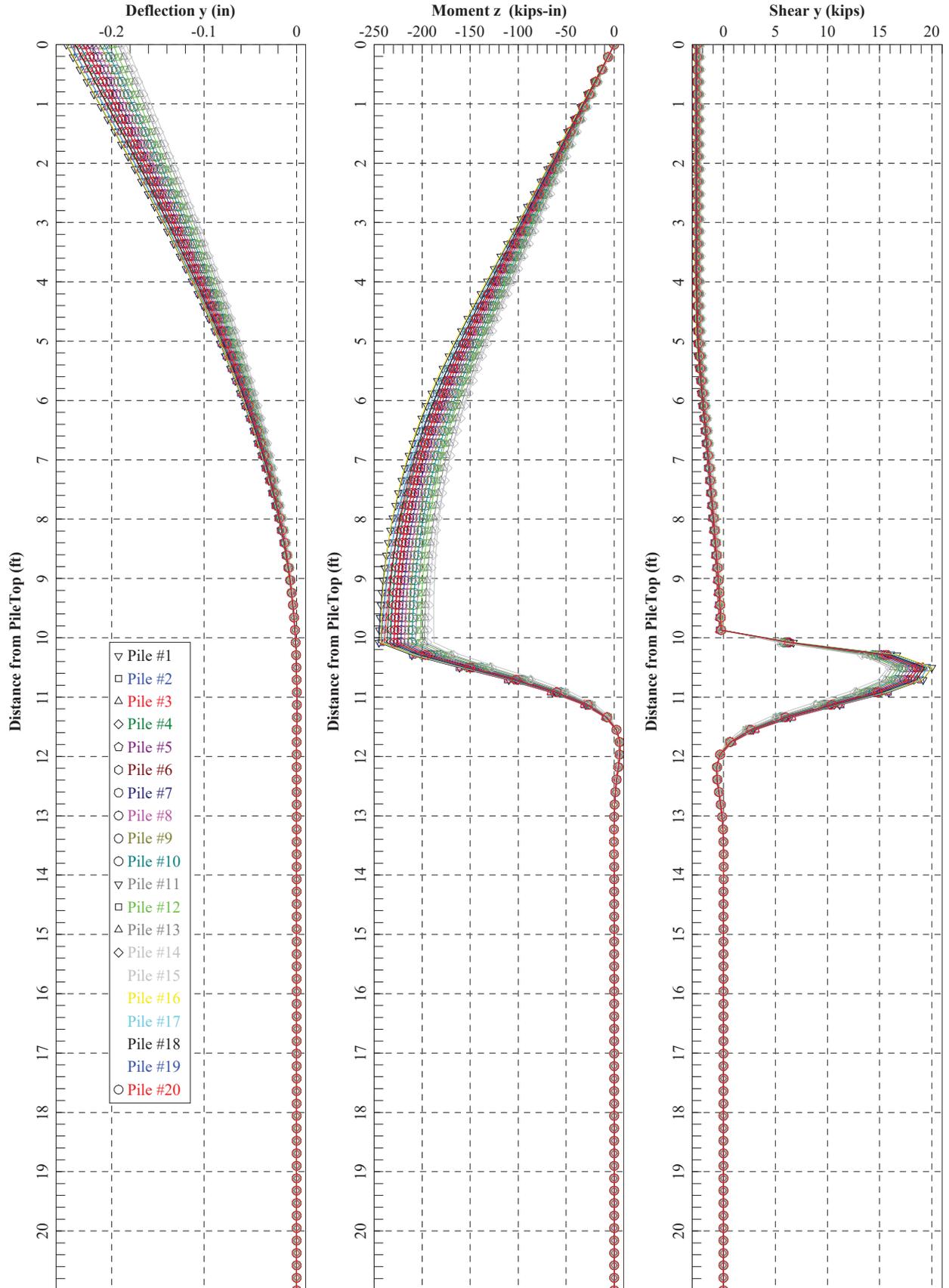


# 10.75-inch-diameter Pile Extreme I Resultant

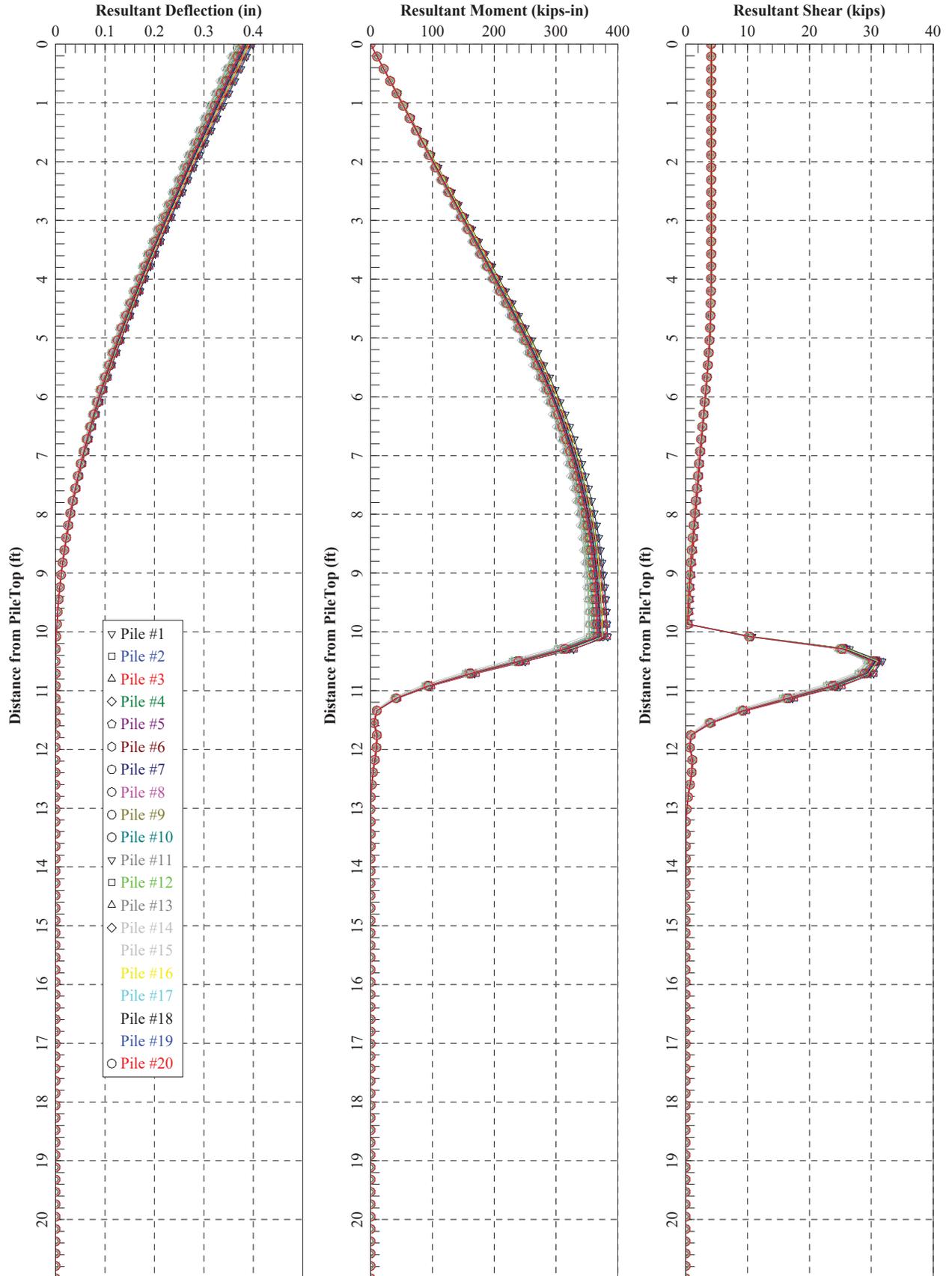


- ▽ Pile #1
- Pile #2
- △ Pile #3
- ◇ Pile #4
- Pile #5
- Pile #6
- Pile #7
- Pile #8
- Pile #9
- Pile #10
- ▽ Pile #11
- Pile #12
- △ Pile #13
- ◇ Pile #14
- Pile #15
- Pile #16
- Pile #17
- Pile #18
- Pile #19
- Pile #20

10.75-inch-diameter Pile  
Extreme II  
Longitudinal



10.75-inch-diameter Pile  
Extreme II  
Resultant



## **GROUP Output Files**

9.625-inch-diameter Pile  
GROUP Output File

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GROUP for Windows, Version 2016.10.13

Serial Number : 239146278

Analysis of A Group of Piles  
Subjected to Axial and Lateral Loading

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Time and Date of Analysis  
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Date: August 06, 2024      Time: 11:31:47

\*\*\*\*\*      COMPUTATION RESULTS      \*\*\*\*\*

Rosemont Street Bridge Micropiles

\*\*\*\*\*      LOAD CASES RESULTS      \*\*\*\*\*

LOAD CASE : 1  
CASE NAME : Strength I  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
 ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.9105	1.0000
2	0.8894	1.0000
3	0.8233	1.0000
4	0.9678	1.0000
5	0.9801	1.0000
6	0.9801	1.0000
7	0.9801	1.0000
8	0.9801	1.0000
9	0.9801	1.0000
10	0.9801	1.0000
11	0.9801	1.0000
12	0.9825	1.0000
13	0.9612	1.0000
14	0.9594	1.0000
15	0.9979	1.0000
16	0.9808	1.0000
17	0.9801	1.0000
18	0.9801	1.0000
19	0.9801	1.0000
20	0.9801	1.0000
21	0.9801	1.0000
22	0.9801	1.0000
23	0.9801	1.0000
24	0.9801	1.0000
25	0.9801	1.0000
26	0.9801	1.0000
27	0.9480	1.0000
28	0.9299	1.0000
29	0.9594	1.0000
30	0.9594	1.0000
31	0.9979	1.0000
32	0.9908	1.0000
33	0.8135	1.0000
34	0.8135	1.0000
35	0.8153	1.0000
36	0.9908	1.0000

37	0.8135	1.0000
38	0.8135	1.0000
39	0.8118	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1937.61	-568.160	-198.370
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	12803.9	52786.9

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
0.0130776	-2.32543	-0.79306
ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
1.42880E-03	-6.76118E-06	1.09309E-04

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

-----

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	0.012372	-2.6087	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
2	0.012615	-2.5573	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
3	0.012859	-2.5059	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
4	0.013102	-2.4544	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
5	0.013346	-2.4030	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04

6	0.013589	-2.3516	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
7	0.013832	-2.3001	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
8	0.014076	-2.2487	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
9	0.014319	-2.1973	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
10	0.014563	-2.1458	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
11	0.014806	-2.0944	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
12	0.015050	-2.0429	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
13	0.016237	-1.9802	-0.8130	1.4288E-03	-6.7612E-06	1.0931E-04
14	0.017888	-1.9323	-0.8316	1.4288E-03	-6.7612E-06	1.0931E-04
15	0.019538	-1.8843	-0.8502	1.4288E-03	-6.7612E-06	1.0931E-04
16	4.5309E-03	-2.6026	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
17	4.7743E-03	-2.5512	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
18	5.0177E-03	-2.4997	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
19	5.2611E-03	-2.4483	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
20	5.5045E-03	-2.3969	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
21	5.7479E-03	-2.3454	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
22	5.9913E-03	-2.2940	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
23	6.2347E-03	-2.2425	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
24	6.4781E-03	-2.1911	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
25	6.7215E-03	-2.1397	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
26	6.9649E-03	-2.0882	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
27	7.2083E-03	-2.0368	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
28	7.4522E-03	-1.9910	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
29	9.0758E-03	-1.9430	-0.7171	1.4288E-03	-6.7612E-06	1.0931E-04
30	0.010727	-1.8951	-0.7357	1.4288E-03	-6.7612E-06	1.0931E-04
31	0.012377	-1.8471	-0.7543	1.4288E-03	-6.7612E-06	1.0931E-04
32	0.028413	-2.5313	-1.0062	1.4288E-03	-6.7612E-06	1.0931E-04
33	0.024500	-2.5282	-0.9549	1.4288E-03	-6.7612E-06	1.0931E-04
34	0.020586	-2.5252	-0.9036	1.4288E-03	-6.7612E-06	1.0931E-04
35	0.016672	-2.5221	-0.8522	1.4288E-03	-6.7612E-06	1.0931E-04
36	0.027219	-2.6597	-0.9986	1.4288E-03	-6.7612E-06	1.0931E-04
37	0.023306	-2.6566	-0.9472	1.4288E-03	-6.7612E-06	1.0931E-04
38	0.019392	-2.6535	-0.8959	1.4288E-03	-6.7612E-06	1.0931E-04
39	0.015478	-2.6505	-0.8446	1.4288E-03	-6.7612E-06	1.0931E-04
MINIMUM	4.5309E-03	-2.6597	-1.0062	1.4288E-03	-6.7612E-06	1.0931E-04
Pile N.	16	36	32	1	1	1
MAXIMUM	0.028413	-1.8471	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	47.583	-16.112	-5.0756	0.0000	0.0000	0.0000
2	48.519	-15.757	-5.0575	0.0000	0.0000	0.0000
3	49.455	-15.206	-4.9792	0.0000	0.0000	0.0000
4	50.391	-15.475	-5.1624	0.0000	0.0000	0.0000
5	51.328	-15.229	-5.1856	0.0000	0.0000	0.0000
6	52.264	-14.937	-5.1945	0.0000	0.0000	0.0000
7	53.200	-14.644	-5.2039	0.0000	0.0000	0.0000
8	54.136	-14.351	-5.2138	0.0000	0.0000	0.0000
9	55.072	-14.056	-5.2238	0.0000	0.0000	0.0000
10	56.008	-13.758	-5.2331	0.0000	0.0000	0.0000
11	56.944	-13.459	-5.2425	0.0000	0.0000	0.0000
12	57.880	-13.167	-5.2551	0.0000	0.0000	0.0000
13	62.446	-12.676	-5.2909	0.0000	0.0000	0.0000
14	68.795	-12.283	-5.3697	0.0000	0.0000	0.0000
15	75.144	-11.976	-5.4838	0.0000	0.0000	0.0000
16	17.426	-17.084	-4.7135	0.0000	0.0000	0.0000
17	18.362	-16.792	-4.7198	0.0000	0.0000	0.0000
18	19.298	-16.498	-4.7273	0.0000	0.0000	0.0000
19	20.234	-16.199	-4.7351	0.0000	0.0000	0.0000
20	21.170	-15.896	-4.7432	0.0000	0.0000	0.0000
21	22.106	-15.591	-4.7516	0.0000	0.0000	0.0000
22	23.043	-15.285	-4.7605	0.0000	0.0000	0.0000
23	23.979	-14.979	-4.7700	0.0000	0.0000	0.0000
24	24.915	-14.669	-4.7789	0.0000	0.0000	0.0000
25	25.851	-14.357	-4.7874	0.0000	0.0000	0.0000
26	26.787	-14.045	-4.7964	0.0000	0.0000	0.0000
27	27.723	-13.641	-4.7742	0.0000	0.0000	1.7904E-10
28	28.557	-13.312	-4.7645	0.0000	0.0000	1.7904E-10
29	34.906	-12.992	-4.8862	0.0000	0.0000	1.7904E-10
30	41.255	-12.588	-4.9746	0.0000	0.0000	0.0000
31	47.604	-12.272	-5.0960	0.0000	0.0000	0.0000
32	109.28	-14.506	-5.8793	0.0000	0.0000	0.0000
33	94.225	-14.188	-5.4730	0.0000	0.0000	0.0000
34	79.173	-14.538	-5.3174	0.0000	0.0000	0.0000
35	64.121	-14.895	-5.1498	0.0000	0.0000	0.0000
36	104.69	-15.191	-5.8378	0.0000	0.0000	0.0000
37	89.634	-14.821	-5.4163	0.0000	0.0000	0.0000
38	74.582	-15.189	-5.2599	0.0000	0.0000	0.0000

39	59.530	-15.545	-5.0858	0.0000	0.0000	0.0000	0.0000
MINIMUM	17.426	-17.084	-5.8793	0.0000	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1	1
MAXIMUM	109.28	-11.976	-4.7135	0.0000	0.0000	1.7904E-10	1.7904E-10
Pile N.	32	15	16	1	1	27	27

THE PILE COORDINATE SYSTEM (LOCAL AXES)

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 \* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
*****	*****	*****	*****	*****	*****	*****
1	0.012372	-2.6087	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
2	0.012615	-2.5573	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
3	0.012859	-2.5059	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
4	0.013102	-2.4544	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
5	0.013346	-2.4030	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
6	0.013589	-2.3516	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
7	0.013832	-2.3001	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
8	0.014076	-2.2487	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
9	0.014319	-2.1973	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
10	0.014563	-2.1458	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
11	0.014806	-2.0944	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
12	0.015050	-2.0429	-0.8014	1.4288E-03	-6.7612E-06	1.0931E-04
13	0.016237	-1.9802	-0.8130	1.4288E-03	-6.7612E-06	1.0931E-04
14	0.017888	-1.9323	-0.8316	1.4288E-03	-6.7612E-06	1.0931E-04
15	0.019538	-1.8843	-0.8502	1.4288E-03	-6.7612E-06	1.0931E-04
16	4.5309E-03	-2.6026	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
17	4.7743E-03	-2.5512	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
18	5.0177E-03	-2.4997	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
19	5.2611E-03	-2.4483	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
20	5.5045E-03	-2.3969	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
21	5.7479E-03	-2.3454	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
22	5.9913E-03	-2.2940	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
23	6.2347E-03	-2.2425	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
24	6.4781E-03	-2.1911	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
25	6.7215E-03	-2.1397	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
26	6.9649E-03	-2.0882	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04

27	7.2083E-03	-2.0368	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
28	7.4252E-03	-1.9910	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
29	9.0758E-03	-1.9430	-0.7171	1.4288E-03	-6.7612E-06	1.0931E-04
30	0.010727	-1.8951	-0.7357	1.4288E-03	-6.7612E-06	1.0931E-04
31	0.012377	-1.8471	-0.7543	1.4288E-03	-6.7612E-06	1.0931E-04
32	0.028413	-2.5313	-1.0062	1.4288E-03	-6.7612E-06	1.0931E-04
33	0.024500	-2.5282	-0.9549	1.4288E-03	-6.7612E-06	1.0931E-04
34	0.020586	-2.5252	-0.9036	1.4288E-03	-6.7612E-06	1.0931E-04
35	0.016672	-2.5221	-0.8522	1.4288E-03	-6.7612E-06	1.0931E-04
36	0.027219	-2.6597	-0.9986	1.4288E-03	-6.7612E-06	1.0931E-04
37	0.023306	-2.6566	-0.9472	1.4288E-03	-6.7612E-06	1.0931E-04
38	0.019392	-2.6535	-0.8959	1.4288E-03	-6.7612E-06	1.0931E-04
39	0.015478	-2.6505	-0.8446	1.4288E-03	-6.7612E-06	1.0931E-04
MINIMUM	4.5309E-03	-2.6597	-1.0062	1.4288E-03	-6.7612E-06	1.0931E-04
Pile N.	16	36	32	1	1	1
MAXIMUM	0.028413	-1.8471	-0.6985	1.4288E-03	-6.7612E-06	1.0931E-04
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL,KIP	LAT. Y,KIP	LAT. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	47.583	-16.112	-5.0756	0.0000	0.0000	0.0000
2	48.519	-15.757	-5.0575	0.0000	0.0000	0.0000
3	49.455	-15.206	-4.9792	0.0000	0.0000	0.0000
4	50.391	-15.475	-5.1624	0.0000	0.0000	0.0000
5	51.328	-15.229	-5.1856	0.0000	0.0000	0.0000
6	52.264	-14.937	-5.1945	0.0000	0.0000	0.0000
7	53.200	-14.644	-5.2039	0.0000	0.0000	0.0000
8	54.136	-14.351	-5.2138	0.0000	0.0000	0.0000
9	55.072	-14.056	-5.2238	0.0000	0.0000	0.0000
10	56.008	-13.758	-5.2331	0.0000	0.0000	0.0000
11	56.944	-13.459	-5.2425	0.0000	0.0000	0.0000
12	57.880	-13.167	-5.2511	0.0000	0.0000	0.0000
13	62.446	-12.676	-5.2909	0.0000	0.0000	0.0000
14	68.795	-12.283	-5.3697	0.0000	0.0000	0.0000
15	75.144	-11.976	-5.4838	0.0000	0.0000	0.0000
16	17.426	-17.084	-4.7135	0.0000	0.0000	0.0000
17	18.362	-16.792	-4.7198	0.0000	0.0000	0.0000
18	19.298	-16.498	-4.7273	0.0000	0.0000	0.0000

19	20.234	-16.199	-4.7351	0.0000	0.0000	0.0000	0.0000
20	21.170	-15.896	-4.7432	0.0000	0.0000	0.0000	0.0000
21	22.106	-15.591	-4.7516	0.0000	0.0000	0.0000	0.0000
22	23.043	-15.285	-4.7605	0.0000	0.0000	0.0000	0.0000
23	23.979	-14.979	-4.7700	0.0000	0.0000	0.0000	0.0000
24	24.915	-14.669	-4.7789	0.0000	0.0000	0.0000	0.0000
25	25.851	-14.357	-4.7874	0.0000	0.0000	0.0000	0.0000
26	26.787	-14.045	-4.7964	0.0000	0.0000	0.0000	0.0000
27	27.723	-13.641	-4.7742	0.0000	0.0000	1.7904E-10	0.0000
28	28.557	-13.312	-4.7645	0.0000	0.0000	1.7904E-10	0.0000
29	34.906	-12.992	-4.8862	0.0000	0.0000	1.7904E-10	0.0000
30	41.255	-12.588	-4.9746	0.0000	0.0000	0.0000	0.0000
31	47.604	-12.272	-5.0960	0.0000	0.0000	0.0000	0.0000
32	109.28	-14.506	-5.8793	0.0000	0.0000	0.0000	0.0000
33	94.225	-14.188	-5.4730	0.0000	0.0000	0.0000	0.0000
34	79.173	-14.538	-5.3174	0.0000	0.0000	0.0000	0.0000
35	64.121	-14.895	-5.1498	0.0000	0.0000	0.0000	0.0000
36	104.69	-15.191	-5.8378	0.0000	0.0000	0.0000	0.0000
37	89.634	-14.821	-5.4163	0.0000	0.0000	0.0000	0.0000
38	74.582	-15.189	-5.2599	0.0000	0.0000	0.0000	0.0000
39	59.530	-15.545	-5.0858	0.0000	0.0000	0.0000	0.0000
MINIMUM	17.426	-17.084	-5.8793	0.0000	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1	1
MAXIMUM	109.28	-11.976	-4.7135	0.0000	0.0000	1.7904E-10	1.7904E-10
Pile N.	32	15	16	1	1	27	27

PILE GROUP STRESS, KIP/IN\*\*2  
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1	0.6713
2	0.6845
3	0.6977
4	0.7109
5	0.7241
6	0.7373
7	0.7505
8	0.7638
9	0.7770
10	0.7902
11	0.8034
12	0.8166

13	0.8810
14	0.9706
15	1.0601
16	0.2458
17	0.2591
18	0.2723
19	0.2855
20	0.2987
21	0.3119
22	0.3251
23	0.3383
24	0.3515
25	0.3647
26	0.3779
27	0.3911
28	0.4029
29	0.4924
30	0.5820
31	0.6716
32	1.5417
33	1.3293
34	1.1170
35	0.9046
36	1.4769
37	1.2645
38	1.0522
39	0.8398
MINIMUM	0.2458
Pile N.	16
MAXIMUM	1.5417
Pile N.	32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL.		MOMENT	MOMENT	SHEAR	SHEAR	SOIL REACT		SOIL REACT		TOTAL	FLEX. RIG.		FLEX. RIG.	
	y-DIR	z-DIR	y-DIR	z-DIR					y-DIR	z-DIR	STRESS	STRESS		z-DIR	z-DIR	y-DIR	y-DIR
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
	IN	IN	IN	IN	KIP-IN	KIP-IN	KIP	KIP	KIP/IN	KIP/IN	KIP/IN	KIP/IN	KIP/IN**2	KIP/IN**2	KIP-IN**2	KIP-IN**2	KIP-IN**2

1	-2.6087	-0.8014	-1724.4	-544.86	-16.112	-5.0756	-26.965	-8.3245	0.6713	2.3748E+05	2.9495E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	2.3100	10.080	10.080	0.0000	11.130	11.130
2	-2.5573	-0.8014	-1691.5	-544.38	-15.757	-5.0575	-26.288	-8.2651	0.6845	2.3715E+05	2.9419E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
3	-2.5059	-0.8014	-1649.8	-541.52	-15.206	-4.9792	-24.641	-7.8677	0.6977	2.2521E+05	2.9053E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	1.2600	10.080	10.080	0.0000	11.130	11.130
4	-2.4544	-0.8014	-1636.9	-547.36	-15.475	-5.1624	-27.533	-9.0601	0.7109	2.5784E+05	2.8936E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	0.4200	10.080	10.080	0.0000	11.130	11.130
5	-2.4030	-0.8014	-1606.1	-548.12	-15.229	-5.1856	-27.576	-9.2708	0.7241	2.6310E+05	2.9169E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.2600	0.0000	10.080	10.080	0.0000	11.130	11.130
6	-2.3516	-0.8014	-1573.9	-548.53	-14.937	-5.1945	-27.338	-9.3906	0.7373	2.6604E+05	2.9389E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	1.8900	10.080	10.080	0.0000	11.130	11.130
7	-2.3001	-0.8014	-1541.5	-548.97	-14.644	-5.2039	-27.096	-9.5148	0.7505	2.6891E+05	2.9632E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
8	-2.2487	-0.8014	-1509.1	-549.41	-14.351	-5.2138	-26.850	-9.6452	0.7638	2.7170E+05	2.9685E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
9	-2.1973	-0.8014	-1476.4	-549.79	-14.056	-5.2238	-26.613	-9.7819	0.7770	2.7436E+05	2.9945E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	2.9400	10.080	10.080	0.0000	11.130	11.130
10	-2.1458	-0.8014	-1443.4	-550.09	-13.758	-5.2331	-26.378	-9.9247	0.7902	2.7627E+05	3.0191E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
11	-2.0944	-0.8014	-1410.3	-550.40	-13.459	-5.2425	-26.137	-10.074	0.8034	2.7811E+05	3.0260E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
12	-2.0429	-0.8014	-1377.4	-550.77	-13.167	-5.2551	-25.939	-10.246	0.8166	2.8025E+05	3.0554E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.8400	0.6300	10.080	10.080	0.0000	11.130	11.130
13	-1.9802	-0.8130	-1335.3	-558.27	-12.676	-5.2909	-25.152	-10.394	0.8810	2.8101E+05	3.0353E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	11.130
14	-1.9323	-0.8316	-1302.1	-570.06	-12.283	-5.3697	-24.859	-10.765	0.9706	2.8228E+05	3.0279E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.7300	3.3600	10.080	10.080	0.0000	11.130	11.130
15	-1.8843	-0.8502	-1267.0	-580.94	-11.976	-5.4838	-25.479	-11.564	1.0601	2.8560E+05	3.0657E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130
16	-2.6026	-0.6985	-1737.0	-481.38	-17.084	-4.7135	-28.745	-7.8082	0.2458	2.5058E+05	2.9255E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	1.0500	10.080	10.080	0.0000	11.130	11.130
17	-2.5512	-0.6985	-1706.5	-481.60	-16.792	-4.7198	-28.518	-7.8938	0.2591	2.5376E+05	2.9399E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	2.7300	10.080	10.080	0.0000	11.130	11.130
18	-2.4997	-0.6985	-1675.3	-481.87	-16.498	-4.7273	-28.300	-7.9879	0.2723	2.5699E+05	2.9632E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	0.0000	10.080	10.080	0.0000	11.130	11.130
19	-2.4483	-0.6985	-1643.6	-482.15	-16.199	-4.7351	-28.076	-8.0892	0.2855	2.6026E+05	2.9672E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	2.7300	10.080	10.080	0.0000	11.130	11.130
20	-2.3969	-0.6985	-1611.5	-482.51	-15.896	-4.7432	-27.849	-8.1936	0.2987	2.6338E+05	2.9932E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
21	-2.3454	-0.6985	-1579.2	-482.90	-15.591	-4.7516	-27.617	-8.3026	0.3119	2.6637E+05	3.0178E+05

x(FT)	0.0000	0.0000	10.080	0.0000	2.9400	10.080	10.080	10.080	10.080	0.0000	2.9400	10.080	10.080	0.0000	0.0000	11.130	11.130
22	-2.2940	-0.6985	-1546.7	-483.30	-4.7605	-27.381	-8.4164	-8.4164	-8.4164	-15.285	-4.7605	-27.381	-8.4164	0.3251	2.6930E+05	3.0390E+05	3.0390E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	10.080	10.080	10.080	10.080	3.1500	3.3600	10.080	10.080	0.0000	11.130	11.130	11.130
23	-2.2425	-0.6985	-1514.1	-483.72	-4.7700	-27.143	-8.5341	-8.5341	-8.5341	-14.979	-4.7700	-27.143	-8.5341	0.3383	2.7213E+05	3.0631E+05	3.0631E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130	11.130
24	-2.1911	-0.6985	-1481.1	-484.01	-4.7789	-26.922	-8.6599	-8.6599	-8.6599	-14.669	-4.7789	-26.922	-8.6599	0.3515	2.7455E+05	3.1067E+05	3.1067E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	10.080	10.080	10.080	10.080	1.0500	1.0500	10.080	10.080	0.0000	11.130	11.130	11.130
25	-2.1397	-0.6985	-1448.0	-484.31	-4.7874	-26.696	-8.7912	-8.7912	-8.7912	-14.357	-4.7874	-26.696	-8.7912	0.3647	2.7646E+05	3.1245E+05	3.1245E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	11.130
26	-2.0882	-0.6985	-1414.8	-484.61	-4.7964	-26.462	-8.9264	-8.9264	-8.9264	-14.045	-4.7964	-26.462	-8.9264	0.3779	2.7833E+05	3.1496E+05	3.1496E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	10.080	10.080	10.080	10.080	3.1500	0.8400	10.080	10.080	0.0000	11.130	11.130	11.130
27	-2.0368	-0.6985	-1380.2	-484.44	-4.7742	-25.551	-8.8342	-8.8342	-8.8342	-13.641	-4.7742	-25.551	-8.8342	0.3911	2.7771E+05	3.1229E+05	3.1229E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	10.080	10.080	10.080	10.080	2.9400	1.4700	10.080	10.080	0.0000	11.130	11.130	11.130
28	-1.9910	-0.6985	-1349.8	-484.44	-4.7645	-24.961	-8.8277	-8.8277	-8.8277	-13.312	-4.7645	-24.961	-8.8277	0.4029	2.7801E+05	3.1051E+05	3.1051E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130	11.130
29	-1.9430	-0.7171	-1317.6	-496.78	-4.8862	-25.374	-9.4347	-9.4347	-9.4347	-12.992	-4.8862	-25.374	-9.4347	0.4924	2.8195E+05	3.1547E+05	3.1547E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	10.080	10.080	10.080	10.080	2.3100	3.3600	10.080	10.080	0.0000	11.130	11.130	11.130
30	-1.8951	-0.7357	-1283.6	-508.43	-4.9746	-25.116	-9.8188	-9.8188	-9.8188	-12.588	-4.9746	-25.116	-9.8188	0.5820	2.8304E+05	3.1342E+05	3.1342E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	10.080	10.080	3.3600	0.0000	10.080	10.080	0.0000	11.130	11.130	11.130
31	-1.8471	-0.7543	-1248.4	-519.49	-5.0960	-25.768	-10.589	-10.589	-10.589	-12.272	-5.0960	-25.768	-10.589	0.6716	2.8637E+05	3.2137E+05	3.2137E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.1000	10.080	10.080	10.080	10.080	2.1000	0.2100	10.080	10.080	0.0000	11.130	11.130	11.130
32	-2.5313	-1.0062	-1667.1	-676.17	-5.8793	-27.743	-11.088	-11.088	-11.088	-14.506	-5.8793	-27.743	-11.088	1.5417	2.5667E+05	2.9413E+05	2.9413E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	10.080	10.080	10.080	10.080	0.6300	0.0000	10.080	10.080	0.0000	11.130	11.130	11.130
33	-2.5282	-0.9549	-1646.9	-635.81	-5.4730	-24.139	-9.0892	-9.0892	-9.0892	-14.188	-5.4730	-24.139	-9.0892	1.3293	2.2015E+05	2.8407E+05	2.8407E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	10.080	10.080	10.080	10.080	0.4200	0.8400	10.080	10.080	0.0000	11.130	11.130	11.130
34	-2.5252	-0.9036	-1649.8	-604.22	-5.3174	-24.259	-8.6543	-8.6543	-8.6543	-14.538	-5.3174	-24.259	-8.6543	1.1170	2.2046E+05	2.8596E+05	2.8596E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	10.080	10.080	10.080	10.080	2.9400	3.1500	10.080	10.080	0.0000	11.130	11.130	11.130
35	-2.5221	-0.8522	-1653.0	-572.60	-5.1498	-24.415	-8.2243	-8.2243	-8.2243	-14.895	-5.1498	-24.415	-8.2243	0.9046	2.2123E+05	2.8792E+05	2.8792E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	10.080	10.080	10.080	10.080	1.6800	1.4700	10.080	10.080	0.0000	11.130	11.130	11.130
36	-2.6597	-0.9986	-1743.1	-670.73	-5.8378	-28.336	-10.727	-10.727	-10.727	-15.191	-5.8378	-28.336	-10.727	1.4769	2.4898E+05	2.9263E+05	2.9263E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	10.080	10.080	10.080	10.080	0.4200	1.2600	10.080	10.080	0.0000	11.130	11.130	11.130
37	-2.6566	-0.9472	-1716.0	-627.97	-5.4163	-24.973	-8.8450	-8.8450	-8.8450	-14.821	-5.4163	-24.973	-8.8450	1.2645	2.0062E+05	2.8145E+05	2.8145E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	10.080	10.080	3.3600	2.1000	10.080	10.080	0.0000	11.130	11.130	11.130
38	-2.6535	-0.8959	-1719.1	-596.51	-5.2599	-25.075	-8.4117	-8.4117	-8.4117	-15.189	-5.2599	-25.075	-8.4117	1.0522	2.0099E+05	2.8325E+05	2.8325E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130	11.130
39	-2.6505	-0.8446	-1721.6	-564.71	-5.0858	-25.150	-7.9608	-7.9608	-7.9608	-15.545	-5.0858	-25.150	-7.9608	0.8398	2.0063E+05	2.8536E+05	2.8536E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	10.080	10.080	10.080	10.080	0.6300	0.6300	10.080	10.080	0.0000	11.130	11.130	11.130
Min.	-2.6597	-1.0062	-1743.1	-676.17	-5.8793	-28.745	-11.564	-11.564	-11.564	-17.084	-5.8793	-28.745	-11.564	0.2458	2.0062E+05	2.8145E+05	2.8145E+05
Piile N.	36	32	36	32	32	16	15	15	15	16	32	16	15	16	37	37	37

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL.		MOMENT		MOMENT		SHEAR		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.		
	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	
1	4.8353E-03	1.4093E-03	43.804	22.186	165.07	51.537	20.094	5.8569	0.9466	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	0.9466	5.1206E+06	5.1206E+06	5.1206E+06	0.9466	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	
2	4.8501E-03	1.4390E-03	43.157	22.248	161.75	51.432	19.609	5.8177	0.9653	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	0.9653	5.1206E+06	5.1206E+06	5.1206E+06	0.9653	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
3	5.4504E-03	1.6244E-03	44.243	23.263	158.61	51.226	19.014	5.6399	0.9839	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	0.9839	5.1206E+06	5.1206E+06	5.1206E+06	0.9839	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	11.340	11.340	10.710	10.710	10.920	11.340	11.340	11.340	11.340	11.340	11.340	11.340	11.340	11.340	11.340	11.340
4	3.8364E-03	1.2185E-03	36.108	20.555	154.02	51.279	20.853	6.6229	1.0025	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.0025	5.1206E+06	5.1206E+06	5.1206E+06	1.0025	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
5	3.5717E-03	1.1633E-03	34.343	19.880	150.32	51.124	21.017	6.8451	1.0211	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.0211	5.1206E+06	5.1206E+06	5.1206E+06	1.0211	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
6	3.4108E-03	1.1367E-03	33.034	19.465	146.76	50.992	20.912	6.9690	1.0398	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.0398	5.1206E+06	5.1206E+06	5.1206E+06	1.0398	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
7	3.2511E-03	1.1091E-03	31.846	19.037	143.21	50.856	20.804	7.0976	1.0584	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.0584	5.1206E+06	5.1206E+06	5.1206E+06	1.0584	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
8	3.0931E-03	1.0821E-03	30.784	18.652	139.67	50.733	20.691	7.2389	1.0770	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.0770	5.1206E+06	5.1206E+06	5.1206E+06	1.0770	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
9	2.9604E-03	1.0608E-03	29.889	18.335	136.10	50.575	20.310	7.2778	1.0956	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.0956	5.1206E+06	5.1206E+06	5.1206E+06	1.0956	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
10	2.8591E-03	1.0491E-03	29.299	18.183	133.75	50.508	19.615	7.1974	1.1142	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.1142	5.1206E+06	5.1206E+06	5.1206E+06	1.1142	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
11	2.7586E-03	1.0382E-03	28.806	18.074	131.63	50.921	18.925	7.1228	1.1329	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.1329	5.1206E+06	5.1206E+06	5.1206E+06	1.1329	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
12	2.6495E-03	1.0224E-03	28.239	17.893	129.63	51.395	18.222	7.0319	1.1515	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.1515	5.1206E+06	5.1206E+06	5.1206E+06	1.1515	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
13	2.6096E-03	1.0547E-03	27.783	18.236	125.58	52.088	17.559	7.0965	1.2423	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.2423	5.1206E+06	5.1206E+06	5.1206E+06	1.2423	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
14	2.5289E-03	1.0721E-03	27.356	18.572	122.71	53.328	16.983	7.1996	1.3686	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.3686	5.1206E+06	5.1206E+06	5.1206E+06	1.3686	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
15	2.3294E-03	1.0363E-03	26.803	18.473	120.01	54.641	16.272	7.2389	1.4949	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	1.4949	5.1206E+06	5.1206E+06	5.1206E+06	1.4949	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
16	4.2200E-03	1.1007E-03	39.709	18.570	164.85	45.376	21.600	5.6341	0.3467	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	0.3467	5.1206E+06	5.1206E+06	5.1206E+06	0.3467	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
17	4.0598E-03	1.0814E-03	38.348	18.264	161.40	45.269	21.502	5.7274	0.3653	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	0.3653	5.1206E+06	5.1206E+06	5.1206E+06	0.3653	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
18	3.8938E-03	1.0593E-03	36.865	17.912	157.89	45.153	21.418	5.8268	0.3839	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	0.3839	5.1206E+06	5.1206E+06	5.1206E+06	0.3839	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	

x(FT)	11.130	11.130	10.710	11.130	11.130	11.130	11.130	11.130	0.4026	5.1206E+06	0.0000	0.0000
19	3.7261E-03	1.0376E-03	35.568	17.604	154.33	45.049	21.326	5.9390	0.4026	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
20	3.5602E-03	1.0140E-03	34.246	17.230	150.76	44.931	21.234	6.0479	0.4212	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
21	3.3965E-03	9.8998E-04	32.946	16.858	147.18	44.814	21.137	6.1607	0.4398	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
22	3.2340E-03	9.6545E-04	31.754	16.487	143.60	44.697	21.037	6.2801	0.4584	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
23	3.0732E-03	9.4008E-04	30.667	16.102	140.03	44.576	20.934	6.4037	0.4770	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
24	2.9603E-03	9.2638E-04	29.931	15.891	136.61	44.413	20.309	6.3554	0.4957	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
25	2.8580E-03	9.1639E-04	29.323	15.778	134.53	44.483	19.608	6.2869	0.5143	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
26	2.7562E-03	9.0582E-04	28.837	15.650	132.43	44.853	18.909	6.2144	0.5329	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
27	2.7844E-03	9.3777E-04	28.368	15.825	128.30	44.539	18.476	6.2227	0.5515	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
28	2.7657E-03	9.5346E-04	27.956	15.903	125.29	44.488	18.003	6.2062	0.5681	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
29	2.5586E-03	9.2873E-04	27.513	15.937	124.15	46.341	17.183	6.2371	0.6944	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
30	2.4773E-03	9.4663E-04	26.991	16.295	120.92	47.453	16.637	6.3573	0.8207	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
31	2.2776E-03	9.1504E-04	26.630	16.175	118.19	48.731	15.910	6.3917	0.9470	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
32	3.8910E-03	1.4956E-03	37.079	24.125	157.29	63.430	20.949	8.0523	2.1740	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
33	5.7203E-03	2.0263E-03	44.943	23.141	158.91	60.320	19.508	6.8584	1.8746	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000	0.0000
34	5.7024E-03	1.9066E-03	44.953	23.137	159.14	57.286	19.458	6.4436	1.5751	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000	0.0000
35	5.6588E-03	1.7766E-03	44.914	24.400	159.35	54.258	19.385	6.0089	1.2757	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000	0.0000
36	4.2810E-03	1.5528E-03	40.666	24.070	165.81	63.305	21.214	7.6946	2.0827	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
37	6.6742E-03	2.1886E-03	51.158	22.922	165.15	58.961	20.272	6.6061	1.7832	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000	0.0000
38	6.6472E-03	2.0598E-03	51.051	22.734	165.60	56.036	20.368	6.2608	1.4838	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000	0.0000

39	6.6584E-03	1.9381E-03	51.120	23.112	165.90	53.031	20.424	5.8825	1.1843	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000
Max.	6.6742E-03	2.1886E-03	51.158	24.400	165.90	63.430	21.600	8.0523	2.1740	5.1206E+06	5.1206E+06
Pile N.	37	37	37	35	39	32	16	32	32	1	1

LOAD CASE : 2  
CASE NAME : Strength III  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.9155	1.0000
2	0.8952	1.0000
3	0.8249	1.0000
4	0.9753	1.0000
5	0.9880	1.0000
6	0.9880	1.0000
7	0.9880	1.0000
8	0.9880	1.0000
9	0.9880	1.0000
10	0.9880	1.0000
11	0.9880	1.0000
12	0.9878	1.0000
13	0.9670	1.0000
14	0.9654	1.0000
15	0.9982	1.0000
16	0.9884	1.0000
17	0.9880	1.0000
18	0.9880	1.0000
19	0.9880	1.0000
20	0.9880	1.0000
21	0.9880	1.0000
22	0.9880	1.0000
23	0.9880	1.0000
24	0.9880	1.0000

25	0.9880	1.0000
26	0.9880	1.0000
27	0.9559	1.0000
28	0.9357	1.0000
29	0.9654	1.0000
30	0.9654	1.0000
31	0.9982	1.0000
32	0.9904	1.0000
33	0.8039	1.0000
34	0.8039	1.0000
35	0.8080	1.0000
36	0.9904	1.0000
37	0.8039	1.0000
38	0.8039	1.0000
39	0.8060	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1649.32	-555.480	-148.440
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	7409.52	41508.5

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
0.0111191	-2.21875	-0.57503
ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
1.27740E-03	-5.64832E-06	8.68437E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	0.010504	-2.4720	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
2	0.010707	-2.4261	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
3	0.010910	-2.3801	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
4	0.011114	-2.3341	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
5	0.011317	-2.2881	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
6	0.011520	-2.2421	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
7	0.011724	-2.1961	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
8	0.011927	-2.1501	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
9	0.012130	-2.1041	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
10	0.012334	-2.0582	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
11	0.012537	-2.0122	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
12	0.012740	-1.9662	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
13	0.013696	-1.9101	-0.5929	1.2774E-03	-5.6483E-06	8.6844E-05
14	0.015017	-1.8673	-0.6095	1.2774E-03	-5.6483E-06	8.6844E-05
15	0.016337	-1.8244	-0.6261	1.2774E-03	-5.6483E-06	8.6844E-05
16	4.2752E-03	-2.4665	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
17	4.4786E-03	-2.4206	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
18	4.6819E-03	-2.3746	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
19	4.8852E-03	-2.3286	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
20	5.0886E-03	-2.2826	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
21	5.2919E-03	-2.2366	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
22	5.4953E-03	-2.1906	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
23	5.6986E-03	-2.1446	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
24	5.9019E-03	-2.0987	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
25	6.1053E-03	-2.0527	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
26	6.3086E-03	-2.0067	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
27	6.5120E-03	-1.9607	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
28	6.6931E-03	-1.9197	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
29	8.0138E-03	-1.8769	-0.5071	1.2774E-03	-5.6483E-06	8.6844E-05
30	9.3347E-03	-1.8340	-0.5238	1.2774E-03	-5.6483E-06	8.6844E-05
31	0.010656	-1.7911	-0.5404	1.2774E-03	-5.6483E-06	8.6844E-05
32	0.023263	-2.4028	-0.7656	1.2774E-03	-5.6483E-06	8.6844E-05
33	0.020154	-2.4001	-0.7197	1.2774E-03	-5.6483E-06	8.6844E-05
34	0.017046	-2.3973	-0.6738	1.2774E-03	-5.6483E-06	8.6844E-05

35	0.013937	-2.3946	-0.6279	1.2774E-03	-5.6483E-06	8.6844E-05
36	0.022290	-2.5176	-0.7588	1.2774E-03	-5.6483E-06	8.6844E-05
37	0.019181	-2.5148	-0.7129	1.2774E-03	-5.6483E-06	8.6844E-05
38	0.016072	-2.5121	-0.6670	1.2774E-03	-5.6483E-06	8.6844E-05
39	0.012963	-2.5093	-0.6211	1.2774E-03	-5.6483E-06	8.6844E-05
MINIMUM	4.2752E-03	-2.5176	-0.7656	1.2774E-03	-5.6483E-06	8.6844E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.023263	-1.7911	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X, KIP	FOR. Y, KIP	FOR. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1	40.397	-15.664	-3.8119	0.0000	0.0000	0.0000
2	41.179	-15.334	-3.8003	0.0000	0.0000	0.0000
3	41.961	-14.809	-3.7418	0.0000	0.0000	0.0000
4	42.743	-15.096	-3.8831	0.0000	0.0000	0.0000
5	43.525	-14.875	-3.9009	0.0000	0.0000	0.0000
6	44.307	-14.608	-3.9078	0.0000	0.0000	0.0000
7	45.089	-14.339	-3.9145	0.0000	0.0000	0.0000
8	45.871	-14.070	-3.9216	0.0000	0.0000	0.0000
9	46.654	-13.801	-3.9291	0.0000	0.0000	0.0000
10	47.436	-13.525	-3.9348	0.0000	0.0000	0.0000
11	48.218	-13.243	-3.9392	0.0000	0.0000	0.0000
12	49.000	-12.961	-3.9436	0.0000	0.0000	-1.7904E-10
13	52.674	-12.520	-3.9867	0.0000	0.0000	0.0000
14	57.754	-12.175	-4.0716	0.0000	0.0000	0.0000
15	62.833	-11.908	-4.1812	0.0000	0.0000	0.0000
16	16.443	-16.463	-3.4047	0.0000	0.0000	0.0000
17	17.225	-16.192	-3.4101	0.0000	0.0000	0.0000
18	18.007	-15.921	-3.4163	0.0000	0.0000	0.0000
19	18.789	-15.649	-3.4226	2.7408E-27	-4.4761E-11	0.0000
20	19.571	-15.374	-3.4290	0.0000	0.0000	0.0000
21	20.353	-15.097	-3.4349	0.0000	0.0000	0.0000
22	21.135	-14.819	-3.4409	0.0000	0.0000	0.0000
23	21.917	-14.541	-3.4473	0.0000	0.0000	0.0000
24	22.699	-14.264	-3.4545	0.0000	0.0000	0.0000
25	23.481	-13.974	-3.4584	2.7408E-27	-4.4761E-11	-1.7904E-10
26	24.263	-13.681	-3.4621	0.0000	0.0000	0.0000

27	25.045	-13.315	-3.4475	0.0000	0.0000	1.7904E-10
28	25.742	-13.010	-3.4392	0.0000	0.0000	0.0000
29	30.821	-12.728	-3.5503	0.0000	0.0000	0.0000
30	35.901	-12.380	-3.6428	0.0000	0.0000	0.0000
31	40.981	-12.105	-3.7561	0.0000	0.0000	0.0000
32	89.469	-14.423	-4.7036	0.0000	0.0000	0.0000
33	77.513	-14.010	-4.3134	0.0000	0.0000	0.0000
34	65.557	-14.273	-4.1255	0.0000	0.0000	0.0000
35	53.601	-14.550	-3.9312	0.0000	0.0000	0.0000
36	85.726	-15.066	-4.6564	0.0000	0.0000	0.0000
37	73.770	-14.629	-4.2663	0.0000	0.0000	0.0000
38	61.814	-14.903	-4.0777	0.0000	0.0000	0.0000
39	49.858	-15.185	-3.8811	0.0000	0.0000	0.0000
MINIMUM	16.443	-16.463	-4.7036	0.0000	-4.4761E-11	-1.7904E-10
Pile N.	16	16	32	1	19	12
MAXIMUM	89.469	-11.908	-3.4047	2.7408E-27	0.0000	1.7904E-10
Pile N.	32	15	16	19	1	27

THE PILE COORDINATE SYSTEM (LOCAL AXES)

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	0.010504	-2.4720	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
2	0.010707	-2.4261	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
3	0.010910	-2.3801	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
4	0.011114	-2.3341	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
5	0.011317	-2.2881	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
6	0.011520	-2.2421	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
7	0.011724	-2.1961	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
8	0.011927	-2.1501	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
9	0.012130	-2.1041	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
10	0.012334	-2.0582	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
11	0.012537	-2.0122	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
12	0.012740	-1.9662	-0.5825	1.2774E-03	-5.6483E-06	8.6844E-05
13	0.013696	-1.9101	-0.5929	1.2774E-03	-5.6483E-06	8.6844E-05
14	0.015017	-1.8673	-0.6095	1.2774E-03	-5.6483E-06	8.6844E-05

15	0.0116337	-1.8244	-0.6261	1.2774E-03	-5.6483E-06	8.6844E-05
16	4.2752E-03	-2.4665	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
17	4.4786E-03	-2.4206	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
18	4.6819E-03	-2.3746	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
19	4.8852E-03	-2.3286	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
20	5.0886E-03	-2.2826	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
21	5.2919E-03	-2.2366	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
22	5.4953E-03	-2.1906	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
23	5.6986E-03	-2.1446	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
24	5.9019E-03	-2.0987	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
25	6.1053E-03	-2.0527	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
26	6.3086E-03	-2.0067	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
27	6.5120E-03	-1.9607	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
28	6.6931E-03	-1.9197	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
29	8.0138E-03	-1.8769	-0.5071	1.2774E-03	-5.6483E-06	8.6844E-05
30	9.3347E-03	-1.8340	-0.5238	1.2774E-03	-5.6483E-06	8.6844E-05
31	0.0110656	-1.7911	-0.5404	1.2774E-03	-5.6483E-06	8.6844E-05
32	0.023263	-2.4028	-0.7656	1.2774E-03	-5.6483E-06	8.6844E-05
33	0.020154	-2.4001	-0.7197	1.2774E-03	-5.6483E-06	8.6844E-05
34	0.017046	-2.3973	-0.6738	1.2774E-03	-5.6483E-06	8.6844E-05
35	0.013937	-2.3946	-0.6279	1.2774E-03	-5.6483E-06	8.6844E-05
36	0.022290	-2.5176	-0.7588	1.2774E-03	-5.6483E-06	8.6844E-05
37	0.019181	-2.5148	-0.7129	1.2774E-03	-5.6483E-06	8.6844E-05
38	0.016072	-2.5121	-0.6670	1.2774E-03	-5.6483E-06	8.6844E-05
39	0.012963	-2.5093	-0.6211	1.2774E-03	-5.6483E-06	8.6844E-05
MINIMUM	4.2752E-03	-2.5176	-0.7656	1.2774E-03	-5.6483E-06	8.6844E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.023263	-1.7911	-0.4905	1.2774E-03	-5.6483E-06	8.6844E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1	40.397	-15.664	-3.8119	0.0000	0.0000	0.0000
2	41.179	-15.334	-3.8003	0.0000	0.0000	0.0000
3	41.961	-14.809	-3.7418	0.0000	0.0000	0.0000
4	42.743	-15.096	-3.8831	0.0000	0.0000	0.0000
5	43.525	-14.875	-3.9009	0.0000	0.0000	0.0000
6	44.307	-14.608	-3.9078	0.0000	0.0000	0.0000

7	45.089	-14.339	-3.9145	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8	45.871	-14.070	-3.9216	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9	46.654	-13.801	-3.9291	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	47.436	-13.525	-3.9348	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
11	48.218	-13.243	-3.9392	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	49.000	-12.961	-3.9436	0.0000	0.0000	0.0000	0.0000	0.0000	-1.7904E-10
13	52.674	-12.520	-3.9867	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	57.754	-12.175	-4.0716	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	62.833	-11.908	-4.1812	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16	16.443	-16.463	-3.4047	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	17.225	-16.192	-3.4101	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18	18.007	-15.921	-3.4163	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	18.789	-15.649	-3.4226	0.0000	0.0000	0.0000	-4.4761E-11	0.0000	0.0000
20	19.571	-15.374	-3.4290	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21	20.353	-15.097	-3.4349	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	21.135	-14.819	-3.4409	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	21.917	-14.541	-3.4473	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	22.699	-14.264	-3.4545	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	23.481	-13.974	-3.4584	0.0000	0.0000	0.0000	-4.4761E-11	0.0000	-1.7904E-10
26	24.263	-13.681	-3.4621	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	25.045	-13.315	-3.4475	0.0000	0.0000	0.0000	0.0000	0.0000	1.7904E-10
28	25.742	-13.010	-3.4392	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	30.821	-12.728	-3.5503	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	35.901	-12.380	-3.6428	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	40.981	-12.105	-3.7561	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	89.469	-14.423	-4.7036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33	77.513	-14.010	-4.3134	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	65.557	-14.273	-4.1255	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35	53.601	-14.550	-3.9312	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
36	85.726	-15.066	-4.6564	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
37	73.770	-14.629	-4.2663	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
38	61.814	-14.903	-4.0777	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
39	49.858	-15.185	-3.8811	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
MINIMUM	16.443	-16.463	-4.7036	0.0000	0.0000	-4.4761E-11	-1.7904E-10	-1.7904E-10	-1.7904E-10
Pile N.	16	16	32	1	1	19	12	12	12
MAXIMUM	89.469	-11.908	-3.4047	0.0000	0.0000	0.0000	1.7904E-10	1.7904E-10	1.7904E-10
Pile N.	32	15	16	1	1	1	1	1	27

PILE GROUP    STRESS,KIP/IN\*\*2  
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1	0.5699
2	0.5809
3	0.5920
4	0.6030
5	0.6140
6	0.6251
7	0.6361
8	0.6472
9	0.6582
10	0.6692
11	0.6803
12	0.6913
13	0.7431
14	0.8148
15	0.8864
16	0.2320
17	0.2430
18	0.2540
19	0.2651
20	0.2761
21	0.2871
22	0.2982
23	0.3092
24	0.3202
25	0.3313
26	0.3423
27	0.3533
28	0.3632
29	0.4348
30	0.5065
31	0.5782
32	1.2622
33	1.0936
34	0.9249
35	0.7562
36	1.2094
37	1.0407
38	0.8721
39	0.7034

MINIMUM 0.2320

Pile N. 16  
 MAXIMUM 1.2622  
 Pile N. 32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL.		MOMENT		MOMENT		SHEAR		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.		
	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	STRESS	KIP-IN**2	z-Dir	KIP-IN**2	Y-Dir	KIP-IN**2	
1	-2.4720	-0.5825	-0.5825	-1647.1	-402.14	-15.664	-3.8119	-26.911	-6.4145	0.5699	2.5025E+05	2.9937E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.5809	2.5010E+05	2.9798E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.3600	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.5809	2.5010E+05	2.9798E+05	0.0000	11.130
2	-2.4261	-0.5825	-0.5825	-1616.5	-401.89	-15.334	-3.8003	-26.276	-6.3788	0.5809	2.5010E+05	2.9798E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.5809	2.5010E+05	2.9798E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.6300	0.2100	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.5809	2.5010E+05	2.9798E+05	0.0000	11.130
3	-2.3801	-0.5825	-0.5825	-1579.1	-400.14	-14.809	-3.7418	-24.524	-6.0553	0.5920	2.4021E+05	2.9152E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.5920	2.4021E+05	2.9152E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	2.9400	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.5920	2.4021E+05	2.9152E+05	0.0000	11.130
4	-2.3341	-0.5825	-0.5825	-1567.2	-404.43	-15.096	-3.8831	-27.650	-6.9800	0.6030	2.6832E+05	3.2175E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6030	2.6832E+05	3.2175E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.6300	2.7300	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6140	2.7245E+05	3.2871E+05	0.0000	11.130
5	-2.2881	-0.5825	-0.5825	-1539.1	-404.95	-14.875	-3.9009	-27.726	-7.1393	0.6140	2.7245E+05	3.2871E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6140	2.7245E+05	3.2871E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	2.9400	2.5200	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6251	2.7445E+05	3.3286E+05	0.0000	11.130
6	-2.2421	-0.5825	-0.5825	-1509.6	-405.14	-14.608	-3.9078	-27.539	-7.2341	0.6251	2.7445E+05	3.3286E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6251	2.7445E+05	3.3286E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.1500	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6361	2.7615E+05	3.3708E+05	0.0000	11.130
7	-2.1961	-0.5825	-0.5825	-1480.1	-405.36	-14.339	-3.9145	-27.348	-7.3312	0.6361	2.7615E+05	3.3708E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6361	2.7615E+05	3.3708E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6472	2.7784E+05	3.4422E+05	0.0000	11.130
8	-2.1501	-0.5825	-0.5825	-1450.6	-405.61	-14.070	-3.9216	-27.154	-7.4295	0.6472	2.7784E+05	3.4422E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6472	2.7784E+05	3.4422E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	2.5200	1.6800	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6582	2.7952E+05	3.5298E+05	0.0000	11.130
9	-2.1041	-0.5825	-0.5825	-1421.1	-405.86	-13.801	-3.9291	-26.955	-7.5306	0.6582	2.7952E+05	3.5298E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6582	2.7952E+05	3.5298E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	2.1000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6692	2.8115E+05	3.5661E+05	0.0000	11.130
10	-2.0582	-0.5825	-0.5825	-1390.5	-405.79	-13.525	-3.9348	-26.830	-7.6598	0.6692	2.8115E+05	3.5661E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6692	2.8115E+05	3.5661E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6803	2.8221E+05	3.5832E+05	0.0000	11.130
11	-2.0122	-0.5825	-0.5825	-1359.1	-405.52	-13.243	-3.9392	-26.683	-7.7896	0.6803	2.8221E+05	3.5832E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6803	2.8221E+05	3.5832E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6913	2.8329E+05	3.6104E+05	0.0000	11.130
12	-1.9662	-0.5825	-0.5825	-1327.9	-405.29	-12.961	-3.9436	-26.555	-7.9306	0.6913	2.8329E+05	3.6104E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.6913	2.8329E+05	3.6104E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.4200	2.7300	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.7431	2.8371E+05	3.5421E+05	0.0000	11.130
13	-1.9101	-0.5825	-0.5825	-1290.0	-411.91	-12.520	-3.9867	-25.854	-8.0882	0.7431	2.8371E+05	3.5421E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.7431	2.8371E+05	3.5421E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	2.9400	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.8148	2.8499E+05	3.5073E+05	0.0000	11.130
14	-1.8673	-0.6095	-0.6095	-1259.9	-422.40	-12.175	-4.0716	-25.621	-8.4261	0.8148	2.8499E+05	3.5073E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.8148	2.8499E+05	3.5073E+05	0.0000	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.1500	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.8864	2.8744E+05	3.5921E+05	0.0000	11.130
15	-1.8244	-0.6261	-0.6261	-1228.6	-432.42	-11.908	-4.1812	-26.189	-9.0482	0.8864	2.8744E+05	3.5921E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.8864	2.8744E+05	3.5921E+05	0.0000	11.130



36	-2.5176	-0.7588	-1667.6	-516.16	-4.6564	-28.291	-8.6102	1.2094	2.5940E+05	2.9391E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	0.0000	11.130	11.130
37	-2.5148	-0.7129	-1645.9	-480.77	-4.2663	-24.343	-6.8940	1.0407	2.2196E+05	2.9320E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130
38	-2.5121	-0.6670	-1647.9	-451.86	-4.0777	-24.430	-6.4873	0.8721	2.2210E+05	2.9536E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	10.080	10.080	0.0000	11.130	11.130
39	-2.5093	-0.6211	-1650.3	-422.97	-3.8811	-24.561	-6.0896	0.7034	2.2282E+05	2.9768E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130
Min.	-2.5176	-0.7656	-1667.6	-521.31	-4.7036	-28.710	-9.0482	0.2320	2.2196E+05	2.9152E+05
Pile N.	36	32	36	32	32	16	15	16	37	3

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		TOTAL		FLEX. RIG.	
	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	STRESS	KIP-IN**2	z-DIR	y-DIR
	IN	IN	KIP-IN	KIP-IN	KIP	KIP	KIP/IN	KIP/IN	KIP/IN**2	KIP-IN**2	KIP-IN**2	KIP-IN**2
1	4.2373E-03	9.6889E-04	38.181	15.440	37.670	10.710	20.281	4.6375	0.8037	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
2	4.2453E-03	9.8869E-04	37.668	15.502	37.611	152.54	19.824	4.6167	0.8192	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
3	4.7136E-03	1.1080E-03	39.322	16.237	37.531	149.67	18.389	4.3225	0.8348	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
4	3.3026E-03	8.0675E-04	32.170	13.516	37.288	145.48	21.233	5.1869	0.8504	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
5	3.0775E-03	7.6815E-04	30.900	13.020	37.151	142.13	21.284	5.3126	0.8659	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
6	2.9844E-03	7.5982E-04	30.323	12.898	37.025	139.74	20.640	5.2550	0.8815	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
7	2.8933E-03	7.5160E-04	29.730	12.779	37.143	137.91	20.010	5.1981	0.8970	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
8	2.8023E-03	7.4225E-04	29.265	12.618	37.401	136.07	19.381	5.1334	0.9126	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
9	2.7119E-03	7.3230E-04	28.831	12.439	37.663	134.21	18.755	5.0646	0.9281	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
10	2.6297E-03	7.2579E-04	28.278	12.337	37.747	131.63	18.187	5.0196	0.9437	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
11	2.5543E-03	7.2121E-04	27.826	12.265	37.716	128.63	17.666	4.9879	0.9593	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
12	2.4790E-03	7.1627E-04	27.468	12.178	37.684	125.64	17.141	4.9526	0.9748	5.1206E+06	5.1206E+06	5.1206E+06

x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
13	2.4509E-03	7.4309E-04	27.091	121.66	16.590	5.0300	1.0479	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
14	2.3831E-03	7.6059E-04	26.615	118.77	16.105	5.1399	1.1490	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
15	2.2127E-03	7.4197E-04	26.396	116.30	15.461	5.1844	1.2500	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
16	3.6441E-03	7.0901E-04	35.161	155.23	21.855	4.2522	0.3271	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
17	3.4992E-03	6.9368E-04	33.943	152.05	21.779	4.3174	0.3427	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
18	3.3510E-03	6.7499E-04	32.836	148.85	21.707	4.3723	0.3582	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
19	3.2036E-03	6.5778E-04	31.790	145.64	21.633	4.4419	0.3738	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
20	3.0799E-03	6.4395E-04	30.935	142.40	21.301	4.4536	0.3893	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
21	2.9862E-03	6.3539E-04	30.355	140.24	20.653	4.3944	0.4049	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
22	2.8943E-03	6.2832E-04	29.753	138.42	20.017	4.3455	0.4205	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
23	2.8024E-03	6.1924E-04	29.286	136.59	19.381	4.2827	0.4360	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
24	2.7084E-03	6.0835E-04	28.893	134.86	18.731	4.2074	0.4516	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
25	2.6314E-03	6.0390E-04	28.298	131.84	18.199	4.1766	0.4671	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	128.84	17.677	4.1509	0.4827	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
26	2.5559E-03	6.0018E-04	27.841	128.84	17.500	4.1509	0.4827	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
27	2.5848E-03	6.2480E-04	27.469	125.38	17.296	4.1808	0.4983	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
28	2.5823E-03	6.3971E-04	27.157	122.42	16.914	4.1900	0.5121	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
29	2.4086E-03	6.2817E-04	26.784	119.97	16.276	4.2450	0.6132	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
30	2.3348E-03	6.4530E-04	26.433	117.09	15.778	4.3608	0.7142	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
31	2.1646E-03	6.2921E-04	26.286	114.61	15.125	4.3965	0.8153	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
32	3.4035E-03	1.0619E-03	33.216	148.70	21.255	6.6315	1.7799	5.1206E+06	5.1206E+06	5.1206E+06	0.0000	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000

33	4.9938E-03	1.4098E-03	40.869	20.108	150.11	45.644	17.798	5.2141	1.5421	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.340	11.130	0.0000	0.0000
34	4.9797E-03	1.3190E-03	40.872	18.822	150.25	42.896	17.865	4.9209	1.3042	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.340	11.130	0.0000	0.0000
35	4.9269E-03	1.2272E-03	40.638	17.563	150.38	40.210	18.033	4.5972	1.0664	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.340	11.130	0.0000	0.0000
36	3.7684E-03	1.1077E-03	36.139	18.981	156.61	48.253	21.442	6.3029	1.7055	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
37	5.6305E-03	1.4831E-03	44.484	21.070	158.23	45.375	19.043	4.9445	1.4676	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	11.340	11.130	0.0000	0.0000
38	5.6207E-03	1.3882E-03	44.501	19.730	158.39	42.619	19.016	4.6614	1.2297	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	11.340	11.130	0.0000	0.0000
39	5.5796E-03	1.2876E-03	44.445	18.329	158.55	39.866	18.962	4.3873	0.9919	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	11.340	11.130	0.0000	0.0000
Max.	5.6305E-03	1.4831E-03	44.501	21.070	158.55	48.389	21.855	6.6315	1.7799	5.1206E+06	5.1206E+06
Pile N.	37	37	38	37	39	32	16	32	32	1	1

LOAD CASE : 3  
CASE NAME : Strength IV  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.9160	1.0000
2	0.8958	1.0000
3	0.8251	1.0000
4	0.9760	1.0000
5	0.9888	1.0000
6	0.9888	1.0000
7	0.9888	1.0000
8	0.9888	1.0000
9	0.9888	1.0000
10	0.9888	1.0000
11	0.9888	1.0000
12	0.9883	1.0000

13	0.9676	1.0000
14	0.9660	1.0000
15	0.9982	1.0000
16	0.9892	1.0000
17	0.9888	1.0000
18	0.9888	1.0000
19	0.9888	1.0000
20	0.9888	1.0000
21	0.9888	1.0000
22	0.9888	1.0000
23	0.9888	1.0000
24	0.9888	1.0000
25	0.9888	1.0000
26	0.9888	1.0000
27	0.9567	1.0000
28	0.9363	1.0000
29	0.9660	1.0000
30	0.9660	1.0000
31	0.9982	1.0000
32	0.9904	1.0000
33	0.8029	1.0000
34	0.8029	1.0000
35	0.8072	1.0000
36	0.9904	1.0000
37	0.8029	1.0000
38	0.8029	1.0000
39	0.8054	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD, KIPS	HOR. LOAD Y, KIPS	HOR. LOAD Z, KIPS
1858.44	-544.890	-140.510
MOMENT X , KIP-IN	MOMENT Y, KIP-IN	MOMENT Z, KIP-IN
0.00000	6269.76	42152.3

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN                    HORIZONTAL Y,IN                    HORIZONTAL Z,IN  
 0.0125189                    -2.18745                    -0.54603

ANGLE ROT. X,RAD                    ANGLE ROT. Y,RAD                    ANGLE ROT. Z,RAD  
 1.25960E-03                    -5.55308E-06                    8.87274E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	0.011933	-2.4372	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
2	0.012133	-2.3919	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
3	0.012333	-2.3465	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
4	0.012533	-2.3012	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
5	0.012733	-2.2558	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
6	0.012933	-2.2105	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
7	0.013133	-2.1651	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
8	0.013333	-2.1198	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
9	0.013533	-2.0744	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
10	0.013732	-2.0291	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
11	0.013932	-1.9838	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
12	0.014132	-1.9384	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
13	0.015099	-1.8831	-0.5636	1.2596E-03	-5.5531E-06	8.8727E-05
14	0.016441	-1.8409	-0.5800	1.2596E-03	-5.5531E-06	8.8727E-05
15	0.017783	-1.7986	-0.5964	1.2596E-03	-5.5531E-06	8.8727E-05
16	5.5688E-03	-2.4318	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
17	5.7687E-03	-2.3865	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
18	5.9686E-03	-2.3411	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
19	6.1685E-03	-2.2958	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
20	6.3684E-03	-2.2504	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
21	6.5683E-03	-2.2051	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
22	6.7683E-03	-2.1597	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05

23	6.9682E-03	-2.1144	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
24	7.1681E-03	-2.0690	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
25	7.3680E-03	-2.0237	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
26	7.5679E-03	-1.9783	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
27	7.7678E-03	-1.9330	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
28	7.9459E-03	-1.8926	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
29	9.2879E-03	-1.8503	-0.4791	1.2596E-03	-5.5531E-06	8.8727E-05
30	0.010630	-1.8081	-0.4955	1.2596E-03	-5.5531E-06	8.8727E-05
31	0.011972	-1.7658	-0.5119	1.2596E-03	-5.5531E-06	8.8727E-05
32	0.024958	-2.3689	-0.7340	1.2596E-03	-5.5531E-06	8.8727E-05
33	0.021781	-2.3662	-0.6887	1.2596E-03	-5.5531E-06	8.8727E-05
34	0.018604	-2.3635	-0.6434	1.2596E-03	-5.5531E-06	8.8727E-05
35	0.015428	-2.3608	-0.5982	1.2596E-03	-5.5531E-06	8.8727E-05
36	0.023983	-2.4821	-0.7272	1.2596E-03	-5.5531E-06	8.8727E-05
37	0.020806	-2.4794	-0.6819	1.2596E-03	-5.5531E-06	8.8727E-05
38	0.017629	-2.4767	-0.6367	1.2596E-03	-5.5531E-06	8.8727E-05
39	0.014453	-2.4740	-0.5914	1.2596E-03	-5.5531E-06	8.8727E-05
MINIMUM	5.5688E-03	-2.4821	-0.7340	1.2596E-03	-5.5531E-06	8.8727E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.024958	-1.7658	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	45.895	-15.369	-3.6115	0.0000	0.0000	0.0000
2	46.664	-15.043	-3.6005	0.0000	0.0000	0.0000
3	47.433	-14.524	-3.5442	0.0000	0.0000	0.0000
4	48.202	-14.814	-3.6799	0.0000	0.0000	0.0000
5	48.971	-14.594	-3.6965	0.0000	0.0000	0.0000
6	49.740	-14.331	-3.7029	0.0000	0.0000	0.0000
7	50.509	-14.068	-3.7094	0.0000	0.0000	0.0000
8	51.277	-13.805	-3.7164	0.0000	0.0000	0.0000
9	52.046	-13.536	-3.7220	0.0000	0.0000	0.0000
10	52.815	-13.261	-3.7261	0.0000	0.0000	0.0000
11	53.584	-12.985	-3.7304	0.0000	0.0000	0.0000
12	54.353	-12.708	-3.7346	0.0000	0.0000	0.0000
13	58.070	-12.275	-3.7773	0.0000	0.0000	0.0000
14	63.232	-11.936	-3.8606	0.0000	0.0000	0.0000

15	68.394	-11.671	-3.9669	0.0000	0.0000	0.0000	0.0000	0.0000
16	21.418	-16.169	-3.2099	0.0000	0.0000	0.0000	0.0000	0.0000
17	22.186	-15.902	-3.2152	0.0000	0.0000	0.0000	0.0000	0.0000
18	22.955	-15.636	-3.2212	0.0000	0.0000	0.0000	0.0000	0.0000
19	23.724	-15.368	-3.2271	0.0000	0.0000	0.0000	0.0000	0.0000
20	24.493	-15.097	-3.2327	0.0000	0.0000	0.0000	0.0000	0.0000
21	25.262	-14.825	-3.2384	0.0000	0.0000	0.0000	0.0000	0.0000
22	26.031	-14.552	-3.2443	0.0000	0.0000	0.0000	0.0000	0.0000
23	26.800	-14.282	-3.2511	0.0000	0.0000	0.0000	0.0000	0.0000
24	27.568	-13.998	-3.2549	0.0000	0.0000	0.0000	0.0000	0.0000
25	28.337	-13.712	-3.2584	0.0000	0.0000	0.0000	0.0000	0.0000
26	29.106	-13.427	-3.2623	0.0000	0.0000	0.0000	-1.7904E-10	0.0000
27	29.875	-13.068	-3.2485	0.0000	0.0000	0.0000	0.0000	0.0000
28	30.560	-12.768	-3.2407	0.0000	0.0000	0.0000	0.0000	0.0000
29	35.721	-12.490	-3.3494	0.0000	0.0000	0.0000	0.0000	0.0000
30	40.884	-12.147	-3.4400	0.0000	0.0000	0.0000	0.0000	0.0000
31	46.045	-11.875	-3.5499	2.7408E-27	-4.4761E-11	0.0000	0.0000	0.0000
32	95.986	-14.121	-4.4829	0.0000	0.0000	0.0000	0.0000	0.0000
33	83.769	-13.717	-4.1040	0.0000	0.0000	0.0000	0.0000	0.0000
34	71.552	-13.980	-3.9196	0.0000	0.0000	0.0000	0.0000	0.0000
35	59.335	-14.260	-3.7291	0.0000	0.0000	0.0000	0.0000	0.0000
36	92.237	-14.755	-4.4369	0.0000	0.0000	0.0000	0.0000	0.0000
37	80.020	-14.328	-4.0588	0.0000	0.0000	0.0000	0.0000	0.0000
38	67.803	-14.604	-3.8742	0.0000	0.0000	0.0000	0.0000	0.0000
39	55.586	-14.890	-3.6814	0.0000	0.0000	0.0000	0.0000	0.0000
MINIMUM	21.418	-16.169	-4.4829	0.0000	-4.4761E-11	-1.7904E-10		
Pile N.	16	16	32	1	31	26		
MAXIMUM	95.986	-11.671	-3.2099	2.7408E-27	0.0000	0.0000		
Pile N.	32	15	16	31	1	1		

THE PILE COORDINATE SYSTEM (LOCAL AXES)

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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
*****	*****	*****	*****	*****	*****	*****
1	0.011933	-2.4372	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
2	0.012133	-2.3919	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05

3	0.012333	-2.3465	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
4	0.012533	-2.3012	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
5	0.012733	-2.2558	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
6	0.012933	-2.2105	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
7	0.013133	-2.1651	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
8	0.013333	-2.1198	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
9	0.013533	-2.0744	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
10	0.013732	-2.0291	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
11	0.013932	-1.9838	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
12	0.014132	-1.9384	-0.5534	1.2596E-03	-5.5531E-06	8.8727E-05
13	0.015099	-1.8831	-0.5636	1.2596E-03	-5.5531E-06	8.8727E-05
14	0.016441	-1.8409	-0.5800	1.2596E-03	-5.5531E-06	8.8727E-05
15	0.017783	-1.7986	-0.5964	1.2596E-03	-5.5531E-06	8.8727E-05
16	5.5688E-03	-2.4318	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
17	5.7687E-03	-2.3865	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
18	5.9686E-03	-2.3411	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
19	6.1685E-03	-2.2958	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
20	6.3684E-03	-2.2504	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
21	6.5683E-03	-2.2051	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
22	6.7683E-03	-2.1597	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
23	6.9682E-03	-2.1144	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
24	7.1681E-03	-2.0690	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
25	7.3680E-03	-2.0237	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
26	7.5679E-03	-1.9783	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
27	7.7678E-03	-1.9330	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
28	7.9459E-03	-1.8926	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05
29	9.2879E-03	-1.8503	-0.4791	1.2596E-03	-5.5531E-06	8.8727E-05
30	0.010630	-1.8081	-0.4955	1.2596E-03	-5.5531E-06	8.8727E-05
31	0.011972	-1.7658	-0.5119	1.2596E-03	-5.5531E-06	8.8727E-05
32	0.024958	-2.3689	-0.7340	1.2596E-03	-5.5531E-06	8.8727E-05
33	0.021781	-2.3662	-0.6887	1.2596E-03	-5.5531E-06	8.8727E-05
34	0.018604	-2.3635	-0.6434	1.2596E-03	-5.5531E-06	8.8727E-05
35	0.015428	-2.3608	-0.5982	1.2596E-03	-5.5531E-06	8.8727E-05
36	0.023983	-2.4821	-0.7772	1.2596E-03	-5.5531E-06	8.8727E-05
37	0.020806	-2.4794	-0.6819	1.2596E-03	-5.5531E-06	8.8727E-05
38	0.017629	-2.4767	-0.6367	1.2596E-03	-5.5531E-06	8.8727E-05
39	0.014453	-2.4740	-0.5914	1.2596E-03	-5.5531E-06	8.8727E-05
MINIMUM	5.5688E-03	-2.4821	-0.7340	1.2596E-03	-5.5531E-06	8.8727E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.024958	-1.7658	-0.4627	1.2596E-03	-5.5531E-06	8.8727E-05

Pile N. 32 31 16 1 1 1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL, KIP	LAT, Y, KIP	LAT, Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1	45.895	-15.369	-3.6115	0.0000	0.0000	0.0000
2	46.664	-15.043	-3.6005	0.0000	0.0000	0.0000
3	47.433	-14.524	-3.5442	0.0000	0.0000	0.0000
4	48.202	-14.814	-3.6799	0.0000	0.0000	0.0000
5	48.971	-14.594	-3.6965	0.0000	0.0000	0.0000
6	49.740	-14.331	-3.7029	0.0000	0.0000	0.0000
7	50.509	-14.068	-3.7094	0.0000	0.0000	0.0000
8	51.277	-13.805	-3.7164	0.0000	0.0000	0.0000
9	52.046	-13.536	-3.7220	0.0000	0.0000	0.0000
10	52.815	-13.261	-3.7261	0.0000	0.0000	0.0000
11	53.584	-12.985	-3.7304	0.0000	0.0000	0.0000
12	54.353	-12.708	-3.7346	0.0000	0.0000	0.0000
13	58.070	-12.275	-3.7773	0.0000	0.0000	0.0000
14	63.232	-11.936	-3.8606	0.0000	0.0000	0.0000
15	68.394	-11.671	-3.9669	0.0000	0.0000	0.0000
16	21.418	-16.169	-3.2099	0.0000	0.0000	0.0000
17	22.186	-15.902	-3.2152	0.0000	0.0000	0.0000
18	22.955	-15.636	-3.2212	0.0000	0.0000	0.0000
19	23.724	-15.368	-3.2271	0.0000	0.0000	0.0000
20	24.493	-15.097	-3.2327	0.0000	0.0000	0.0000
21	25.262	-14.825	-3.2384	0.0000	0.0000	0.0000
22	26.031	-14.552	-3.2443	0.0000	0.0000	0.0000
23	26.800	-14.282	-3.2511	0.0000	0.0000	0.0000
24	27.568	-13.998	-3.2549	0.0000	0.0000	0.0000
25	28.337	-13.712	-3.2584	0.0000	0.0000	0.0000
26	29.106	-13.427	-3.2623	0.0000	0.0000	-1.7904E-10
27	29.875	-13.068	-3.2485	0.0000	0.0000	0.0000
28	30.560	-12.768	-3.2407	0.0000	0.0000	0.0000
29	35.721	-12.490	-3.3494	0.0000	0.0000	0.0000
30	40.884	-12.147	-3.4400	0.0000	0.0000	0.0000
31	46.045	-11.875	-3.5499	0.0000	-4.4761E-11	0.0000
32	95.986	-14.121	-4.4829	0.0000	0.0000	0.0000
33	83.769	-13.717	-4.1040	0.0000	0.0000	0.0000
34	71.552	-13.980	-3.9196	0.0000	0.0000	0.0000
35	59.335	-14.260	-3.7291	0.0000	0.0000	0.0000

36	92.237	-14.755	-4.4369	0.0000	0.0000	0.0000
37	80.020	-14.328	-4.0588	0.0000	0.0000	0.0000
38	67.803	-14.604	-3.8742	0.0000	0.0000	0.0000
39	55.586	-14.890	-3.6814	0.0000	0.0000	0.0000
MINIMUM	21.418	-16.169	-4.4829	0.0000	-4.4761E-11	-1.7904E-10
Pile N.	16	16	32	1	31	26
MAXIMUM	95.986	-11.671	-3.2099	0.0000	0.0000	0.0000
Pile N.	32	15	16	1	1	1

PILE GROUP STRESS,KIP/IN\*\*2  
 \*\*\*\*\*

1	0.6475
2	0.6583
3	0.6692
4	0.6800
5	0.6909
6	0.7017
7	0.7126
8	0.7234
9	0.7343
10	0.7451
11	0.7560
12	0.7668
13	0.8193
14	0.8921
15	0.9649
16	0.3022
17	0.3130
18	0.3239
19	0.3347
20	0.3456
21	0.3564
22	0.3672
23	0.3781
24	0.3889
25	0.3998
26	0.4106
27	0.4215
28	0.4311
29	0.5040

30 0.5768  
 31 0.6496  
 32 1.3542  
 33 1.1818  
 34 1.0095  
 35 0.8371  
 36 1.3013  
 37 1.1289  
 38 0.9566  
 39 0.7842  
  
 MINIMUM 0.3022  
 Pile N. 16  
 MAXIMUM 1.3542  
 Pile N. 32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL. IN	MOMENT		MOMENT KIP-IN	SHEAR		SOIL REACT		SOIL REACT KIP/IN	TOTAL STRESS		FLEX. RIG.		FLEX. RIG. KIP-IN**2
	y-DIR IN	z-DIR IN		y-DIR KIP	z-DIR KIP		y-DIR KIP/IN	z-DIR KIP/IN	STRESS KIP/IN**2	z-DIR KIP-IN**2		FLEX. RIG. KIP-IN**2	y-DIR KIP-IN**2			
1	-2.4372	-0.5534	*****	-1624.6	-382.98	*****	-3.6115	-26.815	-6.1648	0.6475	2.5330E+05	0.6475	2.5330E+05	3.0477E+05	*****	
x(FT)	0.0000	0.0000	*****	10.080	10.080	*****	1.8900	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130	*****	
2	-2.3919	-0.5534	*****	-1594.4	-382.77	*****	-3.6005	-26.187	-6.1331	0.6583	2.5315E+05	0.6583	2.5315E+05	3.0246E+05	*****	
x(FT)	0.0000	0.0000	*****	10.080	10.080	*****	1.0500	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130	*****	
3	-2.3465	-0.5534	*****	-1557.4	-381.10	*****	-3.5442	-24.426	-5.8212	0.6692	2.4327E+05	0.6692	2.4327E+05	2.9486E+05	*****	
x(FT)	0.0000	0.0000	*****	10.080	10.080	*****	2.3100	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130	*****	
4	-2.3012	-0.5534	*****	-1545.5	-385.17	*****	-3.6799	-27.566	-6.7104	0.6800	2.7073E+05	0.6800	2.7073E+05	3.3115E+05	*****	
x(FT)	0.0000	0.0000	*****	10.080	10.080	*****	0.4200	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130	*****	
5	-2.2558	-0.5534	*****	-1517.3	-385.57	*****	-3.6965	-27.664	-6.8633	0.6909	2.7423E+05	0.6909	2.7423E+05	3.4427E+05	*****	
x(FT)	0.0000	0.0000	*****	10.080	10.080	*****	1.8900	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130	*****	
6	-2.2105	-0.5534	*****	-1488.3	-385.79	*****	-3.7029	-27.478	-6.9521	0.7017	2.7595E+05	0.7017	2.7595E+05	3.5247E+05	*****	
x(FT)	0.0000	0.0000	*****	10.080	10.080	*****	0.4200	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130	*****	
7	-2.1651	-0.5534	*****	-1459.2	-386.00	*****	-3.7094	-27.290	-7.0457	0.7126	2.7762E+05	0.7126	2.7762E+05	3.5747E+05	*****	
x(FT)	0.0000	0.0000	*****	10.080	10.080	*****	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130	*****	
8	-2.1198	-0.5534	*****	-1430.1	-386.22	*****	-3.7164	-27.097	-7.1424	0.7234	2.7926E+05	0.7234	2.7926E+05	3.6288E+05	*****	
x(FT)	0.0000	0.0000	*****	10.080	10.080	*****	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130	*****	
9	-2.0744	-0.5534	*****	-1400.1	-386.20	*****	-3.7220	-26.968	-7.2590	0.7343	2.8093E+05	0.7343	2.8093E+05	3.7083E+05	*****	

x(FT)	0.0000	10.080	10.080	3.3600	2.1000	10.080	10.080	0.0000	11.130	11.130
10	-2.0291	-1369.2	-385.94	-13.261	-3.7261	-26.830	-7.3801	0.7451	2.8198E+05	3.7481E+05
x(FT)	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	11.130
11	-1.9838	-1338.4	-385.72	-12.985	-3.7304	-26.715	-7.5133	0.7560	2.8305E+05	3.7865E+05
x(FT)	0.0000	10.080	10.080	0.2100	0.4200	10.080	10.080	0.0000	11.130	11.130
12	-1.9384	-1307.7	-385.49	-12.708	-3.7346	-26.574	-7.6458	0.7668	2.8437E+05	3.8139E+05
x(FT)	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	11.130
13	-1.8831	-1270.3	-391.98	-12.275	-3.7773	-25.877	-7.8050	0.8193	2.8481E+05	3.7088E+05
x(FT)	0.0000	10.080	10.080	3.1500	0.0000	10.080	10.080	0.0000	11.130	11.130
14	-1.8409	-1240.6	-402.28	-11.936	-3.8606	-25.650	-8.1425	0.8921	2.8576E+05	3.6363E+05
x(FT)	0.0000	10.080	10.080	3.3600	0.0000	10.080	10.080	0.0000	11.130	11.130
15	-1.7986	-1209.8	-412.19	-11.671	-3.9669	-26.207	-8.7445	0.9649	2.8849E+05	3.7887E+05
x(FT)	0.0000	10.080	10.080	0.2100	0.2100	10.080	10.080	0.0000	11.130	11.130
16	-2.4318	-1635.6	-326.55	-16.169	-3.2099	-28.614	-5.5277	0.3022	2.6467E+05	3.5530E+05
x(FT)	0.0000	10.080	10.080	1.0500	1.4700	10.080	10.080	0.0000	11.130	11.130
17	-2.3865	-1607.3	-326.78	-15.902	-3.2152	-28.417	-5.5913	0.3130	2.6728E+05	3.6174E+05
x(FT)	0.0000	10.080	10.080	3.3600	1.4700	10.080	10.080	0.0000	11.130	11.130
18	-2.3411	-1578.8	-327.05	-15.636	-3.2212	-28.226	-5.6555	0.3239	2.6989E+05	3.7629E+05
x(FT)	0.0000	10.080	10.080	0.2100	2.9400	10.080	10.080	0.0000	11.130	11.130
19	-2.2958	-1550.1	-327.28	-15.368	-3.2271	-28.044	-5.7270	0.3347	2.7229E+05	3.8571E+05
x(FT)	0.0000	10.080	10.080	3.1500	3.3600	10.080	10.080	0.0000	11.130	11.130
20	-2.2504	-1520.9	-327.45	-15.097	-3.2327	-27.867	-5.8001	0.3456	2.7425E+05	3.9827E+05
x(FT)	0.0000	10.080	10.080	0.0000	0.6300	10.080	10.080	0.0000	11.130	11.130
21	-2.2051	-1491.8	-327.65	-14.825	-3.2384	-27.687	-5.8755	0.3564	2.7599E+05	4.1194E+05
x(FT)	0.0000	10.080	10.080	0.2100	3.3600	10.080	10.080	0.0000	11.130	11.130
22	-2.1597	-1462.6	-327.85	-14.552	-3.2443	-27.503	-5.9532	0.3672	2.7767E+05	4.2690E+05
x(FT)	0.0000	10.080	10.080	0.8400	0.0000	10.080	10.080	0.0000	11.130	11.130
23	-2.1144	-1433.7	-328.14	-14.282	-3.2511	-27.344	-6.0343	0.3781	2.7949E+05	4.5860E+05
x(FT)	0.0000	10.080	10.080	3.3600	2.7300	10.080	10.080	0.0000	11.130	11.130
24	-2.0690	-1402.8	-327.95	-13.998	-3.2549	-27.229	-6.1390	0.3889	2.8094E+05	4.6284E+05
x(FT)	0.0000	10.080	10.080	1.0500	0.0000	10.080	10.080	0.0000	11.130	11.130
25	-2.0237	-1371.8	-327.73	-13.712	-3.2584	-27.086	-6.2429	0.3998	2.8196E+05	4.6416E+05
x(FT)	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
26	-1.9783	-1340.9	-327.54	-13.427	-3.2623	-26.979	-6.3565	0.4106	2.8305E+05	4.7564E+05
x(FT)	0.0000	10.080	10.080	1.6800	2.3100	10.080	10.080	0.0000	11.130	11.130
27	-1.9330	-1311.2	-327.60	-13.068	-3.2485	-26.075	-6.2950	0.4215	2.8256E+05	4.4373E+05
x(FT)	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
28	-1.8926	-1284.3	-327.58	-12.768	-3.2407	-25.471	-6.2843	0.4311	2.8252E+05	4.2797E+05
x(FT)	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
29	-1.8503	-1253.5	-337.69	-12.490	-3.3494	-26.027	-6.7847	0.5040	2.8544E+05	4.5102E+05
x(FT)	0.0000	10.080	10.080	0.0000	1.4700	10.080	10.080	0.0000	11.130	11.130

30	-1.8081	-0.4955	-1223.8	-348.02	-12.147	-3.4400	-25.850	-7.1305	0.5768	2.8643E+05	4.3503E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	2.3100	10.080	10.080	0.0000	11.130	11.130
31	-1.7658	-0.5119	-1192.9	-358.00	-11.875	-3.5499	-26.429	-7.6931	0.6496	2.8939E+05	4.6821E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	1.2600	10.080	10.080	0.0000	11.130	11.130
32	-2.3689	-0.7340	-1574.1	-500.24	-14.121	-4.4829	-27.681	-8.6577	1.3542	2.6885E+05	3.0231E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.8400	2.7300	10.080	10.080	0.0000	11.130	11.130
33	-2.3662	-0.6887	-1555.9	-466.00	-13.717	-4.1040	-23.708	-6.9202	1.1818	2.3773E+05	2.9716E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
34	-2.3635	-0.6434	-1557.8	-437.40	-13.980	-3.9196	-23.801	-6.5116	1.0095	2.3786E+05	2.9463E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.2100	10.080	10.080	0.0000	11.130	11.130
35	-2.3608	-0.5982	-1560.3	-408.87	-14.260	-3.7291	-23.988	-6.1267	0.8371	2.3890E+05	2.8995E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
36	-2.4821	-0.7272	-1644.5	-495.12	-14.755	-4.4369	-28.185	-8.3417	1.3013	2.6216E+05	2.9681E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
37	-2.4794	-0.6819	-1624.0	-460.62	-14.328	-4.0588	-24.201	-6.6613	1.1289	2.2658E+05	2.9541E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	3.3600	10.080	10.080	0.0000	11.130	11.130
38	-2.4767	-0.6367	-1626.0	-432.15	-14.604	-3.8742	-24.287	-6.2561	0.9566	2.2669E+05	2.9784E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	3.3600	10.080	10.080	0.0000	11.130	11.130
39	-2.4740	-0.5914	-1628.6	-403.61	-14.890	-3.6814	-24.424	-5.8703	0.7842	2.2755E+05	2.9208E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	0.0000	10.080	10.080	0.0000	11.130	11.130
Min.	-2.4821	-0.7340	-1644.5	-500.24	-16.169	-4.4829	-28.614	-8.7445	0.3022	2.2658E+05	2.8995E+05
Pile N.	36	32	36	32	16	32	16	15	16	37	35

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL. y-DIR IN	DISPL. z-DIR IN	MOMENT		SHEAR		SOIL REACT		TOTAL STRESS KIP/IN**2	FLEX. RIG.		FLEX. RIG. y-DIR KIP-IN**2
			z-DIR KIP-IN	y-DIR KIP-IN	y-DIR KIP/IN	z-DIR KIP/IN	z-DIR KIP-IN**2	y-DIR KIP-IN**2				
1	4.0878E-03	9.0326E-04	36.920	14.367	152.94	35.749	20.278	4.4808	0.9131	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
2	4.0953E-03	9.2232E-04	36.411	14.448	149.94	35.704	19.824	4.4645	0.9284	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
3	4.5649E-03	1.0383E-03	38.177	15.203	147.14	35.640	18.309	4.1645	0.9436	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
4	3.1706E-03	7.4733E-04	31.354	12.486	142.96	35.367	21.237	5.0057	0.9589	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
5	2.9980E-03	7.1904E-04	30.440	12.099	140.46	35.186	20.752	4.9770	0.9742	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
6	2.9080E-03	7.1003E-04	29.853	11.933	138.66	35.252	20.128	4.9147	0.9895	5.1206E+06	5.1206E+06	5.1206E+06

x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
7	2.8183E-03	7.0213E-04	29.368	136.86	19.508	4.8600	4.8600	1.0048	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
8	2.7289E-03	6.9401E-04	28.962	135.04	18.889	4.8038	4.8038	1.0201	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
9	2.6472E-03	6.8645E-04	28.389	132.57	18.323	4.7515	4.7515	1.0354	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
10	2.5728E-03	6.8148E-04	27.923	129.61	17.808	4.7171	4.7171	1.0507	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
11	2.4977E-03	6.7641E-04	27.591	126.66	17.289	4.6820	4.6820	1.0660	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
12	2.4241E-03	6.7203E-04	27.273	123.71	16.771	4.6493	4.6493	1.0813	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
13	2.3969E-03	6.9843E-04	26.747	119.79	16.235	4.7307	4.7307	1.1553	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
14	2.3299E-03	7.1655E-04	26.428	116.94	15.755	4.8453	4.8453	1.2580	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
15	2.1633E-03	6.9803E-04	26.281	114.50	15.116	4.8776	4.8776	1.3606	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
16	3.5082E-03	6.5009E-04	34.054	152.61	21.857	4.0502	4.0502	0.4261	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
17	3.3651E-03	6.3538E-04	32.954	149.47	21.780	4.1125	4.1125	0.4414	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
18	3.2197E-03	6.1744E-04	31.898	146.31	21.710	4.1633	4.1633	0.4567	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
19	3.0942E-03	6.0437E-04	31.057	143.11	21.418	4.1833	4.1833	0.4720	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
20	3.0017E-03	5.9592E-04	30.480	140.93	20.778	4.1249	4.1249	0.4873	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.710	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
21	2.9108E-03	5.8739E-04	29.894	139.15	20.148	4.0658	4.0658	0.5026	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
22	2.8203E-03	5.7868E-04	29.394	137.36	19.522	4.0055	4.0055	0.5179	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
23	2.7275E-03	5.6597E-04	29.012	135.67	18.879	3.9175	3.9175	0.5332	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
24	2.6502E-03	5.6180E-04	28.420	133.80	18.344	3.8887	3.8887	0.5485	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
25	2.5757E-03	5.5856E-04	27.941	129.84	17.829	3.8663	3.8663	0.5637	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
26	2.4999E-03	5.5294E-04	27.606	126.88	17.304	3.8273	3.8273	0.5790	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	10.500	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000

27	2.5280E-03	5.7772E-04	27.292	9.0034	123.48	29.954	16.931	3.8691	0.5943	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
28	2.5263E-03	5.9263E-04	26.970	9.1707	120.57	29.899	16.558	3.8841	0.6080	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
29	2.3557E-03	5.8154E-04	26.536	9.1485	118.14	30.928	15.929	3.9324	0.7107	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
30	2.2830E-03	5.9972E-04	26.295	9.5661	115.31	31.943	15.438	4.0554	0.8134	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
31	2.1172E-03	5.8331E-04	26.067	9.4243	112.85	32.955	14.794	4.0759	0.9160	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
32	3.2720E-03	9.9365E-04	32.242	17.127	146.09	46.256	21.251	6.4534	1.9096	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
33	4.8276E-03	1.3279E-03	39.431	18.948	147.51	43.613	17.756	4.9558	1.6665	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.340	11.130	0.0000	0.0000
34	4.8236E-03	1.2473E-03	39.407	17.813	147.67	40.959	17.827	4.6490	1.4235	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.340	11.130	0.0000	0.0000
35	4.7773E-03	1.1598E-03	39.210	16.709	147.82	38.325	17.982	4.3656	1.1804	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
36	3.6294E-03	1.0396E-03	35.080	17.836	153.90	46.131	21.433	6.1396	1.8350	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
37	5.4006E-03	1.3879E-03	43.132	19.743	155.47	43.352	18.383	4.8112	1.5920	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	11.340	11.130	0.0000	0.0000
38	5.3923E-03	1.2967E-03	43.164	18.453	155.64	40.646	18.360	4.5272	1.3489	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	11.340	11.130	0.0000	0.0000
39	5.3480E-03	1.2074E-03	43.134	17.229	155.81	38.014	18.305	4.2626	1.1058	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	11.340	11.130	0.0000	0.0000
Max.	5.4006E-03	1.3879E-03	43.164	19.743	155.81	46.256	21.857	6.4534	1.9096	5.1206E+06	5.1206E+06
Pile N.	37	37	38	37	39	32	16	32	32	1	1

LOAD CASE : 4  
CASE NAME : Strength V  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO      P-FACTOR      Y-FACTOR

1	0.9116	1.0000
2	0.8906	1.0000
3	0.8237	1.0000
4	0.9694	1.0000
5	0.9817	1.0000
6	0.9817	1.0000
7	0.9817	1.0000
8	0.9817	1.0000
9	0.9817	1.0000
10	0.9817	1.0000
11	0.9817	1.0000
12	0.9836	1.0000
13	0.9624	1.0000
14	0.9606	1.0000
15	0.9979	1.0000
16	0.9824	1.0000
17	0.9817	1.0000
18	0.9817	1.0000
19	0.9817	1.0000
20	0.9817	1.0000
21	0.9817	1.0000
22	0.9817	1.0000
23	0.9817	1.0000
24	0.9817	1.0000
25	0.9817	1.0000
26	0.9817	1.0000
27	0.9496	1.0000
28	0.9311	1.0000
29	0.9606	1.0000
30	0.9606	1.0000
31	0.9979	1.0000
32	0.9907	1.0000
33	0.8115	1.0000
34	0.8115	1.0000
35	0.8137	1.0000
36	0.9907	1.0000
37	0.8115	1.0000
38	0.8115	1.0000
39	0.8106	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1871.72	-569.100	-189.590
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	11992.7	50750.8

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
0.0126317	-2.31997	-0.75429
ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
1.41119E-03	-6.55678E-06	1.05193E-04

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	0.011943	-2.5998	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
2	0.012179	-2.5490	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
3	0.012415	-2.4982	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
4	0.012651	-2.4474	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
5	0.012887	-2.3966	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
6	0.013123	-2.3458	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
7	0.013359	-2.2950	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
8	0.013595	-2.2442	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
9	0.013831	-2.1934	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
10	0.014067	-2.1426	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04

11	0.014303	-2.0918	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
12	0.014539	-2.0410	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
13	0.015684	-1.9790	-0.7740	1.4112E-03	-6.5568E-06	1.0519E-04
14	0.017274	-1.9317	-0.7924	1.4112E-03	-6.5568E-06	1.0519E-04
15	0.018864	-1.8843	-0.8107	1.4112E-03	-6.5568E-06	1.0519E-04
16	4.3970E-03	-2.5937	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
17	4.6330E-03	-2.5429	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
18	4.8691E-03	-2.4921	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
19	5.1051E-03	-2.4413	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
20	5.3412E-03	-2.3905	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
21	5.5772E-03	-2.3397	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
22	5.8133E-03	-2.2889	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
23	6.0493E-03	-2.2381	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
24	6.2854E-03	-2.1873	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
25	6.5214E-03	-2.1365	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
26	6.7574E-03	-2.0857	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
27	6.9935E-03	-2.0349	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
28	7.2038E-03	-1.9896	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
29	8.7940E-03	-1.9423	-0.6793	1.4112E-03	-6.5568E-06	1.0519E-04
30	0.010384	-1.8949	-0.6976	1.4112E-03	-6.5568E-06	1.0519E-04
31	0.011975	-1.8476	-0.7160	1.4112E-03	-6.5568E-06	1.0519E-04
32	0.027382	-2.5233	-0.9648	1.4112E-03	-6.5568E-06	1.0519E-04
33	0.023616	-2.5203	-0.9141	1.4112E-03	-6.5568E-06	1.0519E-04
34	0.019850	-2.5173	-0.8634	1.4112E-03	-6.5568E-06	1.0519E-04
35	0.016084	-2.5142	-0.8127	1.4112E-03	-6.5568E-06	1.0519E-04
36	0.026229	-2.6501	-0.9573	1.4112E-03	-6.5568E-06	1.0519E-04
37	0.022463	-2.6471	-0.9066	1.4112E-03	-6.5568E-06	1.0519E-04
38	0.018697	-2.6440	-0.8558	1.4112E-03	-6.5568E-06	1.0519E-04
39	0.014931	-2.6410	-0.8051	1.4112E-03	-6.5568E-06	1.0519E-04
MINIMUM	4.3970E-03	-2.6501	-0.9648	1.4112E-03	-6.5568E-06	1.0519E-04
Pile N.	16	36	32	1	1	1
MAXIMUM	0.027382	-1.8476	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X, KIP	FOR. Y, KIP	FOR. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	45.932	-16.121	-4.8538	0.0000	0.0000	0.0000
2	46.840	-15.770	-4.8370	0.0000	0.0000	0.0000

3	47.747	-15.221	-4.7623	0.0000	0.0000	0.0000	0.0000	0.0000
4	48.655	-15.495	-4.9380	0.0000	0.0000	0.0000	0.0000	0.0000
5	49.563	-15.252	-4.9603	0.0000	0.0000	0.0000	0.0000	0.0000
6	50.471	-14.963	-4.9690	0.0000	0.0000	0.0000	0.0000	0.0000
7	51.379	-14.673	-4.9783	0.0000	0.0000	0.0000	0.0000	0.0000
8	52.287	-14.384	-4.9882	0.0000	0.0000	0.0000	0.0000	0.0000
9	53.194	-14.091	-4.9974	0.0000	0.0000	0.0000	0.0000	0.0000
10	54.102	-13.795	-5.0063	0.0000	0.0000	0.0000	0.0000	0.0000
11	55.010	-13.500	-5.0156	0.0000	0.0000	0.0000	0.0000	0.0000
12	55.918	-13.209	-5.0275	0.0000	0.0000	0.0000	0.0000	0.0000
13	60.320	-12.725	-5.0659	0.0000	0.0000	0.0000	1.7904E-10	0.0000
14	66.437	-12.335	-5.1455	0.0000	0.0000	0.0000	0.0000	0.0000
15	72.553	-12.033	-5.2595	0.0000	0.0000	0.0000	0.0000	0.0000
16	16.911	-17.066	-4.4766	0.0000	0.0000	0.0000	0.0000	0.0000
17	17.819	-16.777	-4.4828	0.0000	0.0000	0.0000	0.0000	0.0000
18	18.727	-16.486	-4.4901	0.0000	0.0000	0.0000	0.0000	0.0000
19	19.634	-16.191	-4.4978	0.0000	0.0000	0.0000	0.0000	0.0000
20	20.542	-15.891	-4.5055	0.0000	0.0000	0.0000	0.0000	0.0000
21	21.450	-15.590	-4.5137	0.0000	0.0000	0.0000	0.0000	0.0000
22	22.358	-15.288	-4.5224	0.0000	0.0000	0.0000	0.0000	0.0000
23	23.266	-14.985	-4.5314	0.0000	0.0000	0.0000	0.0000	0.0000
24	24.174	-14.678	-4.5396	0.0000	0.0000	0.0000	0.0000	0.0000
25	25.081	-14.370	-4.5480	0.0000	0.0000	0.0000	0.0000	0.0000
26	25.989	-14.062	-4.5569	0.0000	0.0000	0.0000	0.0000	0.0000
27	26.897	-13.662	-4.5359	0.0000	0.0000	0.0000	0.0000	0.0000
28	27.706	-13.335	-4.5265	0.0000	0.0000	0.0000	0.0000	0.0000
29	33.822	-13.019	-4.6469	0.0000	0.0000	0.0000	-1.7904E-10	0.0000
30	39.938	-12.622	-4.7378	0.0000	0.0000	0.0000	0.0000	0.0000
31	46.055	-12.312	-4.8587	0.0000	0.0000	0.0000	0.0000	0.0000
32	105.31	-14.575	-5.6860	0.0000	0.0000	0.0000	0.0000	0.0000
33	90.828	-14.236	-5.2778	0.0000	0.0000	0.0000	0.0000	0.0000
34	76.344	-14.571	-5.1139	0.0000	0.0000	0.0000	0.0000	0.0000
35	61.859	-14.916	-4.9385	0.0000	0.0000	0.0000	0.0000	0.0000
36	100.88	-15.255	-5.6431	0.0000	0.0000	0.0000	0.0000	0.0000
37	86.393	-14.866	-5.2217	0.0000	0.0000	0.0000	0.0000	0.0000
38	71.908	-15.219	-5.0570	0.0000	0.0000	0.0000	0.0000	0.0000
39	57.423	-15.564	-4.8768	0.0000	0.0000	0.0000	0.0000	0.0000
MINIMUM	16.911	-17.066	-5.6860	0.0000	0.0000	0.0000	-1.7904E-10	0.0000
Pile N.	16	16	32	1	1	1	29	29
MAXIMUM	105.31	-12.033	-4.4766	0.0000	0.0000	0.0000	1.7904E-10	0.0000

THE PILE COORDINATE SYSTEM (LOCAL AXES)

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 \* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
*****	*****	*****	*****	*****	*****	*****
1	0.011943	-2.5998	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
2	0.012179	-2.5490	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
3	0.012415	-2.4982	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
4	0.012651	-2.4474	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
5	0.012887	-2.3966	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
6	0.013123	-2.3458	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
7	0.013359	-2.2950	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
8	0.013595	-2.2442	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
9	0.013831	-2.1934	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
10	0.014067	-2.1426	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
11	0.014303	-2.0918	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
12	0.014539	-2.0410	-0.7625	1.4112E-03	-6.5568E-06	1.0519E-04
13	0.015684	-1.9790	-0.7740	1.4112E-03	-6.5568E-06	1.0519E-04
14	0.017274	-1.9317	-0.7924	1.4112E-03	-6.5568E-06	1.0519E-04
15	0.018864	-1.8843	-0.8107	1.4112E-03	-6.5568E-06	1.0519E-04
16	4.3970E-03	-2.5937	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
17	4.6330E-03	-2.5429	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
18	4.8691E-03	-2.4921	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
19	5.1051E-03	-2.4413	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
20	5.3412E-03	-2.3905	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
21	5.5772E-03	-2.3397	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
22	5.8133E-03	-2.2889	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
23	6.0493E-03	-2.2381	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
24	6.2854E-03	-2.1873	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
25	6.5214E-03	-2.1365	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
26	6.7574E-03	-2.0857	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
27	6.9935E-03	-2.0349	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
28	7.2038E-03	-1.9896	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
29	8.7940E-03	-1.9423	-0.6793	1.4112E-03	-6.5568E-06	1.0519E-04
30	0.010384	-1.8949	-0.6976	1.4112E-03	-6.5568E-06	1.0519E-04
31	0.011975	-1.8476	-0.7160	1.4112E-03	-6.5568E-06	1.0519E-04

32	0.027382	-2.5233	-0.9648	1.4112E-03	-6.5568E-06	1.0519E-04
33	0.023616	-2.5203	-0.9141	1.4112E-03	-6.5568E-06	1.0519E-04
34	0.019850	-2.5173	-0.8634	1.4112E-03	-6.5568E-06	1.0519E-04
35	0.016084	-2.5142	-0.8127	1.4112E-03	-6.5568E-06	1.0519E-04
36	0.026229	-2.6501	-0.9573	1.4112E-03	-6.5568E-06	1.0519E-04
37	0.022463	-2.6471	-0.9066	1.4112E-03	-6.5568E-06	1.0519E-04
38	0.018697	-2.6440	-0.8558	1.4112E-03	-6.5568E-06	1.0519E-04
39	0.014931	-2.6410	-0.8051	1.4112E-03	-6.5568E-06	1.0519E-04
MINIMUM	4.3970E-03	-2.6501	-0.9648	1.4112E-03	-6.5568E-06	1.0519E-04
Pile N.	16	36	32	1	1	1
MAXIMUM	0.027382	-1.8476	-0.6609	1.4112E-03	-6.5568E-06	1.0519E-04
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL, KIP	LAT, Y, KIP	LAT, Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	45.932	-16.121	-4.8538	0.0000	0.0000	0.0000
2	46.840	-15.770	-4.8370	0.0000	0.0000	0.0000
3	47.747	-15.221	-4.7623	0.0000	0.0000	0.0000
4	48.655	-15.495	-4.9380	0.0000	0.0000	0.0000
5	49.563	-15.252	-4.9603	0.0000	0.0000	0.0000
6	50.471	-14.963	-4.9690	0.0000	0.0000	0.0000
7	51.379	-14.673	-4.9783	0.0000	0.0000	0.0000
8	52.287	-14.384	-4.9882	0.0000	0.0000	0.0000
9	53.194	-14.091	-4.9974	0.0000	0.0000	0.0000
10	54.102	-13.795	-5.0063	0.0000	0.0000	0.0000
11	55.010	-13.500	-5.0156	0.0000	0.0000	0.0000
12	55.918	-13.209	-5.0275	0.0000	0.0000	0.0000
13	60.320	-12.725	-5.0659	0.0000	0.0000	1.7904E-10
14	66.437	-12.335	-5.1455	0.0000	0.0000	0.0000
15	72.553	-12.033	-5.2595	0.0000	0.0000	0.0000
16	16.911	-17.066	-4.4766	0.0000	0.0000	0.0000
17	17.819	-16.777	-4.4828	0.0000	0.0000	0.0000
18	18.727	-16.486	-4.4901	0.0000	0.0000	0.0000
19	19.634	-16.191	-4.4978	0.0000	0.0000	0.0000
20	20.542	-15.891	-4.5055	0.0000	0.0000	0.0000
21	21.450	-15.590	-4.5137	0.0000	0.0000	0.0000
22	22.358	-15.288	-4.5224	0.0000	0.0000	0.0000
23	23.266	-14.985	-4.5314	0.0000	0.0000	0.0000

24	24.174	-14.678	-4.5396	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	25.081	-14.370	-4.5480	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	25.989	-14.062	-4.5569	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	26.897	-13.662	-4.5359	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	27.706	-13.335	-4.5265	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	33.822	-13.019	-4.6469	0.0000	0.0000	0.0000	-1.7904E-10	0.0000	0.0000
30	39.938	-12.622	-4.7378	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	46.055	-12.312	-4.8587	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	105.31	-14.575	-5.6860	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33	90.828	-14.236	-5.2778	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	76.344	-14.571	-5.1139	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35	61.859	-14.916	-4.9385	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
36	100.88	-15.255	-5.6431	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
37	86.393	-14.866	-5.2217	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
38	71.908	-15.219	-5.0570	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
39	57.423	-15.564	-4.8768	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
MINIMUM	16.911	-17.066	-5.6860	0.0000	0.0000	0.0000	-1.7904E-10	0.0000	0.0000
Pile N.	16	16	32	1	1	1	29	1	13
MAXIMUM	105.31	-12.033	-4.4766	0.0000	0.0000	0.0000	1.7904E-10	0.0000	0.0000
Pile N.	32	15	16	1	1	1	13	1	13

PILE GROUP STRESS, KIP/IN\*\*2  
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1	0.6480
2	0.6608
3	0.6736
4	0.6864
5	0.6992
6	0.7120
7	0.7248
8	0.7377
9	0.7505
10	0.7633
11	0.7761
12	0.7889
13	0.8510
14	0.9373
15	1.0236
16	0.2386
17	0.2514

18 0.2642  
 19 0.2770  
 20 0.2898  
 21 0.3026  
 22 0.3154  
 23 0.3282  
 24 0.3410  
 25 0.3538  
 26 0.3666  
 27 0.3795  
 28 0.3909  
 29 0.4772  
 30 0.5635  
 31 0.6497  
 32 1.4857  
 33 1.2814  
 34 1.0771  
 35 0.8727  
 36 1.4232  
 37 1.2188  
 38 1.0145  
 39 0.8101

MINIMUM 0.2386  
 Pile N. 16  
 MAXIMUM 1.4857  
 Pile N. 32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL.		MOMENT		MOMENT		SHEAR		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.	
	y-DIR IN	z-DIR IN	y-DIR KIP	z-DIR KIP	y-DIR KIP-IN	z-DIR KIP-IN	y-DIR KIP	z-DIR KIP	y-DIR KIP-IN	z-DIR KIP-IN	y-DIR KIP-IN	z-DIR KIP-IN	y-DIR KIP-IN	z-DIR KIP-IN	STRESS KIP/IN**2	z-DIR KIP-IN**2	z-DIR KIP-IN**2	y-DIR KIP-IN**2	z-DIR KIP-IN**2	y-DIR KIP-IN**2	z-DIR KIP-IN**2	
1	-2.5998	-0.7625	-16.121	-4.8538	-519.47	-1720.1	-16.121	-4.8538	-27.028	-7.9723	-27.028	-7.9723	-27.028	-7.9723	0.6480	2.3876E+05	2.3876E+05	2.9709E+05	2.3876E+05	2.9709E+05	2.3876E+05	2.9709E+05
x(FT)	0.0000	0.0000	0.6300	0.0000	10.080	10.080	0.6300	0.0000	10.080	10.080	10.080	10.080	10.080	10.080	0.0000	11.130	11.130	11.130	11.130	11.130	11.130	11.130
2	-2.5490	-0.7625	-15.770	-4.8370	-519.04	-1687.6	-15.770	-4.8370	-26.359	-7.9171	-26.359	-7.9171	-26.359	-7.9171	0.6608	2.3843E+05	2.3843E+05	2.9632E+05	2.3843E+05	2.9632E+05	2.3843E+05	2.9632E+05
x(FT)	0.0000	0.0000	3.3600	0.0000	10.080	10.080	3.3600	0.0000	10.080	10.080	10.080	10.080	10.080	10.080	0.0000	11.130	11.130	11.130	11.130	11.130	11.130	11.130
3	-2.4982	-0.7625	-15.221	-4.7623	-516.41	-1646.3	-15.221	-4.7623	-24.683	-7.5290	-24.683	-7.5290	-24.683	-7.5290	0.6736	2.2677E+05	2.2677E+05	2.9248E+05	2.2677E+05	2.9248E+05	2.2677E+05	2.9248E+05

x(FT)	0.0000	0.0000	10.080	0.4200	2.1000	10.080	10.080	10.080	10.080	0.0000	11.130	11.130
4	-2.4474	-0.7625	-1633.5	-15.495	-4.9380	-521.88	-27.622	-8.6790	2.5887E+05	0.6864	2.5887E+05	2.9164E+05
x(FT)	0.0000	0.0000	10.080	0.0000	1.4700	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
5	-2.3966	-0.7625	-1603.1	-15.252	-4.9603	-522.64	-27.674	-8.8804	2.6406E+05	0.6992	2.6406E+05	2.9586E+05
x(FT)	0.0000	0.0000	10.080	0.0000	0.0000	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
6	-2.3458	-0.7625	-1571.3	-14.963	-4.9690	-523.03	-27.441	-8.9970	2.6696E+05	0.7120	2.6696E+05	2.9667E+05
x(FT)	0.0000	0.0000	10.080	3.3600	3.3600	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
7	-2.2950	-0.7625	-1539.3	-14.673	-4.9783	-523.45	-27.205	-9.1162	2.6978E+05	0.7248	2.6978E+05	2.9931E+05
x(FT)	0.0000	0.0000	10.080	3.3600	3.1500	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
8	-2.2442	-0.7625	-1507.3	-14.384	-4.9882	-523.89	-26.965	-9.2393	2.7252E+05	0.7377	2.7252E+05	3.0220E+05
x(FT)	0.0000	0.0000	10.080	3.3600	2.7300	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
9	-2.1934	-0.7625	-1474.8	-14.091	-4.9974	-524.17	-26.741	-9.3736	2.7487E+05	0.7505	2.7487E+05	3.0344E+05
x(FT)	0.0000	0.0000	10.080	2.5200	2.5200	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
10	-2.1426	-0.7625	-1442.2	-13.795	-5.0063	-524.47	-26.512	-9.5108	2.7674E+05	0.7633	2.7674E+05	3.0552E+05
x(FT)	0.0000	0.0000	10.080	2.7300	0.2100	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
11	-2.0918	-0.7625	-1409.5	-13.500	-5.0156	-524.78	-26.276	-9.6528	2.7854E+05	0.7761	2.7854E+05	3.0744E+05
x(FT)	0.0000	0.0000	10.080	0.0000	0.0000	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
12	-2.0410	-0.7625	-1376.9	-13.209	-5.0275	-525.14	-26.074	-9.8124	2.8074E+05	0.7889	2.8074E+05	3.1218E+05
x(FT)	0.0000	0.0000	10.080	0.0000	1.0500	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
13	-1.9790	-0.7740	-1335.4	-12.725	-5.0659	-532.56	-25.308	-9.9674	2.8137E+05	0.8510	2.8137E+05	3.0837E+05
x(FT)	0.0000	0.0000	10.080	3.3600	3.3600	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
14	-1.9317	-0.7924	-1302.1	-12.335	-5.1455	-544.02	-25.058	-10.347	2.8247E+05	0.9373	2.8247E+05	3.0677E+05
x(FT)	0.0000	0.0000	10.080	0.4200	0.0000	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
15	-1.8843	-0.8107	-1267.4	-12.033	-5.2595	-554.82	-25.651	-11.104	2.8569E+05	1.0236	2.8569E+05	3.1238E+05
x(FT)	0.0000	0.0000	10.080	-17.066	0.8400	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
16	-2.5937	-0.6609	-1732.4	-17.066	-4.4766	-456.53	-28.813	-7.4348	2.5176E+05	0.2386	2.5176E+05	2.9647E+05
x(FT)	0.0000	0.0000	10.080	3.3600	3.3600	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
17	-2.5429	-0.6609	-1702.1	-16.777	-4.4828	-456.73	-28.590	-7.5181	2.5490E+05	0.2514	2.5490E+05	2.9680E+05
x(FT)	0.0000	0.0000	10.080	3.3600	2.3100	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
18	-2.4921	-0.6609	-1671.3	-16.486	-4.4901	-456.99	-28.377	-7.6077	2.5806E+05	0.2642	2.5806E+05	2.9935E+05
x(FT)	0.0000	0.0000	10.080	2.1000	3.3600	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
19	-2.4413	-0.6609	-1639.9	-16.191	-4.4978	-457.28	-28.158	-7.7027	2.6129E+05	0.2770	2.6129E+05	3.0168E+05
x(FT)	0.0000	0.0000	10.080	0.0000	3.3600	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
20	-2.3905	-0.6609	-1608.2	-15.891	-4.5055	-457.62	-27.935	-7.8032	2.6433E+05	0.2898	2.6433E+05	3.0323E+05
x(FT)	0.0000	0.0000	10.080	0.0000	0.2100	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
21	-2.3397	-0.6609	-1576.2	-15.590	-4.5137	-457.99	-27.708	-7.9072	2.6728E+05	0.3026	2.6728E+05	3.0563E+05
x(FT)	0.0000	0.0000	10.080	0.6300	0.0000	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
22	-2.2889	-0.6609	-1544.2	-15.288	-4.5224	-458.38	-27.478	-8.0136	2.7015E+05	0.3154	2.7015E+05	3.1031E+05
x(FT)	0.0000	0.0000	10.080	3.3600	1.6800	10.080	10.080	10.080	11.130	0.0000	11.130	11.130
23	-2.2381	-0.6609	-1511.9	-14.985	-4.5314	-458.74	-27.253	-8.1278	2.7288E+05	0.3282	2.7288E+05	3.1266E+05
x(FT)	0.0000	0.0000	10.080	0.0000	0.0000	10.080	10.080	10.080	11.130	0.0000	11.130	11.130

24	-2.1873	-0.6609	-1479.2	-459.01	-14.678	-4.5396	-27.037	-8.2471	0.3410	2.7503E+05	3.1644E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
25	-2.1365	-0.6609	-1446.5	-459.31	-14.370	-4.5480	-26.816	-8.3697	0.3538	2.7693E+05	3.2064E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
26	-2.0857	-0.6609	-1413.7	-459.61	-14.062	-4.5569	-26.588	-8.4974	0.3666	2.7875E+05	3.2452E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
27	-2.0349	-0.6609	-1379.6	-459.44	-13.662	-4.5359	-25.681	-8.4123	0.3795	2.7815E+05	3.1850E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
28	-1.9896	-0.6609	-1349.5	-459.43	-13.335	-4.5265	-25.086	-8.4036	0.3909	2.7838E+05	3.1613E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	2.3100	10.080	10.080	0.0000	11.130	11.130
29	-1.9423	-0.6793	-1317.1	-471.44	-13.019	-4.6469	-25.545	-9.0013	0.4772	2.8213E+05	3.2448E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
30	-1.8949	-0.6976	-1283.6	-483.01	-12.622	-4.7378	-25.292	-9.3792	0.5635	2.8320E+05	3.2217E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	11.130
31	-1.8476	-0.7160	-1248.8	-494.00	-12.312	-4.8587	-25.929	-10.117	0.6497	2.8645E+05	3.2553E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
32	-2.5233	-0.9648	-1663.8	-649.63	-14.575	-5.6860	-27.816	-10.694	1.4857	2.5752E+05	2.9633E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.2100	10.080	10.080	0.0000	11.130	11.130
33	-2.5203	-0.9141	-1643.4	-609.87	-14.236	-5.2778	-24.146	-8.7320	1.2814	2.2108E+05	2.8573E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
34	-2.5173	-0.8634	-1646.1	-578.58	-14.571	-5.1139	-24.262	-8.2964	1.0771	2.2136E+05	2.8737E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	11.130
35	-2.5142	-0.8127	-1649.3	-547.18	-14.916	-4.9385	-24.422	-7.8737	0.8727	2.2224E+05	2.8966E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
36	-2.6501	-0.9573	-1739.2	-644.26	-15.255	-5.6431	-28.397	-10.340	1.4232	2.4991E+05	2.9422E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.2100	10.080	10.080	0.0000	11.130	11.130
37	-2.6471	-0.9066	-1712.2	-602.31	-14.866	-5.2217	-24.940	-8.4875	1.2188	2.0208E+05	2.8303E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	0.0000	10.080	10.080	0.0000	11.130	11.130
38	-2.6440	-0.8558	-1715.2	-571.14	-15.219	-5.0570	-25.037	-8.0539	1.0145	2.0245E+05	2.8526E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
39	-2.6410	-0.8051	-1717.8	-539.72	-15.564	-4.8768	-25.119	-7.6098	0.8101	2.0240E+05	2.8695E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	1.4700	10.080	10.080	0.0000	11.130	11.130
Min.	-2.6501	-0.9648	-1739.2	-649.63	-17.066	-5.6860	-28.813	-11.104	0.2386	2.0208E+05	2.8303E+05
Pile N.	36	32	36	32	16	32	16	15	16	37	37

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		TOTAL		FLEX. RIG.	
	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	STRESS	KIP-IN**2	FLEX. RIG.	FLEX. RIG.
	IN	IN	KIP-IN	KIP-IN	KIP	KIP	KIP/IN	KIP/IN	KIP/IN**2	KIP-IN**2	KIP-IN**2	Y-DIR



21	3.3499E-03	9.2721E-04	32.645	15.785	146.71	42.431	21.232	5.8768	0.4267	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
22	3.1891E-03	9.0271E-04	31.529	15.380	143.17	42.395	21.135	5.9825	0.4448	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
23	3.0419E-03	8.8192E-04	30.528	15.075	139.63	42.185	20.904	6.0606	0.4629	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
24	2.9393E-03	8.7170E-04	29.865	14.929	136.83	42.033	20.199	5.9904	0.4809	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
25	2.8383E-03	8.6130E-04	29.272	14.779	134.78	42.246	19.505	5.9190	0.4990	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
26	2.7378E-03	8.5084E-04	28.790	14.638	132.71	42.592	18.814	5.8471	0.5170	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
27	2.7667E-03	8.8228E-04	28.330	14.861	128.61	42.311	18.391	5.8648	0.5351	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
28	2.7508E-03	8.9784E-04	27.936	14.947	125.60	42.257	17.929	5.8518	0.5512	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
29	2.5493E-03	8.7524E-04	27.510	14.939	124.13	43.913	17.142	5.8855	0.6729	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
30	2.4690E-03	8.9306E-04	26.981	15.295	120.94	45.023	16.603	6.0954	0.7945	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
31	2.2741E-03	8.6735E-04	26.632	15.296	118.23	46.298	15.886	6.0589	0.9162	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
32	3.8506E-03	1.4196E-03	36.745	24.172	156.79	60.877	21.037	7.7554	2.0951	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
33	5.6745E-03	1.9254E-03	44.691	23.156	158.39	57.791	19.330	6.4978	1.8070	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000
34	5.6567E-03	1.8055E-03	44.704	24.129	158.60	54.800	19.281	6.0796	1.5188	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000
35	5.6068E-03	1.6825E-03	44.637	23.975	158.80	51.786	19.204	5.6804	1.2306	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000
36	4.2379E-03	1.4725E-03	40.220	24.737	165.23	60.763	21.293	7.3984	2.0069	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
37	6.5972E-03	2.0769E-03	50.570	22.740	164.91	56.604	20.288	6.3378	1.7187	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000
38	6.5706E-03	1.9480E-03	50.463	23.060	165.33	53.698	20.381	5.9822	1.4306	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000
39	6.5653E-03	1.8230E-03	50.455	24.031	165.68	50.755	20.450	5.6044	1.1424	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	10.920	10.920	11.130	0.0000	0.0000
Max.	6.5972E-03	2.0769E-03	50.570	24.737	165.68	60.877	21.678	7.7554	2.0951	5.1206E+06	5.1206E+06
Pile N.	37	37	37	36	39	32	16	32	32	1	1

LOAD CASE : 5  
CASE NAME : Service I  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.9104	1.0000
2	0.8893	1.0000
3	0.8233	1.0000
4	0.9676	1.0000
5	0.9799	1.0000
6	0.9799	1.0000
7	0.9799	1.0000
8	0.9799	1.0000
9	0.9799	1.0000
10	0.9799	1.0000
11	0.9799	1.0000
12	0.9824	1.0000
13	0.9611	1.0000
14	0.9593	1.0000
15	0.9979	1.0000
16	0.9806	1.0000
17	0.9799	1.0000
18	0.9799	1.0000
19	0.9799	1.0000
20	0.9799	1.0000
21	0.9799	1.0000
22	0.9799	1.0000
23	0.9799	1.0000
24	0.9799	1.0000
25	0.9799	1.0000
26	0.9799	1.0000
27	0.9478	1.0000
28	0.9298	1.0000
29	0.9593	1.0000

30	0.9593	1.0000
31	0.9979	1.0000
32	0.9908	1.0000
33	0.8137	1.0000
34	0.8137	1.0000
35	0.8154	1.0000
36	0.9908	1.0000
37	0.8137	1.0000
38	0.8137	1.0000
39	0.8119	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1446.29	-399.340	-141.050
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	7856.52	34869.6

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
9.75261E-03	-1.50267	-0.51489
ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
8.18835E-04	-4.16444E-06	7.25379E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	9.3483E-03	-1.6650	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
2	9.4982E-03	-1.6356	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
3	9.6482E-03	-1.6061	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
4	9.7981E-03	-1.5766	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
5	9.9480E-03	-1.5471	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
6	0.010098	-1.5176	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
7	0.010248	-1.4882	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
8	0.010398	-1.4587	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
9	0.010548	-1.4292	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
10	0.010698	-1.3997	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
11	0.010847	-1.3703	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
12	0.010997	-1.3408	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
13	0.011771	-1.3048	-0.5263	8.1883E-04	-4.1644E-06	7.2538E-05
14	0.012856	-1.2774	-0.5370	8.1883E-04	-4.1644E-06	7.2538E-05
15	0.013940	-1.2499	-0.5476	8.1883E-04	-4.1644E-06	7.2538E-05
16	4.1435E-03	-1.6615	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
17	4.2934E-03	-1.6320	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
18	4.4433E-03	-1.6026	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
19	4.5933E-03	-1.5731	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
20	4.7432E-03	-1.5436	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
21	4.8931E-03	-1.5141	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
22	5.0430E-03	-1.4846	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
23	5.1929E-03	-1.4552	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
24	5.3429E-03	-1.4257	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
25	5.4928E-03	-1.3962	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
26	5.6427E-03	-1.3667	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
27	5.7926E-03	-1.3373	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
28	5.9262E-03	-1.3110	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
29	7.0107E-03	-1.2835	-0.4714	8.1883E-04	-4.1644E-06	7.2538E-05
30	8.0955E-03	-1.2560	-0.4820	8.1883E-04	-4.1644E-06	7.2538E-05
31	9.1801E-03	-1.2286	-0.4927	8.1883E-04	-4.1644E-06	7.2538E-05
32	0.019976	-1.6207	-0.6371	8.1883E-04	-4.1644E-06	7.2538E-05
33	0.017378	-1.6189	-0.6076	8.1883E-04	-4.1644E-06	7.2538E-05
34	0.014780	-1.6171	-0.5782	8.1883E-04	-4.1644E-06	7.2538E-05
35	0.012182	-1.6154	-0.5488	8.1883E-04	-4.1644E-06	7.2538E-05
36	0.019213	-1.6942	-0.6327	8.1883E-04	-4.1644E-06	7.2538E-05
37	0.016615	-1.6925	-0.6032	8.1883E-04	-4.1644E-06	7.2538E-05
38	0.014017	-1.6907	-0.5738	8.1883E-04	-4.1644E-06	7.2538E-05
39	0.011419	-1.6889	-0.5444	8.1883E-04	-4.1644E-06	7.2538E-05

MINIMUM	4.1435E-03	-1.6942	-0.6371	8.1883E-04	-4.1644E-06	7.2538E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.019976	-1.2286	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	35.954	-11.250	-3.6132	0.0000	0.0000	0.0000
2	36.530	-11.018	-3.6016	0.0000	0.0000	0.0000
3	37.107	-10.688	-3.5578	0.0000	0.0000	0.0000
4	37.683	-10.810	-3.6627	0.0000	0.0000	0.0000
5	38.260	-10.648	-3.6751	0.0000	0.0000	0.0000
6	38.837	-10.460	-3.6793	0.0000	0.0000	0.0000
7	39.413	-10.272	-3.6836	0.0000	0.0000	0.0000
8	39.990	-10.084	-3.6880	0.0000	0.0000	0.0000
9	40.566	-9.8960	-3.6926	0.0000	0.0000	0.0000
10	41.143	-9.7080	-3.6975	0.0000	0.0000	0.0000
11	41.720	-9.5192	-3.7023	0.0000	0.0000	0.0000
12	42.296	-9.3350	-3.7091	0.0000	0.0000	0.0000
13	42.872	-9.1508	-3.7160	0.0000	0.0000	0.0000
14	43.448	-8.9666	-3.7228	0.0000	0.0000	0.0000
15	44.024	-8.7824	-3.7296	0.0000	0.0000	0.0000
16	44.600	-8.5982	-3.7364	0.0000	0.0000	0.0000
17	45.176	-8.4140	-3.7432	0.0000	0.0000	0.0000
18	45.752	-8.2298	-3.7500	0.0000	0.0000	0.0000
19	46.328	-8.0456	-3.7568	0.0000	0.0000	0.0000
20	46.904	-7.8614	-3.7636	0.0000	0.0000	0.0000
21	47.480	-7.6772	-3.7704	0.0000	0.0000	0.0000
22	48.056	-7.4930	-3.7772	0.0000	0.0000	0.0000
23	48.632	-7.3088	-3.7840	0.0000	0.0000	0.0000
24	49.208	-7.1246	-3.7908	0.0000	0.0000	0.0000
25	49.784	-6.9404	-3.7976	0.0000	0.0000	0.0000
26	50.360	-6.7562	-3.8044	0.0000	0.0000	0.0000
27	50.936	-6.5720	-3.8112	0.0000	0.0000	0.0000
28	51.512	-6.3878	-3.8180	0.0000	0.0000	0.0000
29	52.088	-6.2036	-3.8248	0.0000	0.0000	0.0000
30	52.664	-6.0194	-3.8316	0.0000	0.0000	0.0000
31	53.240	-5.8352	-3.8384	0.0000	0.0000	0.0000
32	53.816	-5.6510	-3.8452	0.0000	0.0000	0.0000
33	54.392	-5.4668	-3.8520	0.0000	0.0000	0.0000
34	54.968	-5.2826	-3.8588	0.0000	0.0000	0.0000
35	55.544	-5.0984	-3.8656	0.0000	0.0000	0.0000
36	56.120	-4.9142	-3.8724	0.0000	0.0000	0.0000
37	56.696	-4.7300	-3.8792	0.0000	0.0000	0.0000
38	57.272	-4.5458	-3.8860	0.0000	0.0000	0.0000
39	57.848	-4.3616	-3.8928	0.0000	0.0000	0.0000
40	58.424	-4.1774	-3.8996	0.0000	0.0000	0.0000
41	59.000	-3.9932	-3.9064	0.0000	0.0000	0.0000
42	59.576	-3.8090	-3.9132	0.0000	0.0000	0.0000
43	60.152	-3.6248	-3.9200	0.0000	0.0000	0.0000
44	60.728	-3.4406	-3.9268	0.0000	0.0000	0.0000
45	61.304	-3.2564	-3.9336	0.0000	0.0000	0.0000
46	61.880	-3.0722	-3.9404	0.0000	0.0000	0.0000
47	62.456	-2.8880	-3.9472	0.0000	0.0000	0.0000
48	63.032	-2.7038	-3.9540	0.0000	0.0000	0.0000
49	63.608	-2.5196	-3.9608	0.0000	0.0000	0.0000
50	64.184	-2.3354	-3.9676	0.0000	0.0000	0.0000
51	64.760	-2.1512	-3.9744	0.0000	0.0000	0.0000
52	65.336	-1.9670	-3.9812	0.0000	0.0000	0.0000
53	65.912	-1.7828	-3.9880	0.0000	0.0000	0.0000
54	66.488	-1.5986	-3.9948	0.0000	0.0000	0.0000
55	67.064	-1.4144	-3.9999	0.0000	0.0000	0.0000
56	67.640	-1.2302	-4.0000	0.0000	0.0000	0.0000
57	68.216	-1.0460	-4.0000	0.0000	0.0000	0.0000
58	68.792	-0.8618	-4.0000	0.0000	0.0000	0.0000
59	69.368	-0.6776	-4.0000	0.0000	0.0000	0.0000
60	69.944	-0.4934	-4.0000	0.0000	0.0000	0.0000
61	70.520	-0.3092	-4.0000	0.0000	0.0000	0.0000
62	71.096	-0.1250	-4.0000	0.0000	0.0000	0.0000
63	71.672	0.0592	-4.0000	0.0000	0.0000	0.0000
64	72.248	0.2434	-4.0000	0.0000	0.0000	0.0000
65	72.824	0.4276	-4.0000	0.0000	0.0000	0.0000
66	73.400	0.6118	-4.0000	0.0000	0.0000	0.0000
67	73.976	0.7960	-4.0000	0.0000	0.0000	0.0000
68	74.552	0.9802	-4.0000	0.0000	0.0000	0.0000
69	75.128	1.1644	-4.0000	0.0000	0.0000	0.0000
70	75.704	1.3486	-4.0000	0.0000	0.0000	0.0000
71	76.280	1.5328	-4.0000	0.0000	0.0000	0.0000
72	76.856	1.7170	-4.0000	0.0000	0.0000	0.0000
73	77.432	1.9012	-4.0000	0.0000	0.0000	0.0000
74	78.008	2.0854	-4.0000	0.0000	0.0000	0.0000
75	78.584	2.2696	-4.0000	0.0000	0.0000	0.0000
76	79.160	2.4538	-4.0000	0.0000	0.0000	0.0000
77	79.736	2.6380	-4.0000	0.0000	0.0000	0.0000
78	80.312	2.8222	-4.0000	0.0000	0.0000	0.0000
79	80.888	3.0064	-4.0000	0.0000	0.0000	0.0000
80	81.464	3.1906	-4.0000	0.0000	0.0000	0.0000
81	82.040	3.3748	-4.0000	0.0000	0.0000	0.0000
82	82.616	3.5590	-4.0000	0.0000	0.0000	0.0000
83	83.192	3.7432	-4.0000	0.0000	0.0000	0.0000
84	83.768	3.9274	-4.0000	0.0000	0.0000	0.0000
85	84.344	4.1116	-4.0000	0.0000	0.0000	0.0000
86	84.920	4.2958	-4.0000	0.0000	0.0000	0.0000
87	85.496	4.4800	-4.0000	0.0000	0.0000	0.0000
88	86.072	4.6642	-4.0000	0.0000	0.0000	0.0000
89	86.648	4.8484	-4.0000	0.0000	0.0000	0.0000
90	87.224	5.0326	-4.0000	0.0000	0.0000	0.0000
91	87.800	5.2168	-4.0000	0.0000	0.0000	0.0000
92	88.376	5.4010	-4.0000	0.0000	0.0000	0.0000
93	88.952	5.5852	-4.0000	0.0000	0.0000	0.0000
94	89.528	5.7694	-4.0000	0.0000	0.0000	0.0000
95	90.104	5.9536	-4.0000	0.0000	0.0000	0.0000
96	90.680	6.1378	-4.0000	0.0000	0.0000	0.0000
97	91.256	6.3220	-4.0000	0.0000	0.0000	0.0000
98	91.832	6.5062	-4.0000	0.0000	0.0000	0.0000
99	92.408	6.6904	-4.0000	0.0000	0.0000	0.0000
100	92.984	6.8746	-4.0000	0.0000	0.0000	0.0000

32	76.827	-10.494	-4.2101	0.0000	0.0000	0.0000	0.0000
33	66.836	-10.271	-3.9429	0.0000	0.0000	0.0000	0.0000
34	56.844	-10.420	-3.8169	0.0000	0.0000	0.0000	0.0000
35	46.853	-10.571	-3.6869	0.0000	0.0000	0.0000	0.0000
36	73.891	-10.961	-4.1815	0.0000	0.0000	0.0000	0.0000
37	63.900	-10.733	-3.9166	0.0000	0.0000	0.0000	0.0000
38	53.909	-10.888	-3.7899	0.0000	0.0000	0.0000	0.0000
39	43.918	-11.038	-3.6566	0.0000	0.0000	0.0000	0.0000
MINIMUM	15.936	-11.704	-4.2101	0.0000	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1	1
MAXIMUM	76.827	-8.6571	-3.3589	0.0000	0.0000	0.0000	0.0000
Pile N.	32	15	16	1	1	1	1

THE PILE COORDINATE SYSTEM (LOCAL AXES)

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	9.3483E-03	-1.6650	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
2	9.4982E-03	-1.6356	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
3	9.6482E-03	-1.6061	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
4	9.7981E-03	-1.5766	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
5	9.9480E-03	-1.5471	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
6	0.010098	-1.5176	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
7	0.010248	-1.4882	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
8	0.010398	-1.4587	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
9	0.010548	-1.4292	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
10	0.010698	-1.3997	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
11	0.010847	-1.3703	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
12	0.010997	-1.3408	-0.5196	8.1883E-04	-4.1644E-06	7.2538E-05
13	0.011171	-1.3048	-0.5263	8.1883E-04	-4.1644E-06	7.2538E-05
14	0.012856	-1.2774	-0.5370	8.1883E-04	-4.1644E-06	7.2538E-05
15	0.013940	-1.2499	-0.5476	8.1883E-04	-4.1644E-06	7.2538E-05
16	4.1435E-03	-1.6615	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
17	4.2934E-03	-1.6320	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
18	4.4433E-03	-1.6026	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
19	4.5933E-03	-1.5731	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05

20	4.7432E-03	-1.5436	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
21	4.8931E-03	-1.5141	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
22	5.0430E-03	-1.4846	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
23	5.1929E-03	-1.4552	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
24	5.3429E-03	-1.4257	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
25	5.4928E-03	-1.3962	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
26	5.6427E-03	-1.3667	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
27	5.7926E-03	-1.3373	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
28	5.9262E-03	-1.3110	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
29	7.0107E-03	-1.2835	-0.4714	8.1883E-04	-4.1644E-06	7.2538E-05
30	8.0955E-03	-1.2560	-0.4820	8.1883E-04	-4.1644E-06	7.2538E-05
31	9.1801E-03	-1.2286	-0.4927	8.1883E-04	-4.1644E-06	7.2538E-05
32	0.019976	-1.6207	-0.6371	8.1883E-04	-4.1644E-06	7.2538E-05
33	0.017378	-1.6189	-0.6076	8.1883E-04	-4.1644E-06	7.2538E-05
34	0.014780	-1.6171	-0.5782	8.1883E-04	-4.1644E-06	7.2538E-05
35	0.012182	-1.6154	-0.5488	8.1883E-04	-4.1644E-06	7.2538E-05
36	0.019213	-1.6942	-0.6327	8.1883E-04	-4.1644E-06	7.2538E-05
37	0.016615	-1.6925	-0.6032	8.1883E-04	-4.1644E-06	7.2538E-05
38	0.014017	-1.6907	-0.5738	8.1883E-04	-4.1644E-06	7.2538E-05
39	0.011419	-1.6889	-0.5444	8.1883E-04	-4.1644E-06	7.2538E-05
MINIMUM	4.1435E-03	-1.6942	-0.6371	8.1883E-04	-4.1644E-06	7.2538E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.019976	-1.2286	-0.4607	8.1883E-04	-4.1644E-06	7.2538E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	35.954	-11.250	-3.6132	0.0000	0.0000	0.0000
2	36.530	-11.018	-3.6016	0.0000	0.0000	0.0000
3	37.107	-10.688	-3.5578	0.0000	0.0000	0.0000
4	37.683	-10.810	-3.6627	0.0000	0.0000	0.0000
5	38.260	-10.648	-3.6751	0.0000	0.0000	0.0000
6	38.837	-10.460	-3.6793	0.0000	0.0000	0.0000
7	39.413	-10.272	-3.6836	0.0000	0.0000	0.0000
8	39.990	-10.084	-3.6880	0.0000	0.0000	0.0000
9	40.566	-9.8960	-3.6926	0.0000	0.0000	0.0000
10	41.143	-9.7080	-3.6975	0.0000	0.0000	0.0000
11	41.720	-9.5192	-3.7023	0.0000	0.0000	0.0000

12	42.296	-9.3350	-3.7091	0.0000	0.0000	0.0000	0.0000
13	45.272	-9.0369	-3.7334	0.0000	0.0000	0.0000	0.0000
14	49.443	-8.8117	-3.7896	0.0000	0.0000	0.0000	0.0000
15	53.615	-8.6571	-3.8756	0.0000	0.0000	0.0000	0.0000
16	15.936	-11.704	-3.3589	0.0000	0.0000	0.0000	0.0000
17	16.512	-11.510	-3.3619	0.0000	0.0000	0.0000	0.0000
18	17.089	-11.317	-3.3655	0.0000	0.0000	0.0000	0.0000
19	17.666	-11.125	-3.3692	0.0000	0.0000	0.0000	0.0000
20	18.242	-10.933	-3.3732	0.0000	0.0000	0.0000	0.0000
21	18.819	-10.739	-3.3770	0.0000	0.0000	0.0000	0.0000
22	19.395	-10.546	-3.3810	0.0000	0.0000	0.0000	0.0000
23	19.972	-10.353	-3.3852	0.0000	0.0000	0.0000	0.0000
24	20.549	-10.160	-3.3896	0.0000	0.0000	0.0000	0.0000
25	21.125	-9.9663	-3.3941	0.0000	0.0000	0.0000	0.0000
26	21.702	-9.7724	-3.3985	0.0000	0.0000	0.0000	0.0000
27	22.278	-9.5195	-3.3829	0.0000	0.0000	0.0000	0.0000
28	22.792	-9.3146	-3.3755	0.0000	0.0000	0.0000	0.0000
29	26.963	-9.1414	-3.4561	0.0000	0.0000	0.0000	0.0000
30	31.135	-8.9153	-3.5169	0.0000	0.0000	0.0000	0.0000
31	35.307	-8.7535	-3.6019	0.0000	0.0000	0.0000	0.0000
32	76.827	-10.494	-4.2101	0.0000	0.0000	0.0000	0.0000
33	66.836	-10.271	-3.9429	0.0000	0.0000	0.0000	0.0000
34	56.844	-10.420	-3.8169	0.0000	0.0000	0.0000	0.0000
35	46.853	-10.571	-3.6869	0.0000	0.0000	0.0000	0.0000
36	73.891	-10.961	-4.1815	0.0000	0.0000	0.0000	0.0000
37	63.900	-10.733	-3.9166	0.0000	0.0000	0.0000	0.0000
38	53.909	-10.888	-3.7899	0.0000	0.0000	0.0000	0.0000
39	43.918	-11.038	-3.6566	0.0000	0.0000	0.0000	0.0000
MINIMUM	15.936	-11.704	-4.2101	0.0000	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1	1
MAXIMUM	76.827	-8.6571	-3.3589	0.0000	0.0000	0.0000	0.0000
Pile N.	32	15	16	1	1	1	1

PILE GROUP STRESS, KIP/IN\*\*2  
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- 1 0.5072
- 2 0.5154
- 3 0.5235
- 4 0.5316
- 5 0.5398

6	0.5479
7	0.5560
8	0.5642
9	0.5723
10	0.5804
11	0.5886
12	0.5967
13	0.6387
14	0.6975
15	0.7564
16	0.2248
17	0.2330
18	0.2411
19	0.2492
20	0.2574
21	0.2655
22	0.2736
23	0.2818
24	0.2899
25	0.2980
26	0.3062
27	0.3143
28	0.3216
29	0.3804
30	0.4392
31	0.4981
32	1.0839
33	0.9429
34	0.8020
35	0.6610
36	1.0425
37	0.9015
38	0.7605
39	0.6196

MINIMUM	0.2248
Pile N.	16
MAXIMUM	1.0839
Pile N.	32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL. Z-DIR IN	MOMENT		MOMENT Y-DIR KIP-IN	SHEAR		SOIL REACT		SOIL REACT Y-DIR KIP/IN	SOIL REACT		TOTAL STRESS KIP/IN**2	FLEX. RIG.		FLEX. RIG. Y-DIR KIP-IN**2
	Y-DIR IN	Z-DIR IN		Z-DIR KIP-IN	Y-DIR KIP		Y-DIR KIP/IN	Z-DIR KIP	Y-DIR KIP/IN	Z-DIR KIP/IN		Z-DIR KIP-IN**2	FLEX. RIG. KIP-IN**2				
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1	-1.6650	-0.5196	-1130.3	-364.33	-11.250	-3.6132	-24.011	-7.5502	0.5072	2.8721E+05	3.8288E+05	0.5072	2.8721E+05	3.8288E+05	0.5072	2.8721E+05	3.8288E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
2	-1.6356	-0.5196	-1110.7	-364.36	-11.018	-3.6016	-23.368	-7.4834	0.5154	2.8686E+05	3.7200E+05	0.5154	2.8686E+05	3.7200E+05	0.5154	2.8686E+05	3.7200E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
3	-1.6061	-0.5196	-1092.2	-364.69	-10.688	-3.5578	-21.726	-7.0977	0.5235	2.8426E+05	3.4228E+05	0.5235	2.8426E+05	3.4228E+05	0.5235	2.8426E+05	3.4228E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
4	-1.5766	-0.5196	-1068.6	-363.47	-10.810	-3.6627	-25.064	-8.2850	0.5316	2.9298E+05	4.6752E+05	0.5316	2.9298E+05	4.6752E+05	0.5316	2.9298E+05	4.6752E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
5	-1.5471	-0.5196	-1048.1	-363.21	-10.648	-3.6751	-25.246	-8.4913	0.5398	2.9458E+05	5.0039E+05	0.5398	2.9458E+05	5.0039E+05	0.5398	2.9458E+05	5.0039E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.8400	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
6	-1.5176	-0.5196	-1028.2	-363.10	-10.460	-3.6793	-25.137	-8.6147	0.5479	2.9574E+05	5.1192E+05	0.5479	2.9574E+05	5.1192E+05	0.5479	2.9574E+05	5.1192E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
7	-1.4882	-0.5196	-1008.3	-363.01	-10.272	-3.6836	-25.027	-8.7389	0.5560	2.9697E+05	5.3302E+05	0.5560	2.9697E+05	5.3302E+05	0.5560	2.9697E+05	5.3302E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.7300	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
8	-1.4587	-0.5196	-988.41	-362.91	-10.084	-3.6880	-24.913	-8.8702	0.5642	2.9752E+05	5.4504E+05	0.5642	2.9752E+05	5.4504E+05	0.5642	2.9752E+05	5.4504E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
9	-1.4292	-0.5196	-968.51	-362.80	-9.8960	-3.6926	-24.799	-9.0035	0.5723	2.9456E+05	5.6195E+05	0.5723	2.9456E+05	5.6195E+05	0.5723	2.9456E+05	5.6195E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
10	-1.3997	-0.5196	-948.61	-362.70	-9.7080	-3.6975	-24.680	-9.1384	0.5804	2.9092E+05	5.8640E+05	0.5804	2.9092E+05	5.8640E+05	0.5804	2.9092E+05	5.8640E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	1.8900	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
11	-1.3703	-0.5196	-928.75	-362.62	-9.5192	-3.7023	-24.554	-9.2785	0.5886	2.8988E+05	6.1179E+05	0.5886	2.8988E+05	6.1179E+05	0.5886	2.8988E+05	6.1179E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	2.7300	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
12	-1.3408	-0.5196	-908.87	-362.51	-9.3350	-3.7091	-24.479	-9.4448	0.5967	2.9151E+05	6.4806E+05	0.5967	2.9151E+05	6.4806E+05	0.5967	2.9151E+05	6.4806E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
13	-1.3048	-0.5263	-885.03	-366.92	-9.0369	-3.7334	-23.801	-9.5699	0.6387	2.9161E+05	5.8904E+05	0.6387	2.9161E+05	5.8904E+05	0.6387	2.9161E+05	5.8904E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
14	-1.2774	-0.5370	-866.02	-373.67	-8.8117	-3.7896	-23.564	-9.8765	0.6975	2.9383E+05	5.7670E+05	0.6975	2.9383E+05	5.7670E+05	0.6975	2.9383E+05	5.7670E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
15	-1.2499	-0.5476	-845.73	-379.84	-8.6571	-3.8756	-24.202	-10.535	0.7564	3.0080E+05	7.1920E+05	0.7564	3.0080E+05	7.1920E+05	0.7564	3.0080E+05	7.1920E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
16	-1.6615	-0.4607	-1129.9	-326.19	-11.704	-3.3589	-25.889	-7.1946	0.2248	2.9107E+05	5.8328E+05	0.2248	2.9107E+05	5.8328E+05	0.2248	2.9107E+05	5.8328E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130
17	-1.6320	-0.4607	-1109.9	-326.09	-11.510	-3.3619	-25.780	-7.2891	0.2330	2.9213E+05	5.9943E+05	0.2330	2.9213E+05	5.9943E+05	0.2330	2.9213E+05	5.9943E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	0.6300	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	0.0000	11.130	11.130

18	-1.6026	-0.4607	-1089.9	-326.00	-11.317	-3.3655	-25.687	-7.3893	0.2411	2.9282E+05	6.2348E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	0.0000	10.080	10.080	0.0000	11.130	11.130
19	-1.5731	-0.4607	-1069.8	-325.90	-11.125	-3.3692	-25.592	-7.4931	0.2492	2.9351E+05	6.4851E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	2.9400	10.080	10.080	0.0000	11.130	11.130
20	-1.5436	-0.4607	-1049.8	-325.79	-10.933	-3.3732	-25.493	-7.5999	0.2574	2.9466E+05	6.7647E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
21	-1.5141	-0.4607	-1029.8	-325.71	-10.739	-3.3770	-25.391	-7.7106	0.2655	2.9583E+05	7.0587E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	11.130
22	-1.4846	-0.4607	-1009.8	-325.63	-10.546	-3.3810	-25.288	-7.8255	0.2736	2.9708E+05	7.3662E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.4200	10.080	10.080	0.0000	11.130	11.130
23	-1.4552	-0.4607	-989.86	-325.54	-10.353	-3.3852	-25.183	-7.9450	0.2818	2.9743E+05	7.6454E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	11.130
24	-1.4257	-0.4607	-969.89	-325.45	-10.160	-3.3896	-25.078	-8.0653	0.2899	2.9416E+05	8.0422E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	3.3600	10.080	10.080	0.0000	11.130	11.130
25	-1.3962	-0.4607	-949.94	-325.36	-9.9663	-3.3941	-24.969	-8.1924	0.2980	2.9045E+05	8.3560E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
26	-1.3667	-0.4607	-930.04	-325.28	-9.7724	-3.3985	-24.850	-8.3269	0.3062	2.9045E+05	8.5411E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	1.4700	10.080	10.080	0.0000	11.130	11.130
27	-1.3373	-0.4607	-911.19	-325.58	-9.5195	-3.3829	-24.000	-8.2302	0.3143	2.8961E+05	7.6670E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	1.6800	10.080	10.080	0.0000	11.130	11.130
28	-1.3110	-0.4607	-894.04	-325.71	-9.3146	-3.3755	-23.483	-8.2203	0.3216	2.8959E+05	7.2739E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	3.3600	10.080	10.080	0.0000	11.130	11.130
29	-1.2835	-0.4714	-873.97	-332.11	-9.1414	-3.4561	-23.974	-8.7486	0.3804	2.9341E+05	8.3595E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	1.6800	10.080	10.080	0.0000	11.130	11.130
30	-1.2560	-0.4820	-854.92	-338.84	-8.9153	-3.5169	-23.788	-9.0686	0.4392	2.9627E+05	8.2908E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	2.5200	10.080	10.080	0.0000	11.130	11.130
31	-1.2286	-0.4927	-834.02	-344.71	-8.7535	-3.6019	-24.215	-9.6487	0.4981	3.0318E+05	8.7087E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	0.0000	10.080	10.080	0.0000	11.130	11.130
32	-1.6207	-0.6371	-1089.1	-437.75	-10.494	-4.2101	-25.213	-9.9583	1.0839	2.9295E+05	3.7431E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	0.0000	10.080	10.080	0.0000	11.130	11.130
33	-1.6189	-0.6076	-1094.8	-420.92	-10.271	-3.9429	-21.210	-8.0258	0.9429	2.8328E+05	3.1819E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	2.5200	10.080	10.080	0.0000	11.130	11.130
34	-1.6171	-0.5782	-1095.7	-402.15	-10.420	-3.8169	-21.318	-7.6889	0.8020	2.8330E+05	3.2456E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.2100	10.080	10.080	0.0000	11.130	11.130
35	-1.6154	-0.5488	-1096.5	-383.38	-10.571	-3.6869	-21.463	-7.3615	0.6610	2.8342E+05	3.2938E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.1000	3.3600	10.080	10.080	0.0000	11.130	11.130
36	-1.6942	-0.6327	-1139.0	-435.38	-10.961	-4.1815	-25.515	-9.5826	1.0425	2.9083E+05	3.6505E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	3.1500	10.080	10.080	0.0000	11.130	11.130
37	-1.6925	-0.6032	-1144.7	-418.43	-10.733	-3.9166	-21.451	-7.7123	0.9015	2.8122E+05	3.1594E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.8400	3.3600	10.080	10.080	0.0000	11.130	11.130
38	-1.6907	-0.5738	-1145.7	-399.64	-10.888	-3.7899	-21.554	-7.3828	0.7605	2.8123E+05	3.2334E+05



15	1.3187E-03	5.2645E-04	23.950	8.0275	79.741	34.647	9.2113	3.6773	1.0666	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
16	2.0128E-03	5.1515E-04	25.412	7.8138	106.56	29.670	13.816	3.5360	0.3170	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
17	1.9669E-03	5.1065E-04	25.034	7.7428	104.64	29.636	13.491	3.5027	0.3285	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
18	1.9199E-03	5.0464E-04	24.580	7.6503	102.74	29.592	13.169	3.4615	0.3400	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
19	1.8730E-03	4.9866E-04	24.162	7.5580	100.83	29.550	12.847	3.4204	0.3514	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
20	1.8251E-03	4.9245E-04	23.858	7.4623	98.923	29.506	12.519	3.3779	0.3629	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
21	1.7778E-03	4.8631E-04	23.540	7.3674	97.015	29.465	12.195	3.3357	0.3744	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
22	1.7305E-03	4.8019E-04	23.228	7.2732	95.112	29.426	11.870	3.2938	0.3859	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
23	1.6836E-03	4.7456E-04	23.063	7.1868	93.221	29.394	11.548	3.2552	0.3973	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
24	1.6400E-03	4.6792E-04	22.973	7.0844	91.361	29.350	11.249	3.2096	0.4088	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
25	1.5960E-03	4.6233E-04	23.093	6.9989	89.506	29.321	10.947	3.1713	0.4203	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
26	1.5497E-03	4.5805E-04	22.964	6.9342	87.616	29.310	10.630	3.1419	0.4317	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
27	1.5753E-03	4.8221E-04	23.018	7.2228	85.484	29.284	10.451	3.1992	0.4432	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
28	1.5728E-03	4.9501E-04	23.241	7.3702	83.663	29.265	10.236	3.2217	0.4534	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
29	1.4585E-03	4.7319E-04	23.275	7.1143	82.068	29.891	9.7932	3.1774	0.5364	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
30	1.4113E-03	4.8080E-04	23.566	7.2306	80.250	30.530	9.4769	3.2285	0.6194	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
31	1.2898E-03	4.6200E-04	23.847	7.0413	78.609	31.251	9.0097	3.2271	0.7024	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
32	1.9048E-03	7.3019E-04	24.531	12.562	102.86	40.744	13.211	5.0643	1.5284	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
33	2.4429E-03	9.0452E-04	24.516	13.707	100.69	38.274	13.914	5.1519	1.3297	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
34	2.4431E-03	8.6105E-04	24.520	12.969	100.76	36.514	13.915	4.9043	1.1309	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
35	2.4374E-03	8.1693E-04	24.534	12.268	100.87	34.773	13.912	4.6629	0.9321	5.1206E+06	5.1206E+06



18	0.9873	1.0000
19	0.9873	1.0000
20	0.9873	1.0000
21	0.9873	1.0000
22	0.9873	1.0000
23	0.9873	1.0000
24	0.9873	1.0000
25	0.9873	1.0000
26	0.9873	1.0000
27	0.9552	1.0000
28	0.9352	1.0000
29	0.9648	1.0000
30	0.9648	1.0000
31	0.9982	1.0000
32	0.9904	1.0000
33	0.8048	1.0000
34	0.8048	1.0000
35	0.8086	1.0000
36	0.9904	1.0000
37	0.8048	1.0000
38	0.8048	1.0000
39	0.8066	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1281.55	-368.920	-103.810
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	3426.36	24914.0

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN                      HORIZONTAL Y,IN                      HORIZONTAL Z,IN  
 8.62644E-03                      -1.35876                      -0.36328  
 ANGLE ROT. X,RAD                      ANGLE ROT. Y,RAD                      ANGLE ROT. Z,RAD  
 7.13383E-04                      -2.85275E-06                      5.26958E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

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 \* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	8.3669E-03	-1.5002	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
2	8.4697E-03	-1.4745	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
3	8.5723E-03	-1.4489	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
4	8.6751E-03	-1.4232	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
5	8.7778E-03	-1.3975	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
6	8.8804E-03	-1.3718	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
7	8.9832E-03	-1.3461	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
8	9.0858E-03	-1.3204	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
9	9.1886E-03	-1.2948	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
10	9.2912E-03	-1.2691	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
11	9.3939E-03	-1.2434	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
12	9.4966E-03	-1.2177	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
13	0.010051	-1.1864	-0.3732	7.1338E-04	-2.8527E-06	5.2696E-05
14	0.010833	-1.1625	-0.3825	7.1338E-04	-2.8527E-06	5.2696E-05
15	0.011615	-1.1385	-0.3918	7.1338E-04	-2.8527E-06	5.2696E-05
16	4.5851E-03	-1.4971	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
17	4.6878E-03	-1.4715	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
18	4.7905E-03	-1.4458	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
19	4.8932E-03	-1.4201	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
20	4.9959E-03	-1.3944	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
21	5.0986E-03	-1.3687	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
22	5.2013E-03	-1.3431	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
23	5.3040E-03	-1.3174	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
24	5.4067E-03	-1.2917	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
25	5.5094E-03	-1.2660	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
26	5.6121E-03	-1.2403	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
27	5.7148E-03	-1.2146	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05

28	5.8063E-03	-1.1918	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
29	6.5884E-03	-1.1678	-0.3253	7.1338E-04	-2.8527E-06	5.2696E-05
30	7.3706E-03	-1.1439	-0.3347	7.1338E-04	-2.8527E-06	5.2696E-05
31	8.1528E-03	-1.1199	-0.3439	7.1338E-04	-2.8527E-06	5.2696E-05
32	0.016078	-1.4615	-0.4697	7.1338E-04	-2.8527E-06	5.2696E-05
33	0.014190	-1.4600	-0.4441	7.1338E-04	-2.8527E-06	5.2696E-05
34	0.012303	-1.4585	-0.4184	7.1338E-04	-2.8527E-06	5.2696E-05
35	0.010415	-1.4570	-0.3928	7.1338E-04	-2.8527E-06	5.2696E-05
36	0.015539	-1.5256	-0.4659	7.1338E-04	-2.8527E-06	5.2696E-05
37	0.013652	-1.5241	-0.4403	7.1338E-04	-2.8527E-06	5.2696E-05
38	0.011764	-1.5226	-0.4146	7.1338E-04	-2.8527E-06	5.2696E-05
39	9.8763E-03	-1.5210	-0.3890	7.1338E-04	-2.8527E-06	5.2696E-05
MINIMUM	4.5851E-03	-1.5256	-0.4697	7.1338E-04	-2.8527E-06	5.2696E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.016078	-1.1199	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	32.179	-10.351	-2.6672	0.0000	0.0000	0.0000
2	32.574	-10.148	-2.6603	0.0000	0.0000	0.0000
3	32.969	-9.8405	-2.6258	0.0000	0.0000	0.0000
4	33.364	-9.9807	-2.7061	0.0000	0.0000	0.0000
5	33.759	-9.8405	-2.7157	0.0000	0.0000	0.0000
6	34.154	-9.6765	-2.7194	0.0000	0.0000	0.0000
7	34.549	-9.5126	-2.7233	0.0000	0.0000	0.0000
8	34.944	-9.3484	-2.7273	0.0000	0.0000	0.0000
9	35.339	-9.1836	-2.7313	0.0000	0.0000	0.0000
10	35.734	-9.0179	-2.7352	0.0000	0.0000	0.0000
11	36.129	-8.8461	-2.7375	0.0000	0.0000	0.0000
12	36.524	-8.6743	-2.7400	0.0000	0.0000	0.0000
13	38.657	-8.4150	-2.7672	0.0000	0.0000	0.0000
14	41.665	-8.2213	-2.8214	0.0000	0.0000	0.0000
15	44.673	-8.0771	-2.8917	0.0000	0.0000	0.0000
16	17.634	-10.693	-2.4044	0.0000	0.0000	0.0000
17	18.029	-10.525	-2.4073	0.0000	0.0000	0.0000
18	18.424	-10.358	-2.4104	0.0000	0.0000	0.0000
19	18.819	-10.191	-2.4135	0.0000	0.0000	0.0000

20	19.214	-10.024	-2.4167	0.0000	0.0000	0.0000	0.0000	0.0000
21	19.609	-9.8565	-2.4201	0.0000	0.0000	0.0000	0.0000	0.0000
22	20.004	-9.6895	-2.4236	0.0000	0.0000	0.0000	0.0000	0.0000
23	20.399	-9.5216	-2.4271	0.0000	0.0000	0.0000	0.0000	0.0000
24	20.794	-9.3537	-2.4306	0.0000	0.0000	0.0000	0.0000	0.0000
25	21.189	-9.1820	-2.4334	0.0000	0.0000	0.0000	0.0000	0.0000
26	21.584	-9.0068	-2.4355	0.0000	0.0000	0.0000	0.0000	0.0000
27	21.979	-8.7845	-2.4256	0.0000	0.0000	0.0000	0.0000	0.0000
28	22.331	-8.5994	-2.4198	0.0000	0.0000	0.0000	0.0000	0.0000
29	25.339	-8.4477	-2.4888	0.0000	0.0000	0.0000	0.0000	0.0000
30	28.347	-8.2545	-2.5461	0.0000	0.0000	0.0000	0.0000	0.0000
31	31.356	-8.1074	-2.6168	0.0000	0.0000	0.0000	0.0000	0.0000
32	61.836	-9.8301	-3.2655	0.0000	0.0000	0.0000	0.0000	0.0000
33	54.576	-9.5534	-3.0156	0.0000	0.0000	0.0000	0.0000	0.0000
34	47.317	-9.6492	-2.8842	0.0000	0.0000	0.0000	0.0000	0.0000
35	40.057	-9.7528	-2.7519	0.0000	0.0000	0.0000	0.0000	0.0000
36	59.763	-10.239	-3.2357	0.0000	0.0000	0.0000	0.0000	0.0000
37	52.504	-9.9551	-2.9883	0.0000	0.0000	0.0000	0.0000	0.0000
38	45.244	-10.055	-2.8566	0.0000	0.0000	0.0000	0.0000	0.0000
39	37.984	-10.158	-2.7229	0.0000	0.0000	0.0000	0.0000	0.0000
MINIMUM	17.634	-10.693	-3.2655	0.0000	0.0000	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1	1	1
MAXIMUM	61.836	-8.0771	-2.4044	0.0000	0.0000	0.0000	0.0000	0.0000
Pile N.	32	15	16	1	1	1	1	1

THE PILE COORDINATE SYSTEM (LOCAL AXES)

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	8.3669E-03	-1.5002	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
2	8.4697E-03	-1.4745	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
3	8.5723E-03	-1.4489	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
4	8.6751E-03	-1.4232	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
5	8.7778E-03	-1.3975	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
6	8.8804E-03	-1.3718	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
7	8.9832E-03	-1.3461	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05

8	9.0858E-03	-1.3204	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
9	9.1886E-03	-1.2948	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
10	9.2912E-03	-1.2691	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
11	9.3939E-03	-1.2434	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
12	9.4966E-03	-1.2177	-0.3674	7.1338E-04	-2.8527E-06	5.2696E-05
13	0.010051	-1.1864	-0.3732	7.1338E-04	-2.8527E-06	5.2696E-05
14	0.010833	-1.1625	-0.3825	7.1338E-04	-2.8527E-06	5.2696E-05
15	0.011615	-1.1385	-0.3918	7.1338E-04	-2.8527E-06	5.2696E-05
16	4.5851E-03	-1.4971	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
17	4.6878E-03	-1.4715	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
18	4.7905E-03	-1.4458	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
19	4.8932E-03	-1.4201	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
20	4.9959E-03	-1.3944	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
21	5.0986E-03	-1.3687	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
22	5.2013E-03	-1.3431	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
23	5.3040E-03	-1.3174	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
24	5.4067E-03	-1.2917	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
25	5.5094E-03	-1.2660	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
26	5.6121E-03	-1.2403	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
27	5.7148E-03	-1.2146	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
28	5.8063E-03	-1.1918	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
29	6.5884E-03	-1.1678	-0.3253	7.1338E-04	-2.8527E-06	5.2696E-05
30	7.3706E-03	-1.1439	-0.3347	7.1338E-04	-2.8527E-06	5.2696E-05
31	8.1528E-03	-1.1199	-0.3439	7.1338E-04	-2.8527E-06	5.2696E-05
32	0.016078	-1.4615	-0.4697	7.1338E-04	-2.8527E-06	5.2696E-05
33	0.014190	-1.4600	-0.4441	7.1338E-04	-2.8527E-06	5.2696E-05
34	0.012303	-1.4585	-0.4184	7.1338E-04	-2.8527E-06	5.2696E-05
35	0.010415	-1.4570	-0.3928	7.1338E-04	-2.8527E-06	5.2696E-05
36	0.015539	-1.5256	-0.4659	7.1338E-04	-2.8527E-06	5.2696E-05
37	0.013652	-1.5241	-0.4403	7.1338E-04	-2.8527E-06	5.2696E-05
38	0.011764	-1.5226	-0.4146	7.1338E-04	-2.8527E-06	5.2696E-05
39	9.8763E-03	-1.5210	-0.3890	7.1338E-04	-2.8527E-06	5.2696E-05
MINIMUM	4.5851E-03	-1.5256	-0.4697	7.1338E-04	-2.8527E-06	5.2696E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.016078	-1.1199	-0.3161	7.1338E-04	-2.8527E-06	5.2696E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP AXIAL,KIP LAT. y,KIP LAT. z,KIP MOM x,KIP-IN MOM y,KIP-IN MOM z,KIP-IN

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*****
1 32.179 ***** 0.0000 ***** 0.0000 ***** 0.0000
2 32.574 ***** 0.0000 ***** 0.0000 ***** 0.0000
3 32.969 ***** 0.0000 ***** 0.0000 ***** 0.0000
4 33.364 ***** 0.0000 ***** 0.0000 ***** 0.0000
5 33.759 ***** 0.0000 ***** 0.0000 ***** 0.0000
6 34.154 ***** 0.0000 ***** 0.0000 ***** 0.0000
7 34.549 ***** 0.0000 ***** 0.0000 ***** 0.0000
8 34.944 ***** 0.0000 ***** 0.0000 ***** 0.0000
9 35.339 ***** 0.0000 ***** 0.0000 ***** 0.0000
10 35.734 ***** 0.0000 ***** 0.0000 ***** 0.0000
11 36.129 ***** 0.0000 ***** 0.0000 ***** 0.0000
12 36.524 ***** 0.0000 ***** 0.0000 ***** 0.0000
13 38.657 ***** 0.0000 ***** 0.0000 ***** 0.0000
14 41.665 ***** 0.0000 ***** 0.0000 ***** 0.0000
15 44.673 ***** 0.0000 ***** 0.0000 ***** 0.0000
16 17.634 ***** 0.0000 ***** 0.0000 ***** 0.0000
17 18.029 ***** 0.0000 ***** 0.0000 ***** 0.0000
18 18.424 ***** 0.0000 ***** 0.0000 ***** 0.0000
19 18.819 ***** 0.0000 ***** 0.0000 ***** 0.0000
20 19.214 ***** 0.0000 ***** 0.0000 ***** 0.0000
21 19.609 ***** 0.0000 ***** 0.0000 ***** 0.0000
22 20.004 ***** 0.0000 ***** 0.0000 ***** 0.0000
23 20.399 ***** 0.0000 ***** 0.0000 ***** 0.0000
24 20.794 ***** 0.0000 ***** 0.0000 ***** 0.0000
25 21.189 ***** 0.0000 ***** 0.0000 ***** 0.0000
26 21.584 ***** 0.0000 ***** 0.0000 ***** 0.0000
27 21.979 ***** 0.0000 ***** 0.0000 ***** 0.0000
28 22.374 ***** 0.0000 ***** 0.0000 ***** 0.0000
29 22.769 ***** 0.0000 ***** 0.0000 ***** 0.0000
30 23.164 ***** 0.0000 ***** 0.0000 ***** 0.0000
31 23.559 ***** 0.0000 ***** 0.0000 ***** 0.0000
32 23.954 ***** 0.0000 ***** 0.0000 ***** 0.0000
33 24.349 ***** 0.0000 ***** 0.0000 ***** 0.0000
34 24.744 ***** 0.0000 ***** 0.0000 ***** 0.0000
35 25.139 ***** 0.0000 ***** 0.0000 ***** 0.0000
36 25.534 ***** 0.0000 ***** 0.0000 ***** 0.0000
37 25.929 ***** 0.0000 ***** 0.0000 ***** 0.0000
38 26.324 ***** 0.0000 ***** 0.0000 ***** 0.0000
39 26.719 ***** 0.0000 ***** 0.0000 ***** 0.0000
*****

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MINIMUM	17.634	-10.693	-3.2655	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1
MAXIMUM	61.836	-8.0771	-2.4044	0.0000	0.0000	0.0000
Pile N.	32	15	16	1	1	1

PILE GROUP STRESS, KIP/IN\*\*2  
 \*\*\*\*\*

1	0.4540
2	0.4596
3	0.4651
4	0.4707
5	0.4763
6	0.4818
7	0.4874
8	0.4930
9	0.4986
10	0.5041
11	0.5097
12	0.5153
13	0.5454
14	0.5878
15	0.6302
16	0.2488
17	0.2544
18	0.2599
19	0.2655
20	0.2711
21	0.2767
22	0.2822
23	0.2878
24	0.2934
25	0.2989
26	0.3045
27	0.3101
28	0.3150
29	0.3575
30	0.3999
31	0.4424
32	0.8724
33	0.7700
34	0.6675

35 0.5651  
 36 0.8431  
 37 0.7407  
 38 0.6383  
 39 0.5359  
  
 MINIMUM 0.2488  
 Pile N. 16  
 MAXIMUM 0.8724  
 Pile N. 32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL. z-DIR IN	MOMENT		MOMENT y-DIR KIP-IN	SHEAR		SHEAR z-DIR KIP	SOIL REACT		SOIL REACT y-DIR KIP/IN	TOTAL STRESS		TOTAL STRESS KIP/IN**2	FLEX. RIG.		FLEX. RIG. y-DIR KIP-IN**2
	y-DIR IN	z-DIR IN		z-DIR KIP-IN	y-DIR KIP		y-DIR KIP/IN	z-DIR KIP/IN		z-DIR KIP/IN**2	y-DIR KIP/IN**2							
1	-1.5002	-0.3674	-0.3674	-1019.7	-264.76	-10.351	-2.6672	-24.149	-5.9291	0.4540	2.9301E+05	0.4540	2.9301E+05	8.7097E+05	8.7097E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7030E+05	8.7030E+05	11.130	11.130	11.130
2	-1.4745	-0.3674	-0.3674	-1003.0	-264.89	-10.148	-2.6603	-23.589	-5.8882	0.4596	2.9282E+05	0.4596	2.9282E+05	8.7030E+05	8.7030E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.3600	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	6.1768E+05	6.1768E+05	11.130	11.130	11.130
3	-1.4489	-0.3674	-0.3674	-987.14	-265.15	-9.8405	-2.6258	-21.800	-5.5772	0.4651	2.8969E+05	0.4651	2.8969E+05	8.7030E+05	8.7030E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7356E+05	8.7356E+05	11.130	11.130	11.130
4	-1.4232	-0.3674	-0.3674	-965.77	-263.90	-9.9807	-2.7061	-25.312	-6.5700	0.4707	2.9287E+05	0.4707	2.9287E+05	8.7356E+05	8.7356E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7356E+05	8.7356E+05	11.130	11.130	11.130
5	-1.3975	-0.3674	-0.3674	-948.01	-263.69	-9.8405	-2.7157	-25.517	-6.7487	0.4763	2.9006E+05	0.4763	2.9006E+05	8.7356E+05	8.7356E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.4200	2.7300	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7375E+05	8.7375E+05	11.130	11.130	11.130
6	-1.3718	-0.3674	-0.3674	-930.73	-263.63	-9.6765	-2.7194	-25.426	-6.8525	0.4818	2.9137E+05	0.4818	2.9137E+05	8.7375E+05	8.7375E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	3.3600	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7375E+05	8.7375E+05	11.130	11.130	11.130
7	-1.3461	-0.3674	-0.3674	-913.47	-263.56	-9.5126	-2.7233	-25.330	-6.9593	0.4874	2.9252E+05	0.4874	2.9252E+05	8.7395E+05	8.7395E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7395E+05	8.7395E+05	11.130	11.130	11.130
8	-1.3204	-0.3674	-0.3674	-896.21	-263.51	-9.3484	-2.7273	-25.232	-7.0098	0.4930	2.9491E+05	0.4930	2.9491E+05	8.7416E+05	8.7416E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7416E+05	8.7416E+05	11.130	11.130	11.130
9	-1.2948	-0.3674	-0.3674	-879.01	-263.46	-9.1836	-2.7313	-25.131	-7.1839	0.4986	2.9667E+05	0.4986	2.9667E+05	8.7435E+05	8.7435E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7435E+05	8.7435E+05	11.130	11.130	11.130
10	-1.2691	-0.3674	-0.3674	-861.63	-263.36	-9.0179	-2.7352	-24.958	-7.2809	0.5041	2.9937E+05	0.5041	2.9937E+05	8.7456E+05	8.7456E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7456E+05	8.7456E+05	11.130	11.130	11.130
11	-1.2434	-0.3674	-0.3674	-843.33	-263.00	-8.8461	-2.7375	-24.409	-7.2667	0.5097	3.0087E+05	0.5097	3.0087E+05	8.7461E+05	8.7461E+05	11.130	11.130	11.130
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	0.0000	11.130	8.7461E+05	8.7461E+05	11.130	11.130	11.130

12	-1.2177	-0.3674	-825.06	-262.64	-8.6743	-2.7400	-23.859	-7.2518	0.5153	3.0243E+05	8.7465E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.1000	3.1500	10.080	10.080	0.0000	11.130	11.130
13	-1.1864	-0.3732	-804.24	-266.40	-8.4150	-2.7672	-23.100	-7.3089	0.5454	3.0245E+05	8.7418E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	2.5200	10.080	10.080	0.0000	11.130	11.130
14	-1.1625	-0.3825	-787.03	-271.93	-8.2213	-2.8214	-22.577	-7.4582	0.5878	3.0324E+05	8.7350E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	2.9400	10.080	10.080	0.0000	11.130	11.130
15	-1.1385	-0.3918	-767.22	-276.47	-8.0771	-2.8917	-22.180	-7.6589	0.6302	3.1103E+05	8.7411E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
16	-1.4971	-0.3161	-1018.1	-231.57	-10.693	-2.4044	-26.026	-5.5881	0.2488	2.9773E+05	8.7454E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	0.0000	10.080	10.080	0.0000	11.130	11.130
17	-1.4715	-0.3161	-1000.7	-231.51	-10.525	-2.4073	-25.941	-5.6674	0.2544	2.9636E+05	8.7469E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	0.0000	10.080	10.080	0.0000	11.130	11.130
18	-1.4458	-0.3161	-983.27	-231.45	-10.358	-2.4104	-25.864	-5.7509	0.2599	2.9338E+05	8.7485E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
19	-1.4201	-0.3161	-965.94	-231.40	-10.191	-2.4135	-25.785	-5.8370	0.2655	2.9014E+05	8.7501E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.1500	10.080	10.080	0.0000	11.130	11.130
20	-1.3944	-0.3161	-948.62	-231.34	-10.024	-2.4167	-25.698	-5.9265	0.2711	2.9042E+05	8.7517E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.8400	10.080	10.080	0.0000	11.130	11.130
21	-1.3687	-0.3161	-931.30	-231.29	-9.8565	-2.4201	-25.612	-6.0197	0.2767	2.9143E+05	8.7534E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	11.130
22	-1.3431	-0.3161	-913.99	-231.23	-9.6895	-2.4236	-25.521	-6.1159	0.2822	2.9298E+05	8.7552E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	1.8900	10.080	10.080	0.0000	11.130	11.130
23	-1.3174	-0.3161	-896.72	-231.18	-9.5216	-2.4271	-25.429	-6.2161	0.2878	2.9546E+05	8.7571E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.7300	0.8400	10.080	10.080	0.0000	11.130	11.130
24	-1.2917	-0.3161	-879.47	-231.14	-9.3537	-2.4306	-25.335	-6.3198	0.2934	2.9674E+05	8.7588E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
25	-1.2660	-0.3161	-861.57	-230.93	-9.1820	-2.4334	-24.981	-6.3599	0.2989	2.9943E+05	8.7604E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
26	-1.2403	-0.3161	-843.21	-230.62	-9.0068	-2.4355	-24.429	-6.3480	0.3045	3.0103E+05	8.7606E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	3.1500	10.080	10.080	0.0000	11.130	11.130
27	-1.2146	-0.3161	-827.38	-231.00	-8.7845	-2.4256	-23.742	-6.2923	0.3101	2.9935E+05	8.7562E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	1.0500	10.080	10.080	0.0000	11.130	11.130
28	-1.1918	-0.3161	-812.59	-231.16	-8.5994	-2.4198	-23.169	-6.2536	0.3150	2.9926E+05	8.7532E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.2100	10.080	10.080	0.0000	11.130	11.130
29	-1.1678	-0.3253	-792.91	-236.07	-8.4477	-2.4888	-22.778	-6.4461	0.3575	3.0243E+05	8.7550E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	0.2100	10.080	10.080	0.0000	11.130	11.130
30	-1.1439	-0.3347	-775.54	-241.55	-8.2545	-2.5461	-22.253	-6.5980	0.3999	3.0540E+05	8.7525E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.8400	0.0000	10.080	10.080	0.0000	11.130	11.130
31	-1.1199	-0.3439	-755.69	-246.21	-8.1074	-2.6168	-21.854	-6.7928	0.4424	3.1236E+05	8.7553E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	2.7300	10.080	10.080	0.0000	11.130	11.130
32	-1.4615	-0.4697	-985.47	-328.73	-9.8301	-3.2655	-25.379	-8.1150	0.8724	2.9454E+05	8.1167E+05

x(FT)	0.0000	0.0000	10.080	10.080	0.8400	10.080	10.080	0.0000	11.130	11.130
33	-1.4600	-0.4441	-990.89	-313.82	-3.0156	-21.092	-6.4868	0.7700	2.8818E+05	4.0114E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	0.0000	11.130	11.130
34	-1.4585	-0.4184	-991.23	-297.51	-2.8842	-21.180	-6.1469	0.6675	2.8823E+05	4.3307E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130
35	-1.4570	-0.3928	-991.52	-281.21	-2.7519	-21.356	-5.8205	0.5651	2.8855E+05	4.9446E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	10.080	10.080	0.0000	11.130	11.130
36	-1.5256	-0.4659	-1028.8	-326.50	-3.2357	-25.623	-7.8001	0.8431	2.9678E+05	7.5365E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130
37	-1.5241	-0.4403	-1034.1	-311.50	-2.9883	-21.296	-6.2265	0.7407	2.8616E+05	3.9318E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130
38	-1.5226	-0.4146	-1034.5	-295.16	-2.8566	-21.378	-5.8949	0.6383	2.8618E+05	4.2417E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	0.0000	11.130	11.130
39	-1.5210	-0.3890	-1034.9	-278.87	-2.7229	-21.498	-5.5675	0.5359	2.8628E+05	4.7365E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130
Min.	-1.5256	-0.4697	-1034.9	-328.73	-3.2655	-26.026	-8.1150	0.2488	2.8616E+05	3.9318E+05
Pile N.	36	32	39	32	32	16	32	16	37	37

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		TOTAL		FLEX. RIG.	
	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	KIP/IN**2	STRESS	z-DIR	y-DIR
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1	1.9035E-03	4.0824E-04	23.978	6.0155	23.424	12.192	2.6148	0.6402	0.6402	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
2	1.9145E-03	4.1662E-04	23.946	6.0819	23.345	11.990	2.6091	0.6480	0.6480	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
3	2.0748E-03	4.8316E-04	23.991	6.8819	23.354	11.978	2.7894	0.6559	0.6559	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
4	1.6312E-03	3.7531E-04	22.958	5.6721	23.676	11.128	2.5604	0.6638	0.6638	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
5	1.5636E-03	3.6785E-04	23.060	5.5861	23.727	10.806	2.5422	0.6716	0.6716	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
6	1.5226E-03	3.6594E-04	22.868	5.5578	23.735	10.522	2.5290	0.6795	0.6795	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
7	1.4804E-03	3.6398E-04	23.072	5.5288	23.743	10.231	2.5154	0.6873	0.6873	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
8	1.4379E-03	3.6196E-04	23.151	5.4990	23.752	9.9376	2.5015	0.6952	0.6952	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000

9	1.3954E-03	3.5992E-04	23.472	5.4688	82.809	23.763	9.6434	2.4874	0.7030	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
10	1.3539E-03	3.5805E-04	23.736	5.4412	81.147	23.766	9.3571	2.4745	0.7109	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
11	1.3238E-03	3.5752E-04	23.322	5.4331	79.407	23.734	9.1487	2.4708	0.7188	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
12	1.2916E-03	3.5698E-04	23.474	5.4249	77.671	23.700	8.9262	2.4671	0.7266	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
13	1.2871E-03	3.6927E-04	23.330	5.5712	75.515	23.966	8.7078	2.4983	0.7691	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
14	1.2623E-03	3.7736E-04	22.550	5.6896	73.875	24.465	8.5255	2.5486	0.8289	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
15	1.1811E-03	3.7126E-04	21.894	5.6622	72.249	25.011	8.2522	2.5940	0.8887	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
16	1.7171E-03	3.2922E-04	23.199	4.9985	95.981	20.758	11.872	2.2762	0.3508	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
17	1.6786E-03	3.2785E-04	23.091	4.9775	94.343	20.763	11.601	2.2658	0.3587	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
18	1.6406E-03	3.2628E-04	22.991	4.9543	92.723	20.769	11.338	2.2549	0.3665	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
19	1.6027E-03	3.2469E-04	22.973	4.9309	91.108	20.776	11.076	2.2440	0.3744	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
20	1.5612E-03	3.2304E-04	23.045	4.9064	89.459	20.783	10.790	2.2326	0.3823	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
21	1.5202E-03	3.2133E-04	22.857	4.8811	87.803	20.791	10.506	2.2207	0.3901	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
22	1.4774E-03	3.1956E-04	23.078	4.8550	86.148	20.800	10.210	2.2085	0.3980	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
23	1.4346E-03	3.1774E-04	23.169	4.8281	84.488	20.810	9.9146	2.1959	0.4058	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
24	1.3921E-03	3.1586E-04	23.487	4.8003	82.845	20.820	9.6208	2.1829	0.4137	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
25	1.3541E-03	3.1472E-04	23.786	4.7834	81.133	20.809	9.3578	2.1751	0.4215	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
26	1.3238E-03	3.1425E-04	23.343	4.7763	79.388	20.781	9.1490	2.1718	0.4294	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
27	1.3465E-03	3.2471E-04	23.363	4.8790	77.599	20.707	9.0030	2.1711	0.4373	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
28	1.3513E-03	3.3140E-04	23.477	4.9413	76.015	20.652	8.8457	2.1694	0.4443	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
29	1.2732E-03	3.2852E-04	22.592	4.9537	74.428	21.200	8.5988	2.2188	0.5041	5.1206E+06	5.1206E+06



6	0.8681	1.0000
7	0.8681	1.0000
8	0.8681	1.0000
9	0.8681	1.0000
10	0.8681	1.0000
11	0.8681	1.0000
12	0.9098	1.0000
13	0.8812	1.0000
14	0.8762	1.0000
15	0.9938	1.0000
16	0.8730	1.0000
17	0.8681	1.0000
18	0.8681	1.0000
19	0.8681	1.0000
20	0.8681	1.0000
21	0.8681	1.0000
22	0.8681	1.0000
23	0.8681	1.0000
24	0.8681	1.0000
25	0.8681	1.0000
26	0.8681	1.0000
27	0.8353	1.0000
28	0.8492	1.0000
29	0.8762	1.0000
30	0.8762	1.0000
31	0.9938	1.0000
32	0.9960	1.0000
33	0.9312	1.0000
34	0.9312	1.0000
35	0.9064	1.0000
36	0.9960	1.0000
37	0.9312	1.0000
38	0.9312	1.0000
39	0.8846	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS      HOR. LOAD Y,KIPS      HOR. LOAD Z,KIPS  
 478.060              -97.2500              -129.940  
 MOMENT X ,KIP-IN    MOMENT Y,KIP-IN    MOMENT Z,KIP-IN  
 0.00000              7798.80              5406.96

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN      HORIZONTAL Y,IN      HORIZONTAL Z,IN  
 3.23210E-03      -0.30588              -0.41714  
 ANGLE ROT. X,RAD    ANGLE ROT. Y,RAD    ANGLE ROT. Z,RAD  
 1.68600E-04      1.71881E-06              9.57890E-06

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

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 \* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	3.6286E-03	-0.3393	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
2	3.5667E-03	-0.3332	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
3	3.5048E-03	-0.3272	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
4	3.4429E-03	-0.3211	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
5	3.3811E-03	-0.3150	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
6	3.3192E-03	-0.3090	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
7	3.2573E-03	-0.3029	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
8	3.1954E-03	-0.2968	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
9	3.1336E-03	-0.2908	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
10	3.0717E-03	-0.2847	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
11	3.0098E-03	-0.2786	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
12	2.9479E-03	-0.2726	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
13	2.9055E-03	-0.2651	-0.4195	1.6860E-04	1.7188E-06	9.5789E-06
14	3.0176E-03	-0.2595	-0.4217	1.6860E-04	1.7188E-06	9.5789E-06
15	3.0847E-03	-0.2538	-0.4239	1.6860E-04	1.7188E-06	9.5789E-06

16	2.9315E-03	-0.3386	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
17	2.8696E-03	-0.3325	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
18	2.8077E-03	-0.3265	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
19	2.7459E-03	-0.3204	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
20	2.6840E-03	-0.3143	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
21	2.6221E-03	-0.3082	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
22	2.5602E-03	-0.3022	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
23	2.4984E-03	-0.2961	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
24	2.4365E-03	-0.2900	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
25	2.3746E-03	-0.2840	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
26	2.3127E-03	-0.2779	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
27	2.2508E-03	-0.2718	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
28	2.1957E-03	-0.2664	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
29	2.2628E-03	-0.2607	-0.4082	1.6860E-04	1.7188E-06	9.5789E-06
30	2.3299E-03	-0.2551	-0.4104	1.6860E-04	1.7188E-06	9.5789E-06
31	2.3970E-03	-0.2494	-0.4126	1.6860E-04	1.7188E-06	9.5789E-06
32	4.9090E-03	-0.3302	-0.4423	1.6860E-04	1.7188E-06	9.5789E-06
33	4.5611E-03	-0.3298	-0.4362	1.6860E-04	1.7188E-06	9.5789E-06
34	4.2132E-03	-0.3295	-0.4302	1.6860E-04	1.7188E-06	9.5789E-06
35	3.8653E-03	-0.3291	-0.4241	1.6860E-04	1.7188E-06	9.5789E-06
36	5.0120E-03	-0.3453	-0.4414	1.6860E-04	1.7188E-06	9.5789E-06
37	4.6641E-03	-0.3450	-0.4353	1.6860E-04	1.7188E-06	9.5789E-06
38	4.3162E-03	-0.3446	-0.4293	1.6860E-04	1.7188E-06	9.5789E-06
39	3.9683E-03	-0.3442	-0.4232	1.6860E-04	1.7188E-06	9.5789E-06
MINIMUM	2.1957E-03	-0.3453	-0.4423	1.6860E-04	1.7188E-06	9.5789E-06
Pile N.	28	36	32	1	1	1
MAXIMUM	5.0120E-03	-0.2494	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
Pile N.	36	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	13.955	-2.7173	-3.2923	0.0000	0.0000	0.0000
2	13.718	-2.6558	-3.2705	0.0000	0.0000	0.0000
3	13.480	-2.6103	-3.2682	0.0000	0.0000	0.0000
4	13.242	-2.6029	-3.3154	0.0000	0.0000	0.0000
5	13.004	-2.5636	-3.3222	0.0000	0.0000	0.0000
6	12.766	-2.5212	-3.3252	0.0000	0.0000	0.0000
7	12.528	-2.4786	-3.3281	0.0000	0.0000	0.0000

8	12.290	-2.4360	-3.3311	0.0000	0.0000	0.0000	0.0000
9	12.052	-2.3935	-3.3340	0.0000	0.0000	0.0000	0.0000
10	11.814	-2.3510	-3.3370	0.0000	0.0000	0.0000	0.0000
11	11.576	-2.3094	-3.3400	0.0000	0.0000	0.0000	0.0000
12	11.338	-2.2869	-3.3730	0.0000	0.0000	0.0000	0.0000
13	11.348	-2.2201	-3.3644	0.0000	0.0000	0.0000	0.0000
14	11.606	-2.1765	-3.3769	0.0000	0.0000	0.0000	0.0000
15	11.864	-2.1875	-3.4780	0.0000	0.0000	0.0000	0.0000
16	11.275	-2.7426	-3.2393	0.0000	0.0000	0.0000	0.0000
17	11.037	-2.6976	-3.2389	0.0000	0.0000	0.0000	0.0000
18	10.799	-2.6554	-3.2419	0.0000	0.0000	0.0000	0.0000
19	10.561	-2.6130	-3.2449	0.0000	0.0000	0.0000	0.0000
20	10.323	-2.5706	-3.2479	0.0000	0.0000	0.0000	0.0000
21	10.085	-2.5280	-3.2508	0.0000	0.0000	0.0000	0.0000
22	9.8467	-2.4853	-3.2538	0.0000	0.0000	0.0000	0.0000
23	9.6087	-2.4426	-3.2568	0.0000	0.0000	0.0000	0.0000
24	9.3707	-2.4000	-3.2597	0.0000	0.0000	0.0000	0.0000
25	9.1327	-2.3573	-3.2627	0.0000	0.0000	0.0000	0.0000
26	8.8948	-2.3156	-3.2657	0.0000	0.0000	0.0000	0.0000
27	8.6568	-2.2739	-3.2687	0.0000	0.0000	0.0000	0.0000
28	8.4188	-2.2322	-3.2717	0.0000	0.0000	0.0000	0.0000
29	8.1808	-2.1905	-3.2747	0.0000	0.0000	0.0000	0.0000
30	7.9428	-2.1488	-3.2777	0.0000	0.0000	0.0000	0.0000
31	7.7048	-2.1071	-3.2807	0.0000	0.0000	0.0000	0.0000
32	7.4668	-2.0654	-3.2837	0.0000	0.0000	0.0000	0.0000
33	7.2288	-2.0237	-3.2867	0.0000	0.0000	0.0000	0.0000
34	6.9908	-1.9820	-3.2897	0.0000	0.0000	0.0000	0.0000
35	6.7528	-1.9403	-3.2927	0.0000	0.0000	0.0000	0.0000
36	6.5148	-1.8986	-3.2957	0.0000	0.0000	0.0000	0.0000
37	6.2768	-1.8569	-3.2987	0.0000	0.0000	0.0000	0.0000
38	6.0388	-1.8152	-3.3017	0.0000	0.0000	0.0000	0.0000
39	5.8008	-1.7735	-3.3047	0.0000	0.0000	0.0000	0.0000
MINIMUM	8.4447	-2.8210	-3.5536	0.0000	0.0000	-2.2380E-11	0.0000
Pile N.	28	36	32	1	1	30	1
MAXIMUM	19.276	-2.1556	-3.2389	0.0000	0.0000	0.0000	0.0000
Pile N.	36	30	17	1	1	1	1

THE PILE COORDINATE SYSTEM (LOCAL AXES)

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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	3.6286E-03	-0.3393	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
2	3.5667E-03	-0.3332	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
3	3.5048E-03	-0.3272	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
4	3.4429E-03	-0.3211	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
5	3.3811E-03	-0.3150	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
6	3.3192E-03	-0.3090	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
7	3.2573E-03	-0.3029	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
8	3.1954E-03	-0.2968	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
9	3.1336E-03	-0.2908	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
10	3.0717E-03	-0.2847	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
11	3.0098E-03	-0.2786	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
12	2.9479E-03	-0.2726	-0.4181	1.6860E-04	1.7188E-06	9.5789E-06
13	2.9055E-03	-0.2651	-0.4195	1.6860E-04	1.7188E-06	9.5789E-06
14	3.0176E-03	-0.2595	-0.4217	1.6860E-04	1.7188E-06	9.5789E-06
15	3.0847E-03	-0.2538	-0.4239	1.6860E-04	1.7188E-06	9.5789E-06
16	2.9315E-03	-0.3386	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
17	2.8696E-03	-0.3325	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
18	2.8077E-03	-0.3265	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
19	2.7459E-03	-0.3204	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
20	2.6840E-03	-0.3143	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
21	2.6221E-03	-0.3082	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
22	2.5602E-03	-0.3022	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
23	2.4984E-03	-0.2961	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
24	2.4365E-03	-0.2900	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
25	2.3746E-03	-0.2840	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
26	2.3127E-03	-0.2779	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
27	2.2508E-03	-0.2718	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
28	2.1957E-03	-0.2664	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
29	2.2628E-03	-0.2607	-0.4082	1.6860E-04	1.7188E-06	9.5789E-06
30	2.3299E-03	-0.2551	-0.4104	1.6860E-04	1.7188E-06	9.5789E-06
31	2.3970E-03	-0.2494	-0.4126	1.6860E-04	1.7188E-06	9.5789E-06
32	4.9090E-03	-0.3302	-0.4423	1.6860E-04	1.7188E-06	9.5789E-06
33	4.5611E-03	-0.3298	-0.4362	1.6860E-04	1.7188E-06	9.5789E-06
34	4.2132E-03	-0.3295	-0.4302	1.6860E-04	1.7188E-06	9.5789E-06
35	3.8653E-03	-0.3291	-0.4241	1.6860E-04	1.7188E-06	9.5789E-06
36	5.0120E-03	-0.3453	-0.4414	1.6860E-04	1.7188E-06	9.5789E-06

37	4.6641E-03	-0.3450	-0.4353	1.6860E-04	1.7188E-06	9.5789E-06
38	4.3162E-03	-0.3446	-0.4293	1.6860E-04	1.7188E-06	9.5789E-06
39	3.9683E-03	-0.3442	-0.4232	1.6860E-04	1.7188E-06	9.5789E-06
MINIMUM	2.1957E-03	-0.3453	-0.4423	1.6860E-04	1.7188E-06	9.5789E-06
Pile N.	28	36	32	1	1	1
MAXIMUM	5.0120E-03	-0.2494	-0.4060	1.6860E-04	1.7188E-06	9.5789E-06
Pile N.	36	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	13.955	-2.7173	-3.2923	0.0000	0.0000	0.0000
2	13.718	-2.6558	-3.2705	0.0000	0.0000	0.0000
3	13.480	-2.6103	-3.2682	0.0000	0.0000	0.0000
4	13.242	-2.6029	-3.3154	0.0000	0.0000	0.0000
5	13.004	-2.5636	-3.3222	0.0000	0.0000	0.0000
6	12.766	-2.5212	-3.3252	0.0000	0.0000	0.0000
7	12.528	-2.4786	-3.3281	0.0000	0.0000	0.0000
8	12.290	-2.4360	-3.3311	0.0000	0.0000	0.0000
9	12.052	-2.3935	-3.3340	0.0000	0.0000	0.0000
10	11.814	-2.3510	-3.3370	0.0000	0.0000	0.0000
11	11.576	-2.3094	-3.3400	0.0000	0.0000	0.0000
12	11.338	-2.2869	-3.3730	0.0000	0.0000	0.0000
13	11.348	-2.2201	-3.3644	0.0000	0.0000	0.0000
14	11.606	-2.1765	-3.3769	0.0000	0.0000	0.0000
15	11.864	-2.1875	-3.4780	0.0000	0.0000	0.0000
16	11.275	-2.7426	-3.2393	0.0000	0.0000	0.0000
17	11.037	-2.6976	-3.2389	0.0000	0.0000	0.0000
18	10.799	-2.6554	-3.2419	0.0000	0.0000	0.0000
19	10.561	-2.6130	-3.2449	0.0000	0.0000	0.0000
20	10.323	-2.5706	-3.2479	0.0000	0.0000	0.0000
21	10.085	-2.5280	-3.2508	0.0000	0.0000	0.0000
22	9.8467	-2.4853	-3.2538	0.0000	0.0000	0.0000
23	9.6087	-2.4426	-3.2568	0.0000	0.0000	0.0000
24	9.3707	-2.3999	-3.2597	0.0000	0.0000	0.0000
25	9.1327	-2.3573	-3.2627	0.0000	0.0000	0.0000
26	8.8948	-2.3156	-3.2657	0.0000	0.0000	0.0000
27	8.6568	-2.2565	-3.2451	0.0000	0.0000	0.0000
28	8.4447	-2.2254	-3.2577	0.0000	0.0000	0.0000

29	8.7027	-2.1972	-3.2934	0.0000	0.0000	0.0000	0.0000
30	8.9608	-2.1556	-3.3097	0.0000	0.0000	0.0000	-2.2380E-11
31	9.2189	-2.1649	-3.4096	0.0000	0.0000	0.0000	0.0000
32	18.880	-2.7136	-3.5536	0.0000	0.0000	0.0000	0.0000
33	17.542	-2.6826	-3.4707	0.0000	0.0000	0.0000	0.0000
34	16.204	-2.6863	-3.4337	0.0000	0.0000	0.0000	0.0000
35	14.866	-2.6765	-3.3791	0.0000	0.0000	0.0000	0.0000
36	19.276	-2.8210	-3.5400	0.0000	0.0000	0.0000	0.0000
37	17.938	-2.7890	-3.4575	0.0000	0.0000	0.0000	0.0000
38	16.600	-2.7929	-3.4205	0.0000	0.0000	0.0000	0.0000
39	15.262	-2.7702	-3.3507	0.0000	0.0000	0.0000	0.0000
MINIMUM	8.4447	-2.8210	-3.5536	0.0000	0.0000	0.0000	-2.2380E-11
Pile N.	28	36	32	1	1	30	1
MAXIMUM	19.276	-2.1556	-3.2389	0.0000	0.0000	0.0000	0.0000
Pile N.	36	30	17	1	1	1	1

PILE GROUP \* STRESS, KIP/IN\*\*2  
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1	0.1969
2	0.1935
3	0.1902
4	0.1868
5	0.1835
6	0.1801
7	0.1767
8	0.1734
9	0.1700
10	0.1667
11	0.1633
12	0.1600
13	0.1601
14	0.1637
15	0.1674
16	0.1591
17	0.1557
18	0.1524
19	0.1490
20	0.1456
21	0.1423
22	0.1389

23 0.1356  
 24 0.1322  
 25 0.1288  
 26 0.1255  
 27 0.1221  
 28 0.1191  
 29 0.1228  
 30 0.1264  
 31 0.1301  
 32 0.2664  
 33 0.2475  
 34 0.2286  
 35 0.2097  
 36 0.2720  
 37 0.2531  
 38 0.2342  
 39 0.2153  
  
 MINIMUM 0.1191  
 Pile N. 28  
 MAXIMUM 0.2720  
 Pile N. 36

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL.		MOMENT		MOMENT		SHEAR		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.		
	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	
1	-0.3393	-0.4181	-235.82	-284.66	-2.7173	-3.2923	-6.0351	-7.3284	0.1969	8.7392E+05	8.7032E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	9.4500	9.4500	0.0000	0.0000	10.080	10.080	0.0000	8.7348E+05	8.3671E+05	-5.8963	-7.2857	-5.8963	-7.2857	-5.8963	-7.2857	-5.8963	-7.2857	-5.8963	-7.2857	-5.8963	-7.2857
2	-0.3332	-0.4181	-232.66	-285.30	-2.6558	-3.2705	-5.8963	-7.2857	0.1935	8.7348E+05	8.3671E+05	10.080	10.080	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	9.6600	9.4500	2.3100	1.0500	10.080	10.080	0.0000	8.7356E+05	8.2083E+05	-5.7875	-7.2745	-5.7875	-7.2745	-5.7875	-7.2745	-5.7875	-7.2745	-5.7875	-7.2745	-5.7875	-7.2745
3	-0.3272	-0.4181	-228.98	-285.34	-2.6103	-3.2682	-5.7875	-7.2745	0.1902	8.7356E+05	8.2083E+05	10.080	10.080	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	9.6600	9.4500	0.0000	3.3600	10.080	10.080	0.0000	8.7492E+05	8.7143E+05	-5.7490	-7.3346	-5.7490	-7.3346	-5.7490	-7.3346	-5.7490	-7.3346	-5.7490	-7.3346	-5.7490	-7.3346
4	-0.3211	-0.4181	-224.06	-284.07	-2.6029	-3.3154	10.080	10.080	0.1868	8.7492E+05	8.7143E+05	10.080	10.080	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	9.2400	9.2400	3.1500	3.3600	10.080	10.080	0.0000	8.7521E+05	8.7165E+05	-5.6521	-7.3347	-5.6521	-7.3347	-5.6521	-7.3347	-5.6521	-7.3347	-5.6521	-7.3347	-5.6521	-7.3347
5	-0.3150	-0.4181	-220.19	-283.90	-2.5636	-3.3222	10.080	10.080	0.1835	8.7521E+05	8.7165E+05	10.080	10.080	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	9.2400	9.2400	0.0000	0.0000	10.080	10.080	0.0000	8.7521E+05	8.7165E+05	10.080	10.080	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130

6	-0.3090	-0.4181	-216.38	-283.81	-2.5212	-3.3252	-5.5509	-7.3287	0.1801	8.7541E+05	8.7167E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130
7	-0.3029	-0.4181	-212.57	-283.72	-2.4786	-3.3281	-5.4505	-7.3228	0.1767	8.7563E+05	8.7169E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	1.2600	1.8900	10.080	10.080	0.0000	11.130	11.130
8	-0.2968	-0.4181	-208.77	-283.64	-2.4360	-3.3311	-5.3495	-7.3168	0.1734	8.7583E+05	8.7171E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
9	-0.2908	-0.4181	-204.99	-283.55	-2.3935	-3.3340	-5.2488	-7.3108	0.1700	8.7602E+05	8.7173E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
10	-0.2847	-0.4181	-201.22	-283.46	-2.3510	-3.3370	-5.1489	-7.3049	0.1667	8.7622E+05	8.7175E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	1.4700	0.8400	10.080	10.080	0.0000	11.130	11.130
11	-0.2786	-0.4181	-197.59	-283.39	-2.3094	-3.3400	-5.0538	-7.2989	0.1633	8.7643E+05	8.7176E+05
x(FT)	0.0000	0.0000	9.2400	9.0300	2.3100	3.3600	10.080	10.080	0.0000	11.130	11.130
12	-0.2726	-0.4181	-193.44	-282.87	-2.2869	-3.3730	-4.9853	-7.3338	0.1600	8.7723E+05	8.7292E+05
x(FT)	0.0000	0.0000	9.0300	9.0300	1.8900	1.0500	10.080	10.080	0.0000	11.130	11.130
13	-0.2651	-0.4195	-189.21	-283.98	-2.2201	-3.3644	-4.8458	-7.3234	0.1601	8.7704E+05	8.7218E+05
x(FT)	0.0000	0.0000	9.2400	9.0300	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
14	-0.2595	-0.4217	-185.89	-285.38	-2.1765	-3.3769	-4.7552	-7.3519	0.1637	8.7715E+05	8.7191E+05
x(FT)	0.0000	0.0000	9.2400	9.0300	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130
15	-0.2538	-0.4239	-181.76	-285.92	-2.1875	-3.4780	-4.7403	-7.4829	0.1674	8.7882E+05	8.7441E+05
x(FT)	0.0000	0.0000	8.8200	8.6100	3.3600	2.9400	10.080	10.080	0.0000	11.130	11.130
16	-0.3386	-0.4060	-234.77	-276.39	-2.7426	-3.2393	-6.0450	-7.1503	0.1591	8.7452E+05	8.7242E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	1.0500	3.3600	10.080	10.080	0.0000	11.130	11.130
17	-0.3325	-0.4060	-231.02	-276.38	-2.6976	-3.2389	-5.9379	-7.1389	0.1557	8.7463E+05	8.7229E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	0.0000	2.9400	10.080	10.080	0.0000	11.130	11.130
18	-0.3265	-0.4060	-227.22	-276.29	-2.6554	-3.2419	-5.8358	-7.1328	0.1524	8.7485E+05	8.7231E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	3.3600	2.9400	10.080	10.080	0.0000	11.130	11.130
19	-0.3204	-0.4060	-223.42	-276.20	-2.6130	-3.2449	-5.7336	-7.1266	0.1490	8.7505E+05	8.7233E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	2.7300	3.3600	10.080	10.080	0.0000	11.130	11.130
20	-0.3143	-0.4060	-219.61	-276.11	-2.5706	-3.2479	-5.6316	-7.1205	0.1456	8.7525E+05	8.7235E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	1.2600	0.0000	10.080	10.080	0.0000	11.130	11.130
21	-0.3082	-0.4060	-215.80	-276.02	-2.5280	-3.2508	-5.5307	-7.1144	0.1423	8.7546E+05	8.7236E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	2.9400	2.1000	10.080	10.080	0.0000	11.130	11.130
22	-0.3022	-0.4060	-211.99	-275.93	-2.4853	-3.2538	-5.4302	-7.1083	0.1389	8.7567E+05	8.7238E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	0.0000	3.3600	10.080	10.080	0.0000	11.130	11.130
23	-0.2961	-0.4060	-208.19	-275.84	-2.4426	-3.2568	-5.3289	-7.1023	0.1356	8.7587E+05	8.7239E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
24	-0.2900	-0.4060	-204.41	-275.77	-2.3999	-3.2597	-5.2283	-7.0962	0.1322	8.7607E+05	8.7240E+05
x(FT)	0.0000	0.0000	9.2400	9.0300	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
25	-0.2840	-0.4060	-200.65	-275.70	-2.3573	-3.2627	-5.1289	-7.0901	0.1288	8.7627E+05	8.7241E+05
x(FT)	0.0000	0.0000	9.2400	9.0300	0.2100	0.6300	10.080	10.080	0.0000	11.130	11.130
26	-0.2779	-0.4060	-197.04	-275.63	-2.3156	-3.2657	-5.0341	-7.0840	0.1255	8.7647E+05	8.7243E+05

x(FT)	0.0000	0.0000	9.2400	9.0300	1.8900	1.2600	10.080	10.080	10.080	0.0000	11.130	11.130
27	-0.2718	-0.4060	-193.67	-276.05	-2.2565	-3.2451	-4.9083	-7.0432	-7.0432	0.1221	8.7615E+05	8.7129E+05
x(FT)	0.0000	0.0000	9.4500	9.2400	2.7300	1.4700	10.080	10.080	10.080	0.0000	11.130	11.130
28	-0.2664	-0.4060	-190.15	-275.74	-2.2254	-3.2577	-4.8315	-7.0531	-7.0531	0.1191	8.7655E+05	8.7185E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	1.4700	0.6300	10.080	10.080	10.080	0.0000	11.130	11.130
29	-0.2607	-0.4082	-186.52	-276.75	-2.1972	-3.2934	-4.7657	-7.1135	-7.1135	0.1228	8.7713E+05	8.7256E+05
x(FT)	0.0000	0.0000	9.2400	9.0300	0.0000	0.4200	10.080	10.080	10.080	0.0000	11.130	11.130
30	-0.2551	-0.4104	-183.13	-278.09	-2.1556	-3.3097	-4.6785	-7.1467	-7.1467	0.1264	8.7730E+05	8.7250E+05
x(FT)	0.0000	0.0000	9.2400	9.0300	1.4700	0.2100	10.080	10.080	10.080	0.0000	11.130	11.130
31	-0.2494	-0.4126	-178.91	-278.72	-2.1649	-3.4096	-4.6563	-7.2710	-7.2710	0.1301	8.7895E+05	8.7473E+05
x(FT)	0.0000	0.0000	8.8200	8.6100	0.2100	0.0000	10.080	10.080	10.080	0.0000	11.130	11.130
32	-0.3302	-0.4423	-228.70	-298.27	-2.7136	-3.5536	-6.0272	-7.9066	-7.9066	0.2664	8.7672E+05	8.7380E+05
x(FT)	0.0000	0.0000	8.8200	8.8200	2.9400	0.0000	10.080	10.080	10.080	0.0000	11.130	11.130
33	-0.3298	-0.4362	-228.89	-294.89	-2.6826	-3.4707	-5.9686	-7.7384	-7.7384	0.2475	8.7576E+05	8.7270E+05
x(FT)	0.0000	0.0000	9.0300	9.0300	3.3600	3.3600	10.080	10.080	10.080	0.0000	11.130	11.130
34	-0.3295	-0.4302	-228.62	-291.01	-2.6863	-3.4337	-5.9581	-7.6292	-7.6292	0.2286	8.7578E+05	8.7288E+05
x(FT)	0.0000	0.0000	9.0300	9.0300	3.3600	3.3600	10.080	10.080	10.080	0.0000	11.130	11.130
35	-0.3291	-0.4241	-228.56	-287.40	-2.6765	-3.3791	-5.9271	-7.4959	-7.4959	0.2097	8.7538E+05	8.7256E+05
x(FT)	0.0000	0.0000	9.2400	9.0300	0.0000	0.0000	10.080	10.080	10.080	0.0000	11.130	11.130
36	-0.3453	-0.4414	-238.11	-297.83	-2.8210	-3.5400	-6.2870	-7.9073	-7.9073	0.2720	8.7631E+05	8.7380E+05
x(FT)	0.0000	0.0000	8.8200	8.8200	0.2100	0.0000	10.080	10.080	10.080	0.0000	11.130	11.130
37	-0.3450	-0.4353	-238.34	-294.48	-2.7890	-3.4575	-6.2255	-7.7382	-7.7382	0.2531	8.7529E+05	8.7270E+05
x(FT)	0.0000	0.0000	9.0300	9.0300	0.2100	0.0000	10.080	10.080	10.080	0.0000	11.130	11.130
38	-0.3446	-0.4293	-238.07	-290.61	-2.7929	-3.4205	-6.2151	-7.6291	-7.6291	0.2342	8.7531E+05	8.7288E+05
x(FT)	0.0000	0.0000	9.0300	9.0300	0.2100	1.0500	10.080	10.080	10.080	0.0000	11.130	11.130
39	-0.3442	-0.4232	-238.32	-287.30	-2.7702	-3.3507	-6.1636	-7.4721	-7.4721	0.2153	8.7452E+05	8.7187E+05
x(FT)	0.0000	0.0000	9.2400	9.2400	0.0000	0.0000	10.080	10.080	10.080	0.0000	11.130	11.130
Min.	-0.3453	-0.4423	-238.34	-298.27	-2.8210	-3.5536	-6.2870	-7.9073	-7.9073	0.1191	8.7348E+05	8.2083E+05
Pile N.	36	32	37	32	36	32	36	36	36	28	2	3

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.	
	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	KIP/IN**2	KIP/IN**2	z-DIR	y-DIR	KIP-IN**2	KIP-IN**2
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1	3.6828E-04	4.4295E-04	5.2697	6.3390	20.667	24.979	2.1726	2.6132	2.6132	2.6132	0.2776	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000	0.0000	0.0000
2	3.7789E-04	4.6491E-04	5.3093	6.5426	20.297	24.965	2.1398	2.6325	2.6325	2.6325	0.2729	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000	0.0000	0.0000

3	3.7490E-04	4.7024E-04	5.2466	6.5972	19.952	24.960	2.1049	2.6401	0.2682	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
4	3.4198E-04	4.3133E-04	4.9424	6.2341	19.668	24.951	2.0653	2.6049	0.2634	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
5	3.3399E-04	4.2821E-04	4.8394	6.2051	19.334	24.939	2.0297	2.6023	0.2587	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
6	3.2819E-04	4.2794E-04	4.7556	6.2012	18.997	24.925	1.9945	2.6006	0.2540	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
7	3.2238E-04	4.2767E-04	4.6715	6.1973	18.660	24.910	1.9591	2.5990	0.2492	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
8	3.1662E-04	4.2740E-04	4.5880	6.1934	18.324	24.896	1.9241	2.5973	0.2445	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
9	3.1089E-04	4.2713E-04	4.5051	6.1895	17.989	24.882	1.8893	2.5957	0.2398	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
10	3.0519E-04	4.2686E-04	4.4226	6.1856	17.657	24.867	1.8547	2.5940	0.2350	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
11	2.9974E-04	4.2659E-04	4.3437	6.1817	17.339	24.853	1.8215	2.5924	0.2303	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
12	2.7981E-04	4.0527E-04	4.1316	5.9828	17.026	24.847	1.7820	2.5811	0.2256	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
13	2.8290E-04	4.2055E-04	4.1248	6.1313	16.621	24.905	1.7450	2.5941	0.2258	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
14	2.7963E-04	4.2500E-04	4.0677	6.1820	16.325	25.017	1.7151	2.6067	0.2309	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
15	2.3954E-04	3.7131E-04	3.6508	5.6552	16.052	25.108	1.6663	2.5830	0.2360	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
16	3.5394E-04	4.1505E-04	5.1400	6.0279	20.627	24.299	2.1629	2.5363	0.2243	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
17	3.5022E-04	4.1722E-04	5.0745	6.0458	20.285	24.282	2.1283	2.5355	0.2196	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
18	3.4444E-04	4.1694E-04	4.9907	6.0418	19.947	24.267	2.0932	2.5338	0.2148	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
19	3.3867E-04	4.1667E-04	4.9073	6.0378	19.610	24.252	2.0581	2.5321	0.2101	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
20	3.3291E-04	4.1639E-04	4.8238	6.0338	19.273	24.237	2.0231	2.5304	0.2054	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
21	3.2710E-04	4.1611E-04	4.7397	6.0299	18.936	24.223	1.9878	2.5287	0.2006	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
22	3.2128E-04	4.1584E-04	4.6556	6.0259	18.598	24.208	1.9525	2.5271	0.1959	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
23	3.1553E-04	4.1556E-04	4.5723	6.0219	18.263	24.193	1.9175	2.5254	0.1912	5.1206E+06	5.1206E+06

x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
24	3.0980E-04	4.1529E-04	4.4894	17.928	1.8827	2.5237	0.1864	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
25	3.0413E-04	4.1501E-04	4.4072	17.597	1.8482	2.5220	0.1817	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
26	2.9869E-04	4.1473E-04	4.3285	17.280	1.8152	2.5204	0.1770	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
27	3.0505E-04	4.3176E-04	4.3483	16.930	1.7836	2.5245	0.1722	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
28	2.9475E-04	4.2406E-04	4.2318	16.646	1.7521	2.5208	0.1680	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
29	2.8033E-04	4.1200E-04	4.0779	16.369	1.7194	2.5269	0.1731	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
30	2.7532E-04	4.1386E-04	4.0051	16.074	1.6887	2.5384	0.1783	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
31	2.3552E-04	3.6160E-04	3.5897	15.783	1.6384	2.5154	0.1834	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
32	3.0073E-04	3.8916E-04	4.5853	20.247	2.0967	2.7133	0.3756	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
33	3.2343E-04	4.1396E-04	4.8169	20.212	2.1083	2.6983	0.3490	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
34	3.2292E-04	4.0848E-04	4.8093	20.181	2.1049	2.6626	0.3224	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
35	3.3196E-04	4.1502E-04	4.8937	20.143	2.1062	2.6332	0.2957	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
36	3.1312E-04	3.8906E-04	4.7739	21.090	2.1831	2.7126	0.3835	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
37	3.3681E-04	4.1381E-04	5.0158	21.056	2.1955	2.6973	0.3569	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
38	3.3631E-04	4.0833E-04	5.0083	21.025	2.1922	2.6616	0.3302	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
39	3.5480E-04	4.2587E-04	5.1802	20.978	2.1970	2.6370	0.3036	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
Max.	3.7789E-04	4.7024E-04	5.3093	21.090	2.1970	2.7133	0.3835	5.1206E+06	5.1206E+06	5.1206E+06	5.1206E+06
Pile N.	2	3	2	36	39	32	36	1	1	1	1

\*\*\*\*\* SUMMARY FOR LOAD CASES AND COMBINATIONS \*\*\*\*\*

\*\*\*\*\* LOAD CASES RESULTS \*\*\*\*\*

LOAD CASE : 1

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*  
 LOAD X,KIP    LOAD Y,KIP    LOAD Z,KIP    MOM X,KIP-IN    MOM Y,KIP-IN    MOM Z,KIP-IN  
 1937.61    -568.160    -198.370    0.00000    12803.9    52786.9

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

DISP X,IN    DISP Y,IN    DISP Z,IN    ROT X,RAD    ROT Y,RAD    ROT Z,RAD  
 0.0130776    -2.32543    -0.79306    1.42880E-03    -6.76118E-06    1.09309E-04

\* PILE TOP DISPLACEMENTS, GLOBAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****
MINIMUM	4.5309E-03	-2.6597	1.4288E-03	-6.7612E-06	1.0931E-04
Pile N.	16	36	1	1	1
MAXIMUM	0.028413	-1.8471	1.4288E-03	-6.7612E-06	1.0931E-04
Pile N.	32	31	1	1	1

\* PILE TOP REACTIONS, GLOBAL \*

FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****
MINIMUM	17.426	-17.084	0.0000	0.0000	0.0000
Pile N.	16	16	1	1	1
MAXIMUM	109.28	-11.976	0.0000	0.0000	1.7904E-10
Pile N.	32	15	1	1	27

\* PILE TOP DISPLACEMENTS, LOCAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****
MINIMUM	4.5309E-03	-2.6597	1.4288E-03	-6.7612E-06	1.0931E-04
Pile N.	16	36	1	1	1
MAXIMUM	0.028413	-1.8471	1.4288E-03	-6.7612E-06	1.0931E-04
Pile N.	32	31	1	1	1

\* PILE TOP REACTIONS, LOCAL \*

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AXIAL,KIP      LAT. Y,KIP  LAT. Z,KIP  MOM X,KIP-IN  MOM Y,KIP-IN  MOM Z,KIP-IN
*****      *****      *****      *****      *****      *****
MINIMUM      17.426      -17.084      -5.8793      0.0000      0.0000      0.0000
Pile N.      16          16          32          1          1          1
MAXIMUM      109.28      -11.976      -4.7135      0.0000      0.0000      1.7904E-10
Pile N.      32          15          16          1          1          27

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\* EFFECTS FOR Laterally Loaded Pile \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		SOIL REACT		TOTAL STRESS KIP/IN**2
	y-DIR IN	z-DIR IN	y-DIR KIP-IN	z-DIR KIP-IN	y-DIR KIP	z-DIR KIP	y-DIR KIP/IN	z-DIR KIP/IN	y-DIR KIP/IN	z-DIR KIP/IN	
Min.	-2.6597	-1.0062	-1743.1	-676.17	-17.084	-5.8793	-28.745	-11.564	-28.745	-11.564	0.2458
Pile N.	36	32	36	32	16	32	16	15	16	15	16
Max.	6.6742E-03	2.1886E-03	51.158	24.400	165.90	63.430	21.600	8.0523	21.600	8.0523	2.1740
Pile N.	37	37	37	35	39	32	16	32	16	32	32

LOAD CASE : 2

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

LOAD X,KIP	LOAD Y,KIP	LOAD Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1649.32	-555.480	-148.440	0.00000	7409.52	41508.5

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

DISP X,IN	DISP Y,IN	DISP Z,IN	ROT X,RAD	ROT Y,RAD	ROT Z,RAD
0.0111191	-2.21875	-0.57503	1.27740E-03	-5.64832E-06	8.68437E-05

\* PILE TOP DISPLACEMENTS, GLOBAL \*

MINIMUM	DISP. X,IN		DISP. Y,IN		DISP. Z,IN		ROT. X,RAD		ROT. Y,RAD		ROT. Z,RAD	
	16	36	16	36	16	36	16	36	16	36	16	36
4.2752E-03	-2.5176	-0.7656	1.2774E-03	-5.6483E-06	-0.7656	1.2774E-03	-5.6483E-06	1.2774E-03	-5.6483E-06	1.2774E-03	-5.6483E-06	1.2774E-03
Pile N.	16	36	16	36	16	36	16	36	16	36	16	36
MAXIMUM	0.023263	-1.7911	-0.4905	1.2774E-03	-0.4905	1.2774E-03	-5.6483E-06	-0.4905	-5.6483E-06	-0.4905	-5.6483E-06	-0.4905
Pile N.	32	31	32	16	32	16	1	32	1	32	1	1

\* PILE TOP REACTIONS, GLOBAL \*

FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****

MINIMUM	16.443	-16.463	-4.7036	0.0000	-4.4761E-11	-1.7904E-10
Pile N.	16	16	32	1	19	12
MAXIMUM	89.469	-11.908	-3.4047	2.7408E-27	0.0000	1.7904E-10
Pile N.	32	15	16	19	1	27

\* PILE TOP DISPLACEMENTS, LOCAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****
4.2752E-03	-2.5176	-0.7656	1.2774E-03	-5.6483E-06	8.6844E-05
Pile N.	36	32	1	1	1
MAXIMUM	0.023263	-1.7911	1.2774E-03	-5.6483E-06	8.6844E-05
Pile N.	32	31	1	1	1

\* PILE TOP REACTIONS, LOCAL \*

AXIAL,KIP	LAT. Y,KIP	LAT. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****
16.443	-16.463	-4.7036	0.0000	-4.4761E-11	-1.7904E-10
Pile N.	16	32	1	19	12
MAXIMUM	89.469	-11.908	0.0000	0.0000	1.7904E-10
Pile N.	32	15	1	1	27

\* EFFECTS FOR Laterally Loaded Pile \*

PILE	DISPL. Y-DIR IN	DISPL. Z-DIR IN	MOMENT Y-DIR KIP-IN	MOMENT Z-DIR KIP-IN	SHEAR Y-DIR KIP	SHEAR Z-DIR KIP	SOIL REACT Y-DIR KIP/IN	SOIL REACT Z-DIR KIP/IN	TOTAL STRESS KIP/IN**2
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
Min.	-2.5176	-0.7656	-1667.6	-521.31	-16.463	-4.7036	-28.710	-9.0482	0.2320
Pile N.	36	32	36	32	16	32	16	15	16
Max.	5.6305E-03	1.4831E-03	44.501	21.070	158.55	48.389	21.855	6.6315	1.7799
Pile N.	37	37	38	37	39	32	16	32	32

LOAD CASE : 3

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

LOAD X,KIP	LOAD Y,KIP	LOAD Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1858.44	-544.890	-140.510	0.00000	6269.76	42152.3

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*



Min.	-2.4821	-0.7340	-1644.5	-500.24	-16.169	-4.4829	-28.614	-8.7445	0.3022
Pile N.	36	32	36	32	16	32	16	15	16
Max.	5.4006E-03	1.3879E-03	43.164	19.743	155.81	46.256	21.857	6.4534	1.9096
Pile N.	37	37	38	37	39	32	16	32	32

LOAD CASE : 4

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

LOAD X,KIP	LOAD Y,KIP	LOAD Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1871.72	-569.100	-189.590	0.00000	11992.7	50750.8

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

DISP X,IN	DISP Y,IN	DISP Z,IN	ROT X,RAD	ROT Y,RAD	ROT Z,RAD
0.0126317	-2.31997	-0.75429	1.41119E-03	-6.55678E-06	1.05193E-04

\* PILE TOP DISPLACEMENTS, GLOBAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****
MINIMUM	4.3970E-03	-2.6501	-0.9648	1.4112E-03	-6.5568E-06
Pile N.	16	36	32	1	1
MAXIMUM	0.027382	-1.8476	-0.6609	1.4112E-03	-6.5568E-06
Pile N.	32	31	16	1	1

\* PILE TOP REACTIONS, GLOBAL \*

FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****
MINIMUM	16.911	-17.066	-5.6860	0.0000	-1.7904E-10
Pile N.	16	16	32	1	29
MAXIMUM	105.31	-12.033	-4.4766	0.0000	1.7904E-10
Pile N.	32	15	16	1	13

\* PILE TOP DISPLACEMENTS, LOCAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****
MINIMUM	4.3970E-03	-2.6501	-0.9648	1.4112E-03	-6.5568E-06
Pile N.	16	36	32	1	1
MAXIMUM	0.027382	-1.8476	-0.6609	1.4112E-03	-6.5568E-06
Pile N.	32	31	16	1	1

\* PILE TOP REACTIONS, LOCAL \*

AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
MINIMUM	16.911	-17.066	-5.6860	0.0000	-1.7904E-10
Pile N.	16	16	32	1	29
MAXIMUM	105.31	-12.033	-4.4766	0.0000	1.7904E-10
Pile N.	32	15	16	1	13

\* EFFECTS FOR Laterally Loaded Pile \*

PILE	DISPL. Y-DIR IN	DISPL. Z-DIR IN	MOMENT		SHEAR		SOIL REACT		SOIL REACT		TOTAL STRESS KIP/IN**2
			Y-DIR KIP-IN	Z-DIR KIP-IN	Y-DIR KIP	Z-DIR KIP	Y-DIR KIP/IN	Z-DIR KIP/IN	Y-DIR KIP/IN	Z-DIR KIP/IN	
Min.	-2.6501	-0.9648	-1739.2	-649.63	-17.066	-5.6860	-28.813	-11.104	0.2386		
Pile N.	36	32	36	32	16	32	16	15	16		
Max.	6.5972E-03	2.0769E-03	50.570	24.737	165.68	60.877	21.678	7.7554	2.0951		
Pile N.	37	37	37	36	39	32	16	32	32		

LOAD CASE : 5

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

LOAD X, KIP	LOAD Y, KIP	LOAD Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1446.29	-399.340	-141.050	0.00000	7856.52	34869.6

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

DISP X, IN	DISP Y, IN	DISP Z, IN	ROT X, RAD	ROT Y, RAD	ROT Z, RAD
9.75261E-03	-1.50267	-0.51489	8.18835E-04	-4.16444E-06	7.25379E-05

\* PILE TOP DISPLACEMENTS, GLOBAL \*

DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
MINIMUM	4.1435E-03	-1.6942	-0.6371	8.1883E-04	-4.1644E-06
Pile N.	16	36	32	1	1
MAXIMUM	0.019976	-1.2286	-0.4607	8.1883E-04	-4.1644E-06
Pile N.	32	31	16	1	1

\* PILE TOP REACTIONS, GLOBAL \*

FOR. X, KIP	FOR. Y, KIP	FOR. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
-------------	-------------	-------------	---------------	---------------	---------------

```

*****
MINIMUM 15.936 -11.704 -4.2101 0.0000 0.0000 0.0000 *****
Pile N. 16 16 32 1 1 1
MAXIMUM 76.827 -8.6571 -3.3589 0.0000 0.0000 0.0000
Pile N. 32 15 16 1 1 1

```

\* PILE TOP DISPLACEMENTS, LOCAL \*

```

DISP. X,IN DISP. Y,IN DISP. Z,IN ROT. X,RAD ROT. Y,RAD ROT. Z,RAD
*****
4.1435E-03 -1.6942 -0.6371 8.1883E-04 -4.1644E-06 7.2538E-05
Pile N. 16 36 32 1 1 1
MAXIMUM 0.019976 -1.2286 -0.4607 8.1883E-04 -4.1644E-06 7.2538E-05
Pile N. 32 31 16 1 1 1

```

\* PILE TOP REACTIONS, LOCAL \*

```

AXIAL,KIP LAT. Y,KIP LAT. Z,KIP MOM X,KIP-IN MOM Y,KIP-IN MOM Z,KIP-IN
*****
15.936 -11.704 -4.2101 0.0000 0.0000 0.0000
Pile N. 16 16 32 1 1 1
MAXIMUM 76.827 -8.6571 -3.3589 0.0000 0.0000 0.0000
Pile N. 32 15 16 1 1 1

```

\* EFFECTS FOR Laterally Loaded Pile \*

PILE	DISPL. Y-DIR IN	DISPL. Z-DIR IN	MOMENT KIP-IN	MOMENT Y-DIR KIP-IN	MOMENT Z-DIR KIP-IN	SHEAR Y-DIR KIP	SHEAR Z-DIR KIP	SOIL REACT Y-DIR KIP/IN	SOIL REACT Z-DIR KIP/IN	SOIL REACT Y-DIR KIP/IN**2	SOIL REACT Z-DIR KIP/IN**2	TOTAL STRESS KIP/IN**2
16	-1.6942	-0.6371	-1146.6	-437.75	-4.2101	16	32	-25.889	-10.535	16	15	0.2248
32	9.0859E-04	25.504	13.747	107.62	40.744	36	37	14.744	5.1751	37	32	1.5284

LOAD CASE : 6

\* TABLE L \* COMPUTATION ON PILE CAP

```

* EQUIVALENT CONCENTRATED LOAD AT ORIGIN *
LOAD X,KIP 1281.55
LOAD Y,KIP -368.920
LOAD Z,KIP -103.810
MOM X,KIP-IN 0.00000
MOM Y,KIP-IN 3426.36
MOM Z,KIP-IN 24914.0

```

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*  
 DISP X,IN DISP Y,IN DISP Z,IN ROT X,RAD ROT Y,RAD ROT Z,RAD  
 8.62644E-03 -1.35876 -0.36328 7.13383E-04 -2.85275E-06 5.26958E-05

\* PILE TOP DISPLACEMENTS, GLOBAL \*  
 DISP. X,IN DISP. Y,IN DISP. Z,IN ROT. X,RAD ROT. Y,RAD ROT. Z,RAD  
 \*\*\*\*\*  
 4.5851E-03 -1.5256 -0.4697 7.1338E-04 -2.8527E-06 5.2696E-05  
 Pile N. 16 36 32 1 1 1  
 MAXIMUM 0.016078 -1.1199 -0.3161 7.1338E-04 -2.8527E-06 5.2696E-05  
 Pile N. 32 31 16 1 1 1

\* PILE TOP REACTIONS, GLOBAL \*  
 FOR. X,KIP FOR. Y,KIP FOR. Z,KIP MOM X,KIP-IN MOM Y,KIP-IN MOM Z,KIP-IN  
 \*\*\*\*\*  
 17.634 -10.693 -3.2655 0.0000 0.0000 0.0000  
 Pile N. 16 16 32 1 1 1  
 MAXIMUM 61.836 -8.0771 -2.4044 0.0000 0.0000 0.0000  
 Pile N. 32 15 16 1 1 1

\* PILE TOP DISPLACEMENTS, LOCAL \*  
 DISP. X,IN DISP. Y,IN DISP. Z,IN ROT. X,RAD ROT. Y,RAD ROT. Z,RAD  
 \*\*\*\*\*  
 4.5851E-03 -1.5256 -0.4697 7.1338E-04 -2.8527E-06 5.2696E-05  
 Pile N. 16 36 32 1 1 1  
 MAXIMUM 0.016078 -1.1199 -0.3161 7.1338E-04 -2.8527E-06 5.2696E-05  
 Pile N. 32 31 16 1 1 1

\* PILE TOP REACTIONS, LOCAL \*  
 AXIAL,KIP LAT. Y,KIP LAT. Z,KIP MOM X,KIP-IN MOM Y,KIP-IN MOM Z,KIP-IN  
 \*\*\*\*\*  
 17.634 -10.693 -3.2655 0.0000 0.0000 0.0000  
 Pile N. 16 16 32 1 1 1  
 MAXIMUM 61.836 -8.0771 -2.4044 0.0000 0.0000 0.0000  
 Pile N. 32 15 16 1 1 1

\* EFFECTS FOR Laterally Loaded Pile \*  
 PILE DISPL. DISPL. Z-DIR IN IN MOMENT Z-DIR KIP-IN SHEAR Y-DIR KIP SHEAR Z-DIR KIP SOIL REACT Y-DIR KIP/IN SOIL REACT Z-DIR KIP/IN TOTAL STRESS KIP/IN\*\*2

```

*****
Min.      -1.5256      -0.4697      -1034.9      -328.73      -10.693      -3.2655      -26.026      -8.1150      0.2488
Pile N.   36           32           39           32           16           32           16           32           16
Max.      2.2805E-03   6.4235E-04   24.041      9.2016      97.065      29.698      12.847      3.6185      1.2302
Pile N.   37           37           37           37           36           32           37           37           32
*****

```

LOAD CASE : 7

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

```

LOAD X,KIP  LOAD Y,KIP  LOAD Z,KIP  MOM X,KIP-IN  MOM Y,KIP-IN  MOM Z,KIP-IN
478.060    -97.2500    -129.940    0.00000      7798.80      5406.96

```

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

```

DISP X,IN  DISP Y,IN  DISP Z,IN  ROT X,RAD  ROT Y,RAD  ROT Z,RAD
3.23210E-03 -0.30588      -0.41714  1.68600E-04  1.71881E-06  9.57890E-06

```

\* PILE TOP DISPLACEMENTS, GLOBAL \*

```

DISP. X,IN  DISP. Y,IN  DISP. Z,IN  ROT. X,RAD  ROT. Y,RAD  ROT. Z,RAD
*****
MINIMUM      2.1957E-03      -0.3453      -0.4423      1.6860E-04      1.7188E-06      9.5789E-06
Pile N.      28           36           32           1           1           1
MAXIMUM      5.0120E-03      -0.2494      -0.4060      1.6860E-04      1.7188E-06      9.5789E-06
Pile N.      36           31           16           1           1           1

```

\* PILE TOP REACTIONS, GLOBAL \*

```

FOR. X,KIP  FOR. Y,KIP  FOR. Z,KIP  MOM X,KIP-IN  MOM Y,KIP-IN  MOM Z,KIP-IN
*****
MINIMUM      8.4447      -2.8210      -3.5536      0.0000      0.0000      -2.2380E-11
Pile N.      28           36           32           1           1           30
MAXIMUM      19.276      -2.1556      -3.2389      0.0000      0.0000      0.0000
Pile N.      36           30           17           1           1           1

```

\* PILE TOP DISPLACEMENTS, LOCAL \*

```

DISP. X,IN  DISP. Y,IN  DISP. Z,IN  ROT. X,RAD  ROT. Y,RAD  ROT. Z,RAD
*****
MINIMUM      2.1957E-03      -0.3453      -0.4423      1.6860E-04      1.7188E-06      9.5789E-06
Pile N.      28           36           32           1           1           1
MAXIMUM      5.0120E-03      -0.2494      -0.4060      1.6860E-04      1.7188E-06      9.5789E-06
Pile N.      36           31           16           1           1           1

```

\* PILE TOP REACTIONS, LOCAL \*

	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
MINIMUM	8.4447	-2.8210	-3.5536	0.0000	0.0000	-2.2380E-11
Pile N.	28	36	32	1	1	30
MAXIMUM	19.276	-2.1556	-3.2389	0.0000	0.0000	0.0000
Pile N.	36	30	17	1	1	1

\* EFFECTS FOR Laterally Loaded Pile \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		SOIL REACT		TOTAL STRESS KIP/IN**2
	Y-DIR IN	Z-DIR IN	Z-DIR KIP-IN	Y-DIR KIP	Y-DIR KIP	Z-DIR KIP	Y-DIR KIP/IN	Z-DIR KIP/IN	Y-DIR KIP/IN	Z-DIR KIP/IN	
Min.	-0.3453	-0.4423	-238.34	-2.8210	-3.5536	-7.9073	-6.2870	-7.9073	0.1191	28	
Pile N.	36	32	37	36	32	36	36	36	28	36	
Max.	3.7789E-04	4.7024E-04	5.3093	21.090	26.388	2.7133	2.1970	2.7133	0.3835	36	
Pile N.	2	3	2	36	32	32	39	32	36	36	

10.75-inch-diameter Pile  
GROUP Output File

=====

GROUP for Windows, Version 2016.10.13

Serial Number : 239146278

Analysis of A Group of Piles  
Subjected to Axial and Lateral Loading

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Time and Date of Analysis  
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Date: August 06, 2024      Time: 15:55:15

\*\*\*\*\*      COMPUTATION RESULTS      \*\*\*\*\*

Rosemont Street Bridge Micropiles

\*\*\*\*\*      LOAD CASES RESULTS      \*\*\*\*\*

LOAD CASE :      1  
CASE NAME :      Strength I  
LOAD TYPE :      Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
 ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.8625	1.0000
2	0.8136	1.0000
3	0.7420	1.0000
4	0.8962	1.0000
5	0.9197	1.0000
6	0.9197	1.0000
7	0.9197	1.0000
8	0.9197	1.0000
9	0.9197	1.0000
10	0.9197	1.0000
11	0.9201	1.0000
12	0.9486	1.0000
13	0.9290	1.0000
14	0.9001	1.0000
15	0.9674	1.0000
16	0.9441	1.0000
17	0.9145	1.0000
18	0.9145	1.0000
19	0.9145	1.0000
20	0.9145	1.0000
21	0.9145	1.0000
22	0.9145	1.0000
23	0.9145	1.0000
24	0.9145	1.0000
25	0.9145	1.0000
26	0.9132	1.0000
27	0.8765	1.0000
28	0.8658	1.0000
29	0.8941	1.0000
30	0.8952	1.0000
31	0.9623	1.0000
32	0.9621	1.0000
33	0.7580	1.0000
34	0.7537	1.0000
35	0.7543	1.0000
36	0.9621	1.0000

37	0.7580	1.0000
38	0.7537	1.0000
39	0.7721	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1937.61	-568.160	-198.370
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	12803.9	52786.9

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
0.0111686	-1.72276	-0.58341
ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
9.96703E-04	-5.77419E-06	9.33524E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****	*****
1	0.010566	-1.9204	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
2	0.010774	-1.8845	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
3	0.010982	-1.8486	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
4	0.011190	-1.8127	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
5	0.011397	-1.7769	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05

6	0.011605	-1.7410	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
7	0.011813	-1.7051	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
8	0.012021	-1.6692	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
9	0.012229	-1.6333	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
10	0.012437	-1.5975	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
11	0.012645	-1.5616	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
12	0.012853	-1.5257	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
13	0.013867	-1.4820	-0.5973	9.9670E-04	-5.7742E-06	9.3352E-05
14	0.015276	-1.4485	-0.6103	9.9670E-04	-5.7742E-06	9.3352E-05
15	0.016686	-1.4151	-0.6233	9.9670E-04	-5.7742E-06	9.3352E-05
16	3.8695E-03	-1.9161	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
17	4.0773E-03	-1.8802	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
18	4.2852E-03	-1.8443	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
19	4.4931E-03	-1.8085	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
20	4.7010E-03	-1.7726	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
21	4.9088E-03	-1.7367	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
22	5.1167E-03	-1.7008	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
23	5.3246E-03	-1.6649	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
24	5.5324E-03	-1.6291	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
25	5.7403E-03	-1.5932	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
26	5.9482E-03	-1.5573	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
27	6.1560E-03	-1.5214	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
28	6.3413E-03	-1.4894	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
29	7.7509E-03	-1.4560	-0.5304	9.9670E-04	-5.7742E-06	9.3352E-05
30	9.1608E-03	-1.4225	-0.5434	9.9670E-04	-5.7742E-06	9.3352E-05
31	0.010571	-1.3891	-0.5564	9.9670E-04	-5.7742E-06	9.3352E-05
32	0.024265	-1.8664	-0.7321	9.9670E-04	-5.7742E-06	9.3352E-05
33	0.020923	-1.8642	-0.6963	9.9670E-04	-5.7742E-06	9.3352E-05
34	0.017581	-1.8621	-0.6605	9.9670E-04	-5.7742E-06	9.3352E-05
35	0.014238	-1.8600	-0.6247	9.9670E-04	-5.7742E-06	9.3352E-05
36	0.023246	-1.9559	-0.7268	9.9670E-04	-5.7742E-06	9.3352E-05
37	0.019904	-1.9538	-0.6910	9.9670E-04	-5.7742E-06	9.3352E-05
38	0.016561	-1.9516	-0.6552	9.9670E-04	-5.7742E-06	9.3352E-05
39	0.013219	-1.9495	-0.6193	9.9670E-04	-5.7742E-06	9.3352E-05
MINIMUM	3.8695E-03	-1.9559	-0.7321	9.9670E-04	-5.7742E-06	9.3352E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.024265	-1.3891	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	47.583	-16.072	-5.0813	0.0000	0.0000	0.0000
2	48.519	-15.593	-5.0248	0.0000	0.0000	0.0000
3	49.455	-15.005	-4.9327	0.0000	0.0000	0.0000
4	50.391	-15.406	-5.1502	0.0000	0.0000	0.0000
5	51.328	-15.218	-5.1862	0.0000	0.0000	0.0000
6	52.264	-14.942	-5.1947	0.0000	0.0000	0.0000
7	53.200	-14.666	-5.2036	0.0000	0.0000	0.0000
8	54.136	-14.390	-5.2129	0.0000	0.0000	0.0000
9	55.072	-14.103	-5.2188	0.0000	0.0000	0.0000
10	56.008	-13.812	-5.2232	0.0000	0.0000	0.0000
11	56.944	-13.522	-5.2286	0.0000	0.0000	0.0000
12	57.880	-13.302	-5.2613	0.0000	0.0000	0.0000
13	62.446	-12.849	-5.2983	0.0000	0.0000	0.0000
14	68.795	-12.430	-5.3516	0.0000	0.0000	0.0000
15	75.144	-12.242	-5.5022	0.0000	0.0000	0.0000
16	17.426	-16.929	-4.7304	0.0000	0.0000	0.0000
17	18.362	-16.533	-4.7066	0.0000	0.0000	0.0000
18	19.298	-16.254	-4.7152	0.0000	0.0000	0.0000
19	20.234	-15.971	-4.7229	0.0000	0.0000	0.0000
20	21.170	-15.687	-4.7306	0.0000	0.0000	0.0000
21	22.106	-15.403	-4.7386	0.0000	0.0000	0.0000
22	23.043	-15.118	-4.7468	0.0000	0.0000	0.0000
23	23.979	-14.835	-4.7561	0.0000	0.0000	0.0000
24	24.915	-14.535	-4.7602	0.0000	0.0000	0.0000
25	25.851	-14.233	-4.7642	0.0000	0.0000	0.0000
26	26.787	-13.930	-4.7679	0.0000	0.0000	0.0000
27	27.723	-13.536	-4.7405	0.0000	0.0000	0.0000
28	28.557	-13.243	-4.7353	0.0000	0.0000	0.0000
29	34.906	-12.957	-4.8507	0.0000	0.0000	0.0000
30	41.255	-12.606	-4.9405	0.0000	0.0000	0.0000
31	47.604	-12.412	-5.0920	0.0000	0.0000	0.0000
32	109.28	-14.959	-6.0002	0.0000	0.0000	0.0000
33	94.225	-14.386	-5.5132	0.0000	0.0000	0.0000
34	79.173	-14.622	-5.3296	0.0000	0.0000	0.0000
35	64.121	-14.879	-5.1436	0.0000	0.0000	0.0000
36	104.69	-15.639	-5.9504	0.0000	0.0000	-2.4977E-10
37	89.634	-15.029	-5.4640	0.0000	0.0000	0.0000
38	74.582	-15.274	-5.2790	0.0000	0.0000	-2.4977E-10

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39      59.530      -15.637      -5.1210      0.0000      0.0000      0.0000      0.0000
MINIMUM      17.426      -16.929      -6.0002      0.0000      0.0000      0.0000      -2.4977E-10
Pile N.      16      16      32      1      1      36
MAXIMUM      109.28      -12.242      -4.7066      0.0000      0.0000      0.0000      0.0000
Pile N.      32      15      17      1      1      1

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THE PILE COORDINATE SYSTEM (LOCAL AXES)

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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	0.010566	-1.9204	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
2	0.010774	-1.8845	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
3	0.010982	-1.8486	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
4	0.011190	-1.8127	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
5	0.011397	-1.7769	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
6	0.011605	-1.7410	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
7	0.011813	-1.7051	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
8	0.012021	-1.6692	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
9	0.012229	-1.6333	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
10	0.012437	-1.5975	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
11	0.012645	-1.5616	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
12	0.012853	-1.5257	-0.5892	9.9670E-04	-5.7742E-06	9.3352E-05
13	0.013867	-1.4820	-0.5973	9.9670E-04	-5.7742E-06	9.3352E-05
14	0.015276	-1.4485	-0.6103	9.9670E-04	-5.7742E-06	9.3352E-05
15	0.016686	-1.4151	-0.6233	9.9670E-04	-5.7742E-06	9.3352E-05
16	3.8695E-03	-1.9161	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
17	4.0773E-03	-1.8802	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
18	4.2852E-03	-1.8443	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
19	4.4931E-03	-1.8085	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
20	4.7010E-03	-1.7726	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
21	4.9088E-03	-1.7367	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
22	5.1167E-03	-1.7008	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
23	5.3246E-03	-1.6649	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
24	5.5324E-03	-1.6291	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
25	5.7403E-03	-1.5932	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
26	5.9482E-03	-1.5573	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05

27	6.1560E-03	-1.5214	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
28	6.3413E-03	-1.4894	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
29	7.7509E-03	-1.4560	-0.5304	9.9670E-04	-5.7742E-06	9.3352E-05
30	9.1608E-03	-1.4225	-0.5434	9.9670E-04	-5.7742E-06	9.3352E-05
31	0.010571	-1.3891	-0.5564	9.9670E-04	-5.7742E-06	9.3352E-05
32	0.024265	-1.8664	-0.7321	9.9670E-04	-5.7742E-06	9.3352E-05
33	0.020923	-1.8642	-0.6963	9.9670E-04	-5.7742E-06	9.3352E-05
34	0.017581	-1.8621	-0.6605	9.9670E-04	-5.7742E-06	9.3352E-05
35	0.014238	-1.8600	-0.6247	9.9670E-04	-5.7742E-06	9.3352E-05
36	0.023246	-1.9559	-0.7268	9.9670E-04	-5.7742E-06	9.3352E-05
37	0.019904	-1.9538	-0.6910	9.9670E-04	-5.7742E-06	9.3352E-05
38	0.016561	-1.9516	-0.6552	9.9670E-04	-5.7742E-06	9.3352E-05
39	0.013219	-1.9495	-0.6193	9.9670E-04	-5.7742E-06	9.3352E-05
MINIMUM	3.8695E-03	-1.9559	-0.7321	9.9670E-04	-5.7742E-06	9.3352E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.024265	-1.3891	-0.5174	9.9670E-04	-5.7742E-06	9.3352E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL,KIP	LAT. Y,KIP	LAT. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	47.583	-16.072	-5.0813	0.0000	0.0000	0.0000
2	48.519	-15.593	-5.0248	0.0000	0.0000	0.0000
3	49.455	-15.005	-4.9327	0.0000	0.0000	0.0000
4	50.391	-15.406	-5.1502	0.0000	0.0000	0.0000
5	51.328	-15.218	-5.1862	0.0000	0.0000	0.0000
6	52.264	-14.942	-5.1947	0.0000	0.0000	0.0000
7	53.200	-14.666	-5.2036	0.0000	0.0000	0.0000
8	54.136	-14.390	-5.2129	0.0000	0.0000	0.0000
9	55.072	-14.103	-5.2188	0.0000	0.0000	0.0000
10	56.008	-13.812	-5.2232	0.0000	0.0000	0.0000
11	56.944	-13.522	-5.2286	0.0000	0.0000	0.0000
12	57.880	-13.302	-5.2613	0.0000	0.0000	0.0000
13	62.446	-12.849	-5.2983	0.0000	0.0000	0.0000
14	68.795	-12.430	-5.3516	0.0000	0.0000	0.0000
15	75.144	-12.242	-5.5022	0.0000	0.0000	0.0000
16	17.426	-16.929	-4.7304	0.0000	0.0000	0.0000
17	18.362	-16.533	-4.7066	0.0000	0.0000	0.0000
18	19.298	-16.254	-4.7152	0.0000	0.0000	0.0000

19	20.234	-15.971	-4.7229	0.0000	0.0000	0.0000	0.0000	0.0000
20	21.170	-15.687	-4.7306	0.0000	0.0000	0.0000	0.0000	0.0000
21	22.106	-15.403	-4.7386	0.0000	0.0000	0.0000	0.0000	0.0000
22	23.043	-15.118	-4.7468	0.0000	0.0000	0.0000	0.0000	0.0000
23	23.979	-14.835	-4.7561	0.0000	0.0000	0.0000	0.0000	0.0000
24	24.915	-14.535	-4.7602	0.0000	0.0000	0.0000	0.0000	0.0000
25	25.851	-14.233	-4.7642	0.0000	0.0000	0.0000	0.0000	0.0000
26	26.787	-13.930	-4.7679	0.0000	0.0000	0.0000	0.0000	0.0000
27	27.723	-13.536	-4.7405	0.0000	0.0000	0.0000	0.0000	0.0000
28	28.557	-13.243	-4.7353	0.0000	0.0000	0.0000	0.0000	0.0000
29	34.906	-12.957	-4.8507	0.0000	0.0000	0.0000	0.0000	0.0000
30	41.255	-12.606	-4.9405	0.0000	0.0000	0.0000	0.0000	0.0000
31	47.604	-12.412	-5.0920	0.0000	0.0000	0.0000	0.0000	0.0000
32	109.28	-14.959	-6.0002	0.0000	0.0000	0.0000	0.0000	0.0000
33	94.225	-14.386	-5.5132	0.0000	0.0000	0.0000	0.0000	0.0000
34	79.173	-14.622	-5.3296	0.0000	0.0000	0.0000	0.0000	0.0000
35	64.121	-14.879	-5.1436	0.0000	0.0000	0.0000	0.0000	0.0000
36	104.69	-15.639	-5.9504	0.0000	0.0000	0.0000	-2.4977E-10	0.0000
37	89.634	-15.029	-5.4640	0.0000	0.0000	0.0000	0.0000	0.0000
38	74.582	-15.274	-5.2790	0.0000	0.0000	0.0000	-2.4977E-10	0.0000
39	59.530	-15.637	-5.1210	0.0000	0.0000	0.0000	0.0000	0.0000
MINIMUM	17.426	-16.929	-6.0002	0.0000	0.0000	0.0000	-2.4977E-10	0.0000
Pile N.	16	16	32	1	1	1	36	1
MAXIMUM	109.28	-12.242	-4.7066	0.0000	0.0000	0.0000	0.0000	0.0000
Pile N.	32	15	17	1	1	1	1	1

PILE GROUP STRESS, KIP/IN\*\*2  
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1	0.5367
2	0.5472
3	0.5578
4	0.5683
5	0.5789
6	0.5895
7	0.6000
8	0.6106
9	0.6211
10	0.6317
11	0.6422
12	0.6528



1	-1.9204	-0.5892	-1723.2	-546.24	-16.072	-5.0813	-27.059	-8.3708	0.5367	3.5344E+05	4.2541E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.4700	3.1500	10.080	10.080	0.0000	11.130	11.130
2	-1.8845	-0.5892	-1683.7	-543.93	-15.593	-5.0248	-25.652	-8.0721	0.5472	3.4578E+05	4.2157E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.2100	10.080	10.080	0.0000	11.130	11.130
3	-1.8486	-0.5892	-1637.9	-539.73	-15.005	-4.9327	-23.696	-7.5733	0.5578	3.3015E+05	4.1607E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	0.4200	10.080	10.080	0.0000	11.130	11.130
4	-1.8127	-0.5892	-1641.4	-550.05	-15.406	-5.1502	-27.321	-8.9763	0.5683	3.7326E+05	4.2920E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.1500	10.080	10.080	0.0000	11.130	11.130
5	-1.7769	-0.5892	-1614.4	-551.51	-15.218	-5.1862	-27.708	-9.3014	0.5789	3.7972E+05	4.1875E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	2.9400	10.080	10.080	0.0000	11.130	11.130
6	-1.7410	-0.5892	-1584.2	-552.07	-14.942	-5.1947	-27.518	-9.4271	0.5895	3.8240E+05	4.1886E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	2.7300	10.080	10.080	0.0000	11.130	11.130
7	-1.7051	-0.5892	-1554.0	-552.65	-14.666	-5.2036	-27.325	-9.5553	0.6000	3.8503E+05	4.2109E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	11.130
8	-1.6692	-0.5892	-1523.7	-553.24	-14.390	-5.2129	-27.127	-9.6890	0.6106	3.8762E+05	4.2197E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	3.1500	10.080	10.080	0.0000	11.130	11.130
9	-1.6333	-0.5892	-1491.9	-553.31	-14.103	-5.2188	-27.007	-9.8549	0.6211	3.8975E+05	4.2415E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	1.4700	10.080	10.080	0.0000	11.130	11.130
10	-1.5975	-0.5892	-1459.6	-553.19	-13.812	-5.2232	-26.832	-10.009	0.6317	3.9201E+05	4.2521E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
11	-1.5616	-0.5892	-1427.4	-553.12	-13.522	-5.2286	-26.717	-10.194	0.6422	3.9397E+05	4.2542E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
12	-1.5257	-0.5892	-1395.5	-553.15	-13.302	-5.2613	-27.323	-10.665	0.6528	3.9776E+05	4.3006E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	0.0000	10.080	10.080	0.0000	11.130	11.130
13	-1.4820	-0.5973	-1355.4	-559.99	-12.849	-5.2983	-26.569	-10.820	0.7043	3.9869E+05	4.2747E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	0.0000	10.080	10.080	0.0000	11.130	11.130
14	-1.4485	-0.6103	-1324.1	-571.01	-12.430	-5.3516	-25.592	-10.891	0.7759	3.9864E+05	4.2220E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
15	-1.4151	-0.6233	-1293.5	-582.34	-12.242	-5.5022	-27.074	-12.034	0.8475	4.0485E+05	4.3020E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.2600	1.4700	10.080	10.080	0.0000	11.130	11.130
16	-1.9161	-0.5174	-1741.5	-488.61	-16.929	-4.7304	-29.286	-8.0325	0.1965	3.7123E+05	4.2538E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	0.0000	10.080	10.080	0.0000	11.130	11.130
17	-1.8802	-0.5174	-1707.1	-487.91	-16.533	-4.7066	-28.376	-7.9306	0.2071	3.6936E+05	4.2127E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	11.130
18	-1.8443	-0.5174	-1677.6	-488.55	-16.254	-4.7152	-28.191	-8.0315	0.2177	3.7342E+05	4.2482E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.8400	10.080	10.080	0.0000	11.130	11.130
19	-1.8085	-0.5174	-1647.5	-489.04	-15.971	-4.7229	-28.017	-8.1401	0.2282	3.7651E+05	4.2551E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	3.1500	10.080	10.080	0.0000	11.130	11.130
20	-1.7726	-0.5174	-1617.2	-489.53	-15.687	-4.7306	-27.838	-8.2497	0.2388	3.7930E+05	4.2762E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	1.2600	10.080	10.080	0.0000	11.130	11.130
21	-1.7367	-0.5174	-1587.0	-490.05	-15.403	-4.7386	-27.656	-8.3627	0.2493	3.8204E+05	4.2992E+05

x(FT)	0.0000	10.080	10.080	2.5200	1.6800	10.080	10.080	10.080	10.080	0.0000	11.130	11.130
22	-1.7008	-1556.7	-490.57	-15.118	-4.7468	-27.470	-8.4806	0.2599	3.8473E+05	0.0000	11.130	4.3041E+05
x(FT)	0.0000	10.080	10.080	0.8400	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
23	-1.6649	-1526.6	-491.19	-14.835	-4.7561	-27.343	-8.6191	0.2704	3.8755E+05	0.0000	11.130	4.3481E+05
x(FT)	0.0000	10.080	10.080	3.3600	2.7300	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
24	-1.6291	-1494.2	-491.09	-14.535	-4.7602	-27.199	-8.7611	0.2810	3.8943E+05	0.0000	11.130	4.3494E+05
x(FT)	0.0000	10.080	10.080	0.4200	1.4700	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
25	-1.5932	-1461.8	-490.98	-14.233	-4.7642	-27.033	-8.9026	0.2916	3.9165E+05	0.0000	11.130	4.3506E+05
x(FT)	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
26	-1.5573	-1429.4	-490.91	-13.930	-4.7679	-26.876	-9.0535	0.3021	3.9353E+05	0.0000	11.130	4.3519E+05
x(FT)	0.0000	10.080	10.080	3.1500	1.2600	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
27	-1.5214	-1396.5	-490.63	-13.536	-4.7405	-25.752	-8.8800	0.3127	3.9296E+05	0.0000	11.130	4.3128E+05
x(FT)	0.0000	10.080	10.080	0.0000	0.8400	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
28	-1.4894	-1367.5	-490.51	-13.243	-4.7353	-25.349	-8.9281	0.3221	3.9401E+05	0.0000	11.130	4.3023E+05
x(FT)	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
29	-1.4560	-1337.0	-501.95	-12.957	-4.8507	-25.908	-9.5577	0.3937	3.9776E+05	0.0000	11.130	4.3485E+05
x(FT)	0.0000	10.080	10.080	0.6300	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
30	-1.4225	-1305.9	-513.14	-12.606	-4.9400	-25.727	-9.9442	0.4653	3.9956E+05	0.0000	11.130	4.3346E+05
x(FT)	0.0000	10.080	10.080	1.4700	0.4200	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
31	-1.3891	-1275.3	-524.54	-12.412	-5.0920	-27.237	-11.022	0.5369	4.0593E+05	0.0000	11.130	4.4590E+05
x(FT)	0.0000	10.080	10.080	3.3600	2.5200	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
32	-1.8664	-1679.8	-674.43	-14.959	-6.0002	-28.606	-11.301	1.2325	3.7859E+05	0.0000	11.130	4.2810E+05
x(FT)	0.0000	10.080	10.080	0.8400	2.1000	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
33	-1.8642	-1643.8	-630.58	-14.386	-5.5132	-23.814	-8.8975	1.0627	3.3267E+05	0.0000	11.130	4.1015E+05
x(FT)	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
34	-1.8621	-1644.6	-600.32	-14.622	-5.3296	-23.819	-8.4558	0.8930	3.3165E+05	0.0000	11.130	4.1241E+05
x(FT)	0.0000	10.080	10.080	1.6800	0.6300	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
35	-1.8600	-1646.6	-570.31	-14.879	-5.1436	-23.943	-8.0575	0.7232	3.3225E+05	0.0000	11.130	4.1423E+05
x(FT)	0.0000	10.080	10.080	1.4700	2.1000	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
36	-1.9559	-1754.4	-668.27	-15.639	-5.9504	-29.136	-10.901	1.1807	3.7014E+05	0.0000	11.130	4.2505E+05
x(FT)	0.0000	10.080	10.080	1.6800	0.2100	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
37	-1.9538	-1714.3	-624.05	-15.029	-5.4640	-24.309	-8.5741	1.0109	3.1636E+05	0.0000	11.130	4.0861E+05
x(FT)	0.0000	10.080	10.080	0.2100	3.3600	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
38	-1.9516	-1715.0	-593.79	-15.274	-5.2790	-24.307	-8.1416	0.8412	3.1509E+05	0.0000	11.130	4.1034E+05
x(FT)	0.0000	10.080	10.080	2.9400	2.7300	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
39	-1.9495	-1722.9	-565.49	-15.637	-5.1210	-24.858	-7.9038	0.6714	3.2301E+05	0.0000	11.130	4.1421E+05
x(FT)	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	0.0000	11.130	11.130
Min.	-1.9559	-1754.4	-674.43	-16.929	-6.0002	-29.286	-12.034	0.1965	3.1509E+05	0.0000	11.130	4.0861E+05
Pile N.	36	36	32	16	32	16	15	16	38	16	38	37

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL.		MOMENT		MOMENT		SHEAR		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.		
	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	
1	4.1496E-03	1.2193E-03	41.077	23.819	157.90	49.562	21.029	6.1787	0.7480	7.1435E+06	7.1435E+06	0.0000	0.0000	0.7480	7.1435E+06	7.1435E+06	0.0000	0.0000	0.7480	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
2	4.3926E-03	1.3050E-03	40.764	24.750	154.32	49.272	19.882	5.9065	0.7627	7.1435E+06	7.1435E+06	0.0000	0.0000	0.7627	7.1435E+06	7.1435E+06	0.0000	0.0000	0.7627	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
3	4.8560E-03	1.4487E-03	42.583	26.120	150.24	48.725	18.250	5.4816	0.7774	7.1435E+06	7.1435E+06	0.0000	0.0000	0.7774	7.1435E+06	7.1435E+06	0.0000	0.0000	0.7774	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
4	3.4756E-03	1.0995E-03	36.709	21.972	149.00	49.649	21.512	6.8951	0.7921	7.1435E+06	7.1435E+06	0.0000	0.0000	0.7921	7.1435E+06	7.1435E+06	0.0000	0.0000	0.7921	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
5	3.2655E-03	1.0642E-03	34.942	21.613	145.88	49.702	21.023	6.8512	0.8068	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8068	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8068	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
6	3.1754E-03	1.0577E-03	34.275	21.509	142.74	49.634	20.443	6.8096	0.8215	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8215	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8215	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
7	3.0859E-03	1.0500E-03	33.619	21.372	139.61	49.552	19.867	6.7599	0.8363	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8363	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8363	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
8	2.9965E-03	1.0427E-03	33.103	21.251	136.49	49.475	19.292	6.7133	0.8510	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8510	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8510	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
9	2.9145E-03	1.0366E-03	32.586	21.132	133.49	49.337	18.764	6.6738	0.8657	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8657	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8657	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.550	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
10	2.8343E-03	1.0319E-03	32.592	21.042	130.60	49.203	18.248	6.6436	0.8804	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8804	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8804	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.550	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
11	2.7529E-03	1.0267E-03	32.527	20.949	127.75	49.060	17.731	6.6129	0.8951	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8951	7.1435E+06	7.1435E+06	0.0000	0.0000	0.8951	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.550	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
12	2.5853E-03	9.8798E-04	32.403	20.420	125.49	49.234	17.168	6.5607	0.9098	7.1435E+06	7.1435E+06	0.0000	0.0000	0.9098	7.1435E+06	7.1435E+06	0.0000	0.0000	0.9098	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.550	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
13	2.5468E-03	1.0178E-03	33.217	20.869	121.52	49.722	16.562	6.6189	0.9816	7.1435E+06	7.1435E+06	0.0000	0.0000	0.9816	7.1435E+06	7.1435E+06	0.0000	0.0000	0.9816	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.550	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
14	2.5552E-03	1.0707E-03	34.945	21.680	118.18	50.500	16.100	6.7464	1.0814	7.1435E+06	7.1435E+06	0.0000	0.0000	1.0814	7.1435E+06	7.1435E+06	0.0000	0.0000	1.0814	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.550	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
15	2.2901E-03	1.0032E-03	34.069	20.933	116.73	52.093	15.509	6.7935	1.1812	7.1435E+06	7.1435E+06	0.0000	0.0000	1.1812	7.1435E+06	7.1435E+06	0.0000	0.0000	1.1812	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.550	11.550	10.500	10.500	11.130	11.130	11.550	10.500	10.500	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
16	3.5544E-03	9.4331E-04	37.298	19.299	158.75	44.306	22.973	6.0970	0.2739	7.1435E+06	7.1435E+06	0.0000	0.0000	0.2739	7.1435E+06	7.1435E+06	0.0000	0.0000	0.2739	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
17	3.6157E-03	9.7741E-04	37.786	19.727	155.51	44.217	22.252	6.0152	0.2886	7.1435E+06	7.1435E+06	0.0000	0.0000	0.2886	7.1435E+06	7.1435E+06	0.0000	0.0000	0.2886	7.1435E+06	7.1435E+06	0.0000	0.0000
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130	11.130
18	3.4764E-03	9.5951E-04	36.769	19.375	152.44	44.176	22.172	6.1197	0.3034	7.1435E+06	7.1435E+06	0.0000	0.0000	0.3034	7.1435E+06	7.1435E+06	0.0000	0.0000	0.3034	7.1435E+06	7.1435E+06	0.0000	0.0000

x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	11.130	0.0000	0.0000
19	3.3786E-03	9.5249E-04	35.964	149.26	44.116	21.627	6.0971	0.3181	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
20	3.2868E-03	9.4589E-04	35.121	146.10	44.046	21.039	6.0548	0.3328	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
21	3.1954E-03	9.3912E-04	34.411	142.95	43.974	20.454	6.0115	0.3475	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
22	3.1046E-03	9.3299E-04	33.745	139.80	43.910	19.873	5.9722	0.3622	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
23	3.0124E-03	9.2467E-04	33.184	136.63	43.816	19.283	5.9190	0.3769	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
24	2.9324E-03	9.2084E-04	32.653	133.55	43.700	18.771	5.8945	0.3916	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
25	2.8515E-03	9.1701E-04	32.546	130.66	43.584	18.253	5.8700	0.4063	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
26	2.7745E-03	9.1405E-04	32.479	127.76	43.460	17.736	5.8430	0.4211	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
27	2.8101E-03	9.5008E-04	33.983	124.05	43.440	17.241	5.8291	0.4358	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
28	2.7687E-03	9.5837E-04	34.906	121.30	43.356	16.780	5.8081	0.4489	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
29	2.5990E-03	9.4290E-04	34.607	119.18	44.197	16.266	5.9012	0.5487	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
30	2.5186E-03	9.5889E-04	34.737	116.46	45.235	15.783	6.0090	0.6485	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
31	2.2526E-03	8.9855E-04	34.400	115.01	46.753	15.175	6.0531	0.7483	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
32	3.2925E-03	1.2530E-03	35.755	152.48	60.962	22.174	8.4390	1.7177	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
33	4.7778E-03	1.6697E-03	42.261	150.89	57.117	18.365	6.4178	1.4811	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
34	4.8087E-03	1.5952E-03	42.422	150.95	54.317	18.360	6.0972	1.2445	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
35	4.7945E-03	1.5088E-03	42.333	151.09	51.567	18.458	5.8084	1.0079	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
36	3.5810E-03	1.2854E-03	37.889	160.26	60.709	22.842	8.1993	1.6456	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
37	5.2816E-03	1.7229E-03	45.592	158.56	56.694	18.612	6.3367	1.4090	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
38	5.3230E-03	1.6474E-03	45.813	158.63	53.891	18.600	6.0199	1.1724	7.1435E+06	7.1435E+06	0.0000
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000

39	5.0697E-03	1.4977E-03	44.341	27.572	159.08	51.323	19.063	5.8492	0.9357	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.340	11.130	0.0000	0.0000
Max.	5.3230E-03	1.7229E-03	45.813	31.314	160.26	60.962	22.973	8.4390	1.7177	7.1435E+06	7.1435E+06
Pile N.	38	37	38	37	36	32	16	32	32	1	1

LOAD CASE : 2  
CASE NAME : Strength III  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.8674	1.0000
2	0.8189	1.0000
3	0.7433	1.0000
4	0.9033	1.0000
5	0.9277	1.0000
6	0.9277	1.0000
7	0.9277	1.0000
8	0.9277	1.0000
9	0.9277	1.0000
10	0.9277	1.0000
11	0.9279	1.0000
12	0.9549	1.0000
13	0.9351	1.0000
14	0.9060	1.0000
15	0.9677	1.0000
16	0.9519	1.0000
17	0.9222	1.0000
18	0.9222	1.0000
19	0.9222	1.0000
20	0.9222	1.0000
21	0.9222	1.0000
22	0.9222	1.0000
23	0.9222	1.0000
24	0.9222	1.0000

25	0.9222	1.0000
26	0.9215	1.0000
27	0.8846	1.0000
28	0.8714	1.0000
29	0.8999	1.0000
30	0.9009	1.0000
31	0.9623	1.0000
32	0.9618	1.0000
33	0.7486	1.0000
34	0.7440	1.0000
35	0.7474	1.0000
36	0.9618	1.0000
37	0.7486	1.0000
38	0.7440	1.0000
39	0.7667	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1649.32	-555.480	-148.440
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	7409.52	41508.5

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
9.49594E-03	-1.65355	-0.42183
ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
9.10466E-04	-4.82378E-06	7.41663E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	8.9704E-03	-1.8341	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
2	9.1440E-03	-1.8013	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
3	9.3177E-03	-1.7685	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
4	9.4913E-03	-1.7358	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
5	9.6650E-03	-1.7030	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
6	9.8387E-03	-1.6702	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
7	0.010012	-1.6374	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
8	0.010186	-1.6047	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
9	0.010360	-1.5719	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
10	0.010533	-1.5391	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
11	0.010707	-1.5063	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
12	0.010881	-1.4735	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
13	0.011697	-1.4336	-0.4345	9.1047E-04	-4.8238E-06	7.4166E-05
14	0.012825	-1.4030	-0.4464	9.1047E-04	-4.8238E-06	7.4166E-05
15	0.013952	-1.3725	-0.4582	9.1047E-04	-4.8238E-06	7.4166E-05
16	3.6511E-03	-1.8302	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
17	3.8248E-03	-1.7974	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
18	3.9984E-03	-1.7646	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
19	4.1721E-03	-1.7318	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
20	4.3458E-03	-1.6991	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
21	4.5194E-03	-1.6663	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
22	4.6931E-03	-1.6335	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
23	4.8667E-03	-1.6007	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
24	5.0404E-03	-1.5680	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
25	5.2140E-03	-1.5352	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
26	5.3877E-03	-1.5024	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
27	5.5613E-03	-1.4696	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
28	5.7161E-03	-1.4404	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
29	6.8440E-03	-1.4099	-0.3734	9.1047E-04	-4.8238E-06	7.4166E-05
30	7.9720E-03	-1.3793	-0.3853	9.1047E-04	-4.8238E-06	7.4166E-05
31	9.1000E-03	-1.3488	-0.3971	9.1047E-04	-4.8238E-06	7.4166E-05
32	0.019867	-1.7847	-0.5577	9.1047E-04	-4.8238E-06	7.4166E-05
33	0.017212	-1.7828	-0.5250	9.1047E-04	-4.8238E-06	7.4166E-05
34	0.014557	-1.7808	-0.4922	9.1047E-04	-4.8238E-06	7.4166E-05

35	0.011902	-1.7789	-0.4595	9.1047E-04	-4.8238E-06	7.4166E-05
36	0.019036	-1.8665	-0.5528	9.1047E-04	-4.8238E-06	7.4166E-05
37	0.016381	-1.8646	-0.5201	9.1047E-04	-4.8238E-06	7.4166E-05
38	0.013726	-1.8626	-0.4874	9.1047E-04	-4.8238E-06	7.4166E-05
39	0.011071	-1.8607	-0.4546	9.1047E-04	-4.8238E-06	7.4166E-05
MINIMUM	3.6511E-03	-1.8665	-0.5577	9.1047E-04	-4.8238E-06	7.4166E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.019867	-1.3488	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	40.397	-15.667	-3.8221	0.0000	0.0000	0.0000
2	41.179	-15.222	-3.7817	0.0000	0.0000	0.0000
3	41.961	-14.648	-3.7103	0.0000	0.0000	0.0000
4	42.743	-15.055	-3.8742	0.0000	0.0000	0.0000
5	43.525	-14.882	-3.9009	0.0000	0.0000	0.0000
6	44.307	-14.615	-3.9045	0.0000	0.0000	0.0000
7	45.089	-14.347	-3.9079	0.0000	0.0000	0.0000
8	45.871	-14.081	-3.9118	0.0000	0.0000	0.0000
9	46.654	-13.814	-3.9160	0.0000	0.0000	0.0000
10	47.436	-13.547	-3.9205	0.0000	0.0000	0.0000
11	48.218	-13.281	-3.9251	0.0000	0.0000	0.0000
12	49.000	-13.079	-3.9490	0.0000	0.0000	0.0000
13	52.674	-12.667	-3.9926	0.0000	0.0000	0.0000
14	57.754	-12.288	-4.0570	0.0000	0.0000	0.0000
15	62.833	-12.125	-4.1912	0.0000	0.0000	0.0000
16	16.443	-16.377	-3.4309	0.0000	0.0000	0.0000
17	17.225	-16.012	-3.4151	0.0000	0.0000	0.0000
18	18.007	-15.753	-3.4207	0.0000	0.0000	0.0000
19	18.789	-15.497	-3.4272	0.0000	0.0000	0.0000
20	19.571	-15.229	-3.4316	0.0000	0.0000	0.0000
21	20.353	-14.956	-3.4347	0.0000	0.0000	0.0000
22	21.135	-14.681	-3.4378	0.0000	0.0000	0.0000
23	21.917	-14.408	-3.4414	0.0000	0.0000	0.0000
24	22.699	-14.135	-3.4451	0.0000	0.0000	0.0000
25	23.481	-13.861	-3.4489	0.0000	0.0000	0.0000
26	24.263	-13.585	-3.4524	0.0000	0.0000	0.0000

27	25.045	-13.218	-3.4334	0.0000	0.0000	0.0000	0.0000
28	25.742	-12.942	-3.4286	0.0000	0.0000	0.0000	0.0000
29	30.821	-12.699	-3.5375	0.0000	0.0000	0.0000	0.0000
30	35.901	-12.389	-3.6282	0.0000	0.0000	0.0000	0.0000
31	40.981	-12.221	-3.7606	0.0000	0.0000	0.0000	0.0000
32	89.469	-14.804	-4.7710	0.0000	0.0000	0.0000	0.0000
33	77.513	-14.161	-4.3233	0.0000	0.0000	0.0000	0.0000
34	65.557	-14.332	-4.1205	0.0000	0.0000	0.0000	0.0000
35	53.601	-14.539	-3.9212	0.0000	0.0000	0.0000	0.0000
36	85.726	-15.434	-4.7214	0.0000	0.0000	0.0000	0.0000
37	73.770	-14.756	-4.2756	0.0000	0.0000	0.0000	0.0000
38	61.814	-14.934	-4.0731	0.0000	0.0000	0.0000	0.0000
39	49.858	-15.241	-3.8948	0.0000	0.0000	0.0000	0.0000
MINIMUM	16.443	-16.377	-4.7710	0.0000	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1	1
MAXIMUM	89.469	-12.125	-3.4151	0.0000	0.0000	0.0000	0.0000
Pile N.	32	15	17	1	1	1	1

THE PILE COORDINATE SYSTEM (LOCAL AXES)

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	8.9704E-03	-1.8341	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
2	9.1440E-03	-1.8013	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
3	9.3177E-03	-1.7685	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
4	9.4913E-03	-1.7358	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
5	9.6650E-03	-1.7030	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
6	9.8387E-03	-1.6702	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
7	0.010012	-1.6374	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
8	0.010186	-1.6047	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
9	0.010360	-1.5719	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
10	0.010533	-1.5391	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
11	0.010707	-1.5063	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
12	0.010881	-1.4735	-0.4271	9.1047E-04	-4.8238E-06	7.4166E-05
13	0.011697	-1.4336	-0.4345	9.1047E-04	-4.8238E-06	7.4166E-05
14	0.012825	-1.4030	-0.4464	9.1047E-04	-4.8238E-06	7.4166E-05

15	0.013952	-1.3725	-0.4582	9.1047E-04	-4.8238E-06	7.4166E-05
16	3.6511E-03	-1.8302	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
17	3.8248E-03	-1.7974	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
18	3.9984E-03	-1.7646	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
19	4.1721E-03	-1.7318	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
20	4.3458E-03	-1.6991	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
21	4.5194E-03	-1.6663	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
22	4.6931E-03	-1.6335	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
23	4.8667E-03	-1.6007	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
24	5.0404E-03	-1.5680	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
25	5.2140E-03	-1.5352	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
26	5.3877E-03	-1.5024	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
27	5.5613E-03	-1.4696	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
28	5.7161E-03	-1.4404	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
29	6.8440E-03	-1.4099	-0.3734	9.1047E-04	-4.8238E-06	7.4166E-05
30	7.9720E-03	-1.3793	-0.3853	9.1047E-04	-4.8238E-06	7.4166E-05
31	9.1000E-03	-1.3488	-0.3971	9.1047E-04	-4.8238E-06	7.4166E-05
32	0.019867	-1.7847	-0.5577	9.1047E-04	-4.8238E-06	7.4166E-05
33	0.017212	-1.7828	-0.5250	9.1047E-04	-4.8238E-06	7.4166E-05
34	0.014557	-1.7808	-0.4922	9.1047E-04	-4.8238E-06	7.4166E-05
35	0.011902	-1.7789	-0.4595	9.1047E-04	-4.8238E-06	7.4166E-05
36	0.019036	-1.8665	-0.5528	9.1047E-04	-4.8238E-06	7.4166E-05
37	0.016381	-1.8646	-0.5201	9.1047E-04	-4.8238E-06	7.4166E-05
38	0.013726	-1.8626	-0.4874	9.1047E-04	-4.8238E-06	7.4166E-05
39	0.011071	-1.8607	-0.4546	9.1047E-04	-4.8238E-06	7.4166E-05
MINIMUM	3.6511E-03	-1.8665	-0.5577	9.1047E-04	-4.8238E-06	7.4166E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.019867	-1.3488	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1	40.397	-15.667	-3.8221	0.0000	0.0000	0.0000
2	41.179	-15.222	-3.7817	0.0000	0.0000	0.0000
3	41.961	-14.648	-3.7103	0.0000	0.0000	0.0000
4	42.743	-15.055	-3.8742	0.0000	0.0000	0.0000
5	43.525	-14.882	-3.9009	0.0000	0.0000	0.0000
6	44.307	-14.615	-3.9045	0.0000	0.0000	0.0000

7	45.089	-14.347	-3.9079	0.0000	0.0000	0.0000
8	45.871	-14.081	-3.9118	0.0000	0.0000	0.0000
9	46.654	-13.814	-3.9160	0.0000	0.0000	0.0000
10	47.436	-13.547	-3.9205	0.0000	0.0000	0.0000
11	48.218	-13.281	-3.9251	0.0000	0.0000	0.0000
12	49.000	-13.079	-3.9490	0.0000	0.0000	0.0000
13	52.674	-12.667	-3.9926	0.0000	0.0000	0.0000
14	57.754	-12.288	-4.0570	0.0000	0.0000	0.0000
15	62.833	-12.125	-4.1912	0.0000	0.0000	0.0000
16	16.443	-16.377	-3.4309	0.0000	0.0000	0.0000
17	17.225	-16.012	-3.4151	0.0000	0.0000	0.0000
18	18.007	-15.753	-3.4207	0.0000	0.0000	0.0000
19	18.789	-15.497	-3.4272	0.0000	0.0000	0.0000
20	19.571	-15.229	-3.4316	0.0000	0.0000	0.0000
21	20.353	-14.956	-3.4347	0.0000	0.0000	0.0000
22	21.135	-14.681	-3.4378	0.0000	0.0000	0.0000
23	21.917	-14.408	-3.4414	0.0000	0.0000	0.0000
24	22.699	-14.135	-3.4451	0.0000	0.0000	0.0000
25	23.481	-13.861	-3.4489	0.0000	0.0000	0.0000
26	24.263	-13.585	-3.4524	0.0000	0.0000	0.0000
27	25.045	-13.218	-3.4334	0.0000	0.0000	0.0000
28	25.742	-12.942	-3.4286	0.0000	0.0000	0.0000
29	30.821	-12.699	-3.5375	0.0000	0.0000	0.0000
30	35.901	-12.389	-3.6282	0.0000	0.0000	0.0000
31	40.981	-12.221	-3.7606	0.0000	0.0000	0.0000
32	89.469	-14.804	-4.7710	0.0000	0.0000	0.0000
33	77.513	-14.161	-4.3233	0.0000	0.0000	0.0000
34	65.557	-14.332	-4.1205	0.0000	0.0000	0.0000
35	53.601	-14.539	-3.9212	0.0000	0.0000	0.0000
36	85.726	-15.434	-4.7214	0.0000	0.0000	0.0000
37	73.770	-14.756	-4.2756	0.0000	0.0000	0.0000
38	61.814	-14.934	-4.0731	0.0000	0.0000	0.0000
39	49.858	-15.241	-3.8948	0.0000	0.0000	0.0000
MINIMUM	16.443	-16.377	-4.7710	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1
MAXIMUM	89.469	-12.125	-3.4151	0.0000	0.0000	0.0000
Pile N.	32	15	17	1	1	1

PILE GROUP STRESS,KIP/IN\*\*2  
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1	0.4556
2	0.4644
3	0.4733
4	0.4821
5	0.4909
6	0.4997
7	0.5085
8	0.5174
9	0.5262
10	0.5350
11	0.5438
12	0.5526
13	0.5941
14	0.6514
15	0.7087
16	0.1855
17	0.1943
18	0.2031
19	0.2119
20	0.2207
21	0.2296
22	0.2384
23	0.2472
24	0.2560
25	0.2648
26	0.2737
27	0.2825
28	0.2903
29	0.3476
30	0.4049
31	0.4622
32	1.0091
33	0.8742
34	0.7394
35	0.6045
36	0.9669
37	0.8320
38	0.6972
39	0.5623

MINIMUM 0.1855

Pile N. 16  
 MAXIMUM 1.0091  
 Pile N. 32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL.		MOMENT		MOMENT		SHEAR		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.				
	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	Y-Dir	Z-Dir	STRESS	KIP-IN**2	Z-Dir	KIP-IN**2	Y-Dir	KIP-IN**2			
1	-1.8341	-0.4271	-0.4271	-1658.7	-406.24	-15.667	-3.8221	-27.184	-6.4652	0.4556	3.6746E+05	4.3481E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4644	3.6098E+05	4.2545E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4644	3.6098E+05	4.2545E+05	0.0000	11.130
2	-1.8013	-0.4271	-0.4271	-1622.8	-404.62	-15.222	-3.7817	-25.818	-6.2519	0.4644	3.6098E+05	4.2545E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4644	3.6098E+05	4.2545E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4644	3.6098E+05	4.2545E+05	0.0000	11.130
3	-1.7685	-0.4271	-0.4271	-1579.5	-401.45	-14.648	-3.7103	-23.748	-5.8374	0.4733	3.4667E+05	4.2704E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4733	3.4667E+05	4.2704E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4733	3.4667E+05	4.2704E+05	0.0000	11.130
4	-1.7358	-0.4271	-0.4271	-1582.3	-408.78	-15.055	-3.8742	-27.616	-6.9337	0.4821	3.8215E+05	4.5174E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4821	3.8215E+05	4.5174E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4821	3.8215E+05	4.5174E+05	0.0000	11.130
5	-1.7030	-0.4271	-0.4271	-1556.7	-409.71	-14.882	-3.9009	-28.156	-7.1973	0.4909	3.8741E+05	4.6488E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4909	3.8741E+05	4.6488E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4909	3.8741E+05	4.6488E+05	0.0000	11.130
6	-1.6702	-0.4271	-0.4271	-1527.2	-409.63	-14.615	-3.9045	-28.038	-7.3059	0.4997	3.8909E+05	4.6658E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4997	3.8909E+05	4.6658E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.4997	3.8909E+05	4.6658E+05	0.0000	11.130
7	-1.6374	-0.4271	-0.4271	-1497.7	-409.55	-14.347	-3.9079	-27.892	-7.4117	0.5085	3.9091E+05	4.6788E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5085	3.9091E+05	4.6788E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5085	3.9091E+05	4.6788E+05	0.0000	11.130
8	-1.6047	-0.4271	-0.4271	-1468.2	-409.51	-14.081	-3.9118	-27.796	-7.5346	0.5174	3.9279E+05	4.7021E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5174	3.9279E+05	4.7021E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5174	3.9279E+05	4.7021E+05	0.0000	11.130
9	-1.5719	-0.4271	-0.4271	-1438.8	-409.46	-13.814	-3.9160	-27.692	-7.6598	0.5262	3.9450E+05	4.7332E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5262	3.9450E+05	4.7332E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5262	3.9450E+05	4.7332E+05	0.0000	11.130
10	-1.5391	-0.4271	-0.4271	-1409.3	-409.43	-13.547	-3.9205	-27.579	-7.7868	0.5350	3.9617E+05	4.7848E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5350	3.9617E+05	4.7848E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5350	3.9617E+05	4.7848E+05	0.0000	11.130
11	-1.5063	-0.4271	-0.4271	-1379.9	-409.41	-13.281	-3.9251	-27.471	-7.9204	0.5438	3.9791E+05	4.8455E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5438	3.9791E+05	4.8455E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5438	3.9791E+05	4.8455E+05	0.0000	11.130
12	-1.4735	-0.4271	-0.4271	-1350.6	-409.43	-13.079	-3.9490	-28.076	-8.2660	0.5526	4.0177E+05	4.9982E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5526	4.0177E+05	4.9982E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5526	4.0177E+05	4.9982E+05	0.0000	11.130
13	-1.4336	-0.4345	-0.4345	-1314.2	-415.74	-12.667	-3.9926	-27.358	-8.4193	0.5941	4.0257E+05	4.9139E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5941	4.0257E+05	4.9139E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.5941	4.0257E+05	4.9139E+05	0.0000	11.130
14	-1.4030	-0.4464	-0.4464	-1285.8	-425.82	-12.288	-4.0570	-26.406	-8.5332	0.6514	4.0238E+05	4.6825E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.6514	4.0238E+05	4.6825E+05	0.0000	11.130	
x(FT)	0.0000	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	0.0000	0.0000	10.080	10.080	10.080	10.080	0.0000	0.0000	11.130	11.130	0.6514	4.0238E+05	4.6825E+05	0.0000	11.130
15	-1.3725	-0.4582	-0.4582	-1257.9	-436.18	-12.125	-4.1912	-27.844	-9.4142	0.7087	4.0826E+05	4.9753E+05	0.0000	10.080	10.080	0.0000	0.0000	11.130	11.130	0.7087	4.0826E+05	4.9753E+05	0.0000	11.130	

x(FT)	0.0000	10.080	10.080	0.0000	10.080	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130
16	-1.8302	-1673.0	-352.90	-3.4309	-29.471	-5.9747	0.1855	3.8106E+05	5.0699E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.2100	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
17	-1.7974	-1641.9	-352.52	-3.4151	-28.577	-5.9020	0.1943	3.7972E+05	4.9553E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
18	-1.7646	-1614.3	-352.86	-3.4207	-28.425	-5.9775	0.2031	3.8225E+05	5.0055E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.4200	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
19	-1.7318	-1587.0	-353.30	-3.4272	-28.303	-6.0598	0.2119	3.8491E+05	5.1017E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
20	-1.6991	-1558.2	-353.42	-3.4316	-28.220	-6.1538	0.2207	3.8698E+05	5.1947E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
21	-1.6663	-1528.6	-353.37	-3.4347	-28.108	-6.2478	0.2296	3.8868E+05	5.2350E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.2100	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
22	-1.6335	-1499.0	-353.30	-3.4378	-27.969	-6.3407	0.2384	3.9046E+05	5.2477E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
23	-1.6007	-1469.5	-353.27	-3.4414	-27.882	-6.4481	0.2472	3.9243E+05	5.2856E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	2.9400	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
24	-1.5680	-1440.0	-353.23	-3.4451	-27.785	-6.5582	0.2560	3.9417E+05	5.3175E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
25	-1.5352	-1410.4	-353.20	-3.4489	-27.681	-6.6708	0.2648	3.9586E+05	5.3627E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	1.0500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
26	-1.5024	-1380.9	-353.18	-3.4524	-27.556	-6.7823	0.2737	3.9757E+05	5.4242E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
27	-1.4696	-1350.9	-353.04	-3.4334	-26.445	-6.6596	0.2825	3.9685E+05	5.2409E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
28	-1.4404	-1324.5	-352.96	-3.4286	-25.990	-6.6795	0.2903	3.9760E+05	5.1820E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
29	-1.4099	-1296.7	-363.21	-3.5375	-26.609	-7.1966	0.3476	4.0157E+05	5.2878E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.4200	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
30	-1.3793	-1268.5	-373.36	-3.6282	-26.473	-7.5366	0.4049	4.0320E+05	5.2332E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	0.8400	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
31	-1.3488	-1240.6	-383.64	-3.7606	-27.934	-8.3487	0.4622	4.0902E+05	5.6636E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
32	-1.7847	-1618.8	-522.58	-4.7710	-28.846	-9.1363	1.0091	3.8595E+05	4.3022E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	1.2600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
33	-1.7828	-1584.0	-484.33	-4.3233	-23.670	-7.0319	0.8742	3.4594E+05	4.2474E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
34	-1.7808	-1584.1	-456.36	-4.1205	-23.642	-6.6062	0.7394	3.4503E+05	4.2650E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	1.4700	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130
35	-1.7789	-1586.1	-428.91	-3.9212	-23.813	-6.2337	0.6045	3.4626E+05	4.3209E+05	0.0000	11.130	11.130	11.130
x(FT)	0.0000	10.080	10.080	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130	11.130



x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.8280	7.1435E+06	0.0000	0.0000
13	2.4068E-03	7.2365E-04	14.758	118.01	15.754	4.7366	4.7366	36.562	15.754	0.8280	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.500	11.130	11.130	0.0000	0.0000	0.0000
14	2.4199E-03	7.6965E-04	15.538	114.95	15.347	4.8811	4.8811	37.383	15.347	0.9078	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.500	11.130	11.130	0.0000	0.0000	0.0000
15	2.1808E-03	7.2312E-04	14.980	113.60	14.772	4.8983	4.8983	38.623	14.772	0.9877	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.500	11.130	11.130	0.0000	0.0000	0.0000
16	3.2529E-03	6.3441E-04	12.909	150.95	21.675	4.2272	4.2272	31.427	21.675	0.2585	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000
17	3.2947E-03	6.5573E-04	13.168	148.11	21.269	4.2330	4.2330	31.407	21.269	0.2707	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.2100
18	3.2110E-03	6.5077E-04	13.076	145.22	20.728	4.2010	4.2010	31.353	20.728	0.2831	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000
19	3.1258E-03	6.4430E-04	12.946	142.33	20.178	4.1592	4.1592	31.285	20.178	0.2953	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000
20	3.0481E-03	6.3896E-04	12.831	139.49	19.677	4.1248	4.1248	31.190	19.677	0.3076	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000
21	2.9746E-03	6.3561E-04	12.761	136.84	19.202	4.1031	4.1031	31.103	19.202	0.3199	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.2100
22	2.9020E-03	6.3300E-04	12.712	134.20	18.734	4.0863	4.0863	31.026	18.734	0.3322	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.2100
23	2.8278E-03	6.2949E-04	12.640	131.57	18.254	4.0636	4.0636	30.932	18.254	0.3445	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000
24	2.7541E-03	6.2608E-04	12.573	128.93	17.779	4.0416	4.0416	30.840	17.779	0.3568	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000
25	2.6807E-03	6.2233E-04	12.496	126.30	17.305	4.0173	4.0173	30.741	17.305	0.3691	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000
26	2.6091E-03	6.1862E-04	12.412	123.67	16.830	3.9902	3.9902	30.710	16.830	0.3814	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.500	11.130	11.130	0.0000	0.0000	0.0000
27	2.6482E-03	6.4601E-04	12.748	120.26	16.398	4.0002	4.0002	30.668	16.398	0.3937	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.2100
28	2.6196E-03	6.5461E-04	12.842	117.66	15.979	3.9928	3.9928	30.630	15.979	0.4046	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000
29	2.4595E-03	6.4643E-04	12.873	115.79	15.493	4.0720	4.0720	31.560	15.493	0.4845	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.500	11.130	11.130	0.0000	0.0000	0.0000
30	2.3864E-03	6.6201E-04	13.212	113.32	15.050	4.1749	4.1749	32.496	15.050	0.5643	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.500	11.130	11.130	0.0000	0.0000	0.0000
31	2.1485E-03	6.2186E-04	12.738	111.96	14.473	4.1891	4.1891	33.672	14.473	0.6442	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	10.500	11.130	11.130	0.0000	0.0000	0.0000
32	3.0752E-03	9.4731E-04	19.638	145.45	20.704	6.3780	6.3780	46.824	20.704	1.4064	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	11.130	11.130	11.130	10.710	11.130	11.130	0.0000	0.0000	0.0000

33	4.4011E-03	1.2340E-03	39.929	22.397	144.19	43.519	18.385	5.1548	1.2184	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
34	4.4321E-03	1.1689E-03	40.052	21.130	144.19	40.975	18.352	4.8400	1.0305	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
35	4.3944E-03	1.0864E-03	39.875	19.662	144.33	38.470	18.495	4.5723	0.8426	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
36	3.2758E-03	9.5508E-04	35.807	19.753	152.69	46.622	22.055	6.4303	1.3475	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
37	4.7972E-03	1.2607E-03	42.304	22.836	151.08	43.147	18.559	4.8774	1.1596	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
38	4.8337E-03	1.1928E-03	42.500	21.508	151.09	40.595	18.520	4.5702	0.9717	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
39	4.6161E-03	1.0740E-03	41.430	19.680	151.53	38.216	19.084	4.4401	0.7837	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
Max.	4.8337E-03	1.2607E-03	42.500	22.836	152.69	46.824	22.055	6.4303	1.4064	7.1435E+06	7.1435E+06
Pile N.	38	37	38	37	36	32	36	36	32	1	1

LOAD CASE : 3  
CASE NAME : Strength IV  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.8679	1.0000
2	0.8195	1.0000
3	0.7434	1.0000
4	0.9040	1.0000
5	0.9285	1.0000
6	0.9285	1.0000
7	0.9285	1.0000
8	0.9285	1.0000
9	0.9285	1.0000
10	0.9285	1.0000
11	0.9287	1.0000
12	0.9556	1.0000

13	0.9357	1.0000
14	0.9066	1.0000
15	0.9677	1.0000
16	0.9527	1.0000
17	0.9230	1.0000
18	0.9230	1.0000
19	0.9230	1.0000
20	0.9230	1.0000
21	0.9230	1.0000
22	0.9230	1.0000
23	0.9230	1.0000
24	0.9230	1.0000
25	0.9230	1.0000
26	0.9223	1.0000
27	0.8855	1.0000
28	0.8720	1.0000
29	0.9005	1.0000
30	0.9015	1.0000
31	0.9623	1.0000
32	0.9618	1.0000
33	0.7476	1.0000
34	0.7429	1.0000
35	0.7467	1.0000
36	0.9618	1.0000
37	0.7476	1.0000
38	0.7429	1.0000
39	0.7662	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1858.44	-544.890	-140.510
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	6269.76	42152.3

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN                    HORIZONTAL Y,IN                    HORIZONTAL Z,IN  
 0.0106914                    -1.62700                    -0.39891

ANGLE ROT. X,RAD                    ANGLE ROT. Y,RAD                    ANGLE ROT. Z,RAD  
 8.94788E-04                    -4.74245E-06                    7.57751E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM  
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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	0.010191	-1.8044	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
2	0.010362	-1.7722	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
3	0.010533	-1.7400	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
4	0.010703	-1.7078	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
5	0.010874	-1.6756	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
6	0.011045	-1.6434	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
7	0.011216	-1.6112	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
8	0.011386	-1.5789	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
9	0.011557	-1.5467	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
10	0.011728	-1.5145	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
11	0.011899	-1.4823	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
12	0.012069	-1.4501	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
13	0.012895	-1.4108	-0.4114	8.9479E-04	-4.7424E-06	7.5775E-05
14	0.014041	-1.3808	-0.4230	8.9479E-04	-4.7424E-06	7.5775E-05
15	0.015187	-1.3508	-0.4347	8.9479E-04	-4.7424E-06	7.5775E-05
16	4.7559E-03	-1.8006	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
17	4.9266E-03	-1.7684	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
18	5.0973E-03	-1.7362	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
19	5.2680E-03	-1.7039	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
20	5.4388E-03	-1.6717	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
21	5.6095E-03	-1.6395	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
22	5.7802E-03	-1.6073	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05

23	5.9510E-03	-1.5751	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
24	6.1217E-03	-1.5429	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
25	6.2924E-03	-1.5107	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
26	6.4631E-03	-1.4785	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
27	6.6339E-03	-1.4462	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
28	6.7860E-03	-1.4175	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
29	7.9321E-03	-1.3875	-0.3513	8.9479E-04	-4.7424E-06	7.5775E-05
30	9.0784E-03	-1.3575	-0.3630	8.9479E-04	-4.7424E-06	7.5775E-05
31	0.010225	-1.3275	-0.3746	8.9479E-04	-4.7424E-06	7.5775E-05
32	0.021314	-1.7559	-0.5324	8.9479E-04	-4.7424E-06	7.5775E-05
33	0.018601	-1.7540	-0.5003	8.9479E-04	-4.7424E-06	7.5775E-05
34	0.015888	-1.7521	-0.4681	8.9479E-04	-4.7424E-06	7.5775E-05
35	0.013176	-1.7502	-0.4360	8.9479E-04	-4.7424E-06	7.5775E-05
36	0.020482	-1.8363	-0.5276	8.9479E-04	-4.7424E-06	7.5775E-05
37	0.017769	-1.8344	-0.4955	8.9479E-04	-4.7424E-06	7.5775E-05
38	0.015056	-1.8325	-0.4633	8.9479E-04	-4.7424E-06	7.5775E-05
39	0.012343	-1.8306	-0.4311	8.9479E-04	-4.7424E-06	7.5775E-05
MINIMUM	4.7559E-03	-1.8363	-0.5324	8.9479E-04	-4.7424E-06	7.5775E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.021314	-1.3275	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	45.895	-15.376	-3.6229	0.0000	0.0000	0.0000
2	46.664	-14.940	-3.5846	0.0000	0.0000	0.0000
3	47.433	-14.373	-3.5155	0.0000	0.0000	0.0000
4	48.202	-14.774	-3.6718	0.0000	0.0000	0.0000
5	48.971	-14.591	-3.6937	0.0000	0.0000	0.0000
6	49.740	-14.329	-3.6969	0.0000	0.0000	0.0000
7	50.509	-14.068	-3.7006	0.0000	0.0000	0.0000
8	51.277	-13.808	-3.7044	0.0000	0.0000	0.0000
9	52.046	-13.547	-3.7085	0.0000	0.0000	0.0000
10	52.815	-13.286	-3.7125	0.0000	0.0000	0.0000
11	53.584	-13.025	-3.7169	0.0000	0.0000	0.0000
12	54.353	-12.829	-3.7399	0.0000	0.0000	0.0000
13	58.070	-12.424	-3.7828	0.0000	0.0000	0.0000
14	63.232	-12.051	-3.8465	0.0000	0.0000	0.0000

15	68.394	-11.891	-3.9759	0.0000	0.0000	0.0000	0.0000
16	21.418	-16.082	-3.2368	0.0000	0.0000	0.0000	0.0000
17	22.186	-15.721	-3.2213	0.0000	0.0000	0.0000	0.0000
18	22.955	-15.471	-3.2273	0.0000	0.0000	0.0000	0.0000
19	23.724	-15.207	-3.2308	0.0000	0.0000	0.0000	0.0000
20	24.493	-14.940	-3.2340	0.0000	0.0000	0.0000	0.0000
21	25.262	-14.672	-3.2369	0.0000	0.0000	0.0000	0.0000
22	26.031	-14.405	-3.2402	0.0000	0.0000	0.0000	0.0000
23	26.800	-14.138	-3.2438	0.0000	0.0000	0.0000	0.0000
24	27.568	-13.870	-3.2474	0.0000	0.0000	0.0000	0.0000
25	28.337	-13.602	-3.2511	0.0000	0.0000	0.0000	0.0000
26	29.106	-13.333	-3.2546	0.0000	0.0000	0.0000	0.0000
27	29.875	-12.973	-3.2365	0.0000	0.0000	0.0000	0.0000
28	30.560	-12.700	-3.2314	0.0000	0.0000	0.0000	0.0000
29	35.721	-12.463	-3.3379	0.0000	0.0000	0.0000	0.0000
30	40.884	-12.158	-3.4271	0.0000	0.0000	0.0000	0.0000
31	46.045	-11.993	-3.5552	0.0000	0.0000	0.0000	0.0000
32	95.986	-14.499	-4.5446	0.0000	0.0000	0.0000	0.0000
33	83.769	-13.877	-4.1137	-3.8236E-27	6.2444E-11	0.0000	0.0000
34	71.552	-14.049	-3.9156	0.0000	0.0000	0.0000	0.0000
35	59.335	-14.258	-3.7207	0.0000	0.0000	0.0000	0.0000
36	92.237	-15.122	-4.4984	0.0000	0.0000	0.0000	0.0000
37	80.020	-14.459	-4.0673	3.8236E-27	-6.2444E-11	0.0000	0.0000
38	67.803	-14.639	-3.8691	0.0000	0.0000	0.0000	0.0000
39	55.586	-14.947	-3.6948	0.0000	0.0000	0.0000	0.0000
MINIMUM	21.418	-16.082	-4.5446	-3.8236E-27	-6.2444E-11	0.0000	0.0000
Pile N.	16	16	32	33	37	1	1
MAXIMUM	95.986	-11.891	-3.2213	3.8236E-27	6.2444E-11	0.0000	0.0000
Pile N.	32	15	17	37	33	1	1

THE PILE COORDINATE SYSTEM (LOCAL AXES)

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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
*****	*****	*****	*****	*****	*****	*****
1	0.010191	-1.8044	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
2	0.010362	-1.7722	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05

3	0.010533	-1.7400	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
4	0.010703	-1.7078	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
5	0.010874	-1.6756	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
6	0.011045	-1.6434	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
7	0.011216	-1.6112	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
8	0.011386	-1.5789	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
9	0.011557	-1.5467	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
10	0.011728	-1.5145	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
11	0.011899	-1.4823	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
12	0.012069	-1.4501	-0.4041	8.9479E-04	-4.7424E-06	7.5775E-05
13	0.012895	-1.4108	-0.4114	8.9479E-04	-4.7424E-06	7.5775E-05
14	0.014041	-1.3808	-0.4230	8.9479E-04	-4.7424E-06	7.5775E-05
15	0.015187	-1.3508	-0.4347	8.9479E-04	-4.7424E-06	7.5775E-05
16	4.7559E-03	-1.8006	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
17	4.9266E-03	-1.7684	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
18	5.0973E-03	-1.7362	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
19	5.2680E-03	-1.7039	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
20	5.4388E-03	-1.6717	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
21	5.6095E-03	-1.6395	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
22	5.7802E-03	-1.6073	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
23	5.9510E-03	-1.5751	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
24	6.1217E-03	-1.5429	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
25	6.2924E-03	-1.5107	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
26	6.4631E-03	-1.4785	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
27	6.6339E-03	-1.4462	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
28	6.7860E-03	-1.4175	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05
29	7.9321E-03	-1.3875	-0.3513	8.9479E-04	-4.7424E-06	7.5775E-05
30	9.0784E-03	-1.3575	-0.3630	8.9479E-04	-4.7424E-06	7.5775E-05
31	0.010225	-1.3275	-0.3746	8.9479E-04	-4.7424E-06	7.5775E-05
32	0.021314	-1.7559	-0.5324	8.9479E-04	-4.7424E-06	7.5775E-05
33	0.018601	-1.7540	-0.5003	8.9479E-04	-4.7424E-06	7.5775E-05
34	0.015888	-1.7521	-0.4681	8.9479E-04	-4.7424E-06	7.5775E-05
35	0.013176	-1.7502	-0.4360	8.9479E-04	-4.7424E-06	7.5775E-05
36	0.020482	-1.8363	-0.5276	8.9479E-04	-4.7424E-06	7.5775E-05
37	0.017769	-1.8344	-0.4955	8.9479E-04	-4.7424E-06	7.5775E-05
38	0.015056	-1.8325	-0.4633	8.9479E-04	-4.7424E-06	7.5775E-05
39	0.012343	-1.8306	-0.4311	8.9479E-04	-4.7424E-06	7.5775E-05
MINIMUM	4.7559E-03	-1.8363	-0.5324	8.9479E-04	-4.7424E-06	7.5775E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.021314	-1.3275	-0.3397	8.9479E-04	-4.7424E-06	7.5775E-05

Pile N. 32 31 16 1 1 1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1	45.895	-15.376	-3.6229	0.0000	0.0000	0.0000
2	46.664	-14.940	-3.5846	0.0000	0.0000	0.0000
3	47.433	-14.373	-3.5155	0.0000	0.0000	0.0000
4	48.202	-14.774	-3.6718	0.0000	0.0000	0.0000
5	48.971	-14.591	-3.6937	0.0000	0.0000	0.0000
6	49.740	-14.329	-3.6969	0.0000	0.0000	0.0000
7	50.509	-14.068	-3.7006	0.0000	0.0000	0.0000
8	51.277	-13.808	-3.7044	0.0000	0.0000	0.0000
9	52.046	-13.547	-3.7085	0.0000	0.0000	0.0000
10	52.815	-13.286	-3.7125	0.0000	0.0000	0.0000
11	53.584	-13.025	-3.7169	0.0000	0.0000	0.0000
12	54.353	-12.829	-3.7399	0.0000	0.0000	0.0000
13	58.070	-12.424	-3.7828	0.0000	0.0000	0.0000
14	63.232	-12.051	-3.8465	0.0000	0.0000	0.0000
15	68.394	-11.891	-3.9759	0.0000	0.0000	0.0000
16	21.418	-16.082	-3.2368	0.0000	0.0000	0.0000
17	22.186	-15.721	-3.2213	0.0000	0.0000	0.0000
18	22.955	-15.471	-3.2273	0.0000	0.0000	0.0000
19	23.724	-15.207	-3.2308	0.0000	0.0000	0.0000
20	24.493	-14.940	-3.2340	0.0000	0.0000	0.0000
21	25.262	-14.672	-3.2369	0.0000	0.0000	0.0000
22	26.031	-14.405	-3.2402	0.0000	0.0000	0.0000
23	26.800	-14.138	-3.2438	0.0000	0.0000	0.0000
24	27.568	-13.870	-3.2474	0.0000	0.0000	0.0000
25	28.337	-13.602	-3.2511	0.0000	0.0000	0.0000
26	29.106	-13.333	-3.2546	0.0000	0.0000	0.0000
27	29.875	-12.973	-3.2365	0.0000	0.0000	0.0000
28	30.560	-12.700	-3.2314	0.0000	0.0000	0.0000
29	35.721	-12.463	-3.3379	0.0000	0.0000	0.0000
30	40.884	-12.158	-3.4271	0.0000	0.0000	0.0000
31	46.045	-11.993	-3.5552	0.0000	0.0000	0.0000
32	95.986	-14.499	-4.5446	0.0000	0.0000	0.0000
33	83.769	-13.877	-4.1137	0.0000	6.2444E-11	0.0000
34	71.552	-14.049	-3.9156	0.0000	0.0000	0.0000
35	59.335	-14.258	-3.7207	0.0000	0.0000	0.0000

36	92.237	-15.122	-4.4984	0.0000	0.0000	0.0000
37	80.020	-14.459	-4.0673	0.0000	-6.2444E-11	0.0000
38	67.803	-14.639	-3.8691	0.0000	0.0000	0.0000
39	55.586	-14.947	-3.6948	0.0000	0.0000	0.0000
MINIMUM	21.418	-16.082	-4.5446	0.0000	-6.2444E-11	0.0000
Pile N.	16	16	32	1	37	1
MAXIMUM	95.986	-11.891	-3.2213	0.0000	6.2444E-11	0.0000
Pile N.	32	15	17	1	33	1

PILE GROUP STRESS,KIP/IN\*\*2  
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1	0.5176
2	0.5263
3	0.5350
4	0.5436
5	0.5523
6	0.5610
7	0.5697
8	0.5783
9	0.5870
10	0.5957
11	0.6044
12	0.6130
13	0.6549
14	0.7132
15	0.7714
16	0.2416
17	0.2502
18	0.2589
19	0.2676
20	0.2762
21	0.2849
22	0.2936
23	0.3023
24	0.3109
25	0.3196
26	0.3283
27	0.3370
28	0.3447
29	0.4029



x(FT)	0.0000	10.0800	10.0800	0.8400	10.0800	10.0800	10.0800	0.8400	10.0800	10.0800	10.0800	0.0000	11.1300	11.1300
10	-1.5145	-1386.3	-388.96	-13.286	-3.7125	-27.607	-7.5033	-3.7125	-27.607	-7.5033	0.5957	3.9767E+05	5.0035E+05	11.130
x(FT)	0.0000	10.0800	10.0800	3.3600	3.3600	10.0800	10.0800	3.3600	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
11	-1.4823	-1357.5	-388.93	-13.025	-3.7169	-27.502	-7.6349	-3.7169	-27.502	-7.6349	0.6044	3.9932E+05	5.0337E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	2.1000	10.0800	10.0800	2.1000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
12	-1.4501	-1328.7	-388.96	-12.829	-3.7399	-28.103	-7.9616	-3.7399	-28.103	-7.9616	0.6130	4.0312E+05	5.2883E+05	11.130
x(FT)	0.0000	10.0800	10.0800	3.1500	2.3100	10.0800	10.0800	2.3100	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
13	-1.4108	-1292.9	-395.15	-12.424	-3.7828	-27.389	-8.1178	-3.7828	-27.389	-8.1178	0.6549	4.0395E+05	5.1352E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	1.4700	10.0800	10.0800	1.4700	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
14	-1.3808	-1265.0	-405.07	-12.051	-3.8465	-26.443	-8.2326	-3.8465	-26.443	-8.2326	0.7132	4.0370E+05	4.9250E+05	11.130
x(FT)	0.0000	10.0800	10.0800	2.5200	0.8400	10.0800	10.0800	0.8400	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
15	-1.3508	-1237.6	-415.14	-11.891	-3.9759	-27.873	-9.0862	-3.9759	-27.873	-9.0862	0.7714	4.0941E+05	5.2555E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	1.6800	10.0800	10.0800	1.6800	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
16	-1.8006	-1647.8	-334.10	-16.082	-3.2368	-29.428	-5.7047	-3.2368	-29.428	-5.7047	0.2416	3.8385E+05	5.5293E+05	11.130
x(FT)	0.0000	10.0800	10.0800	2.3100	0.0000	10.0800	10.0800	0.0000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
17	-1.7684	-1617.0	-333.67	-15.721	-3.2213	-28.506	-5.6341	-3.2213	-28.506	-5.6341	0.2502	3.8234E+05	5.2915E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	0.0000	10.0800	10.0800	0.0000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
18	-1.7362	-1590.2	-334.07	-15.471	-3.2273	-28.389	-5.7108	-3.2273	-28.389	-5.7108	0.2589	3.8497E+05	5.3920E+05	11.130
x(FT)	0.0000	10.0800	10.0800	1.0500	2.5200	10.0800	10.0800	2.5200	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
19	-1.7039	-1561.6	-334.11	-15.207	-3.2308	-28.262	-5.7907	-3.2308	-28.262	-5.7907	0.2676	3.8680E+05	5.4376E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.6300	0.0000	10.0800	10.0800	0.0000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
20	-1.6717	-1532.7	-334.09	-14.940	-3.2340	-28.208	-5.8869	-3.2340	-28.208	-5.8869	0.2762	3.8861E+05	5.5273E+05	11.130
x(FT)	0.0000	10.0800	10.0800	3.3600	1.2600	10.0800	10.0800	1.2600	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
21	-1.6395	-1503.5	-334.03	-14.672	-3.2369	-28.074	-5.9727	-3.2369	-28.074	-5.9727	0.2849	3.9034E+05	5.5500E+05	11.130
x(FT)	0.0000	10.0800	10.0800	1.0500	0.4200	10.0800	10.0800	0.4200	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
22	-1.6073	-1474.6	-334.01	-14.405	-3.2402	-27.991	-6.0706	-3.2402	-27.991	-6.0706	0.2936	3.9229E+05	5.6278E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	0.0000	10.0800	10.0800	0.0000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
23	-1.5751	-1445.6	-333.98	-14.138	-3.2438	-27.898	-6.1705	-3.2438	-27.898	-6.1705	0.3023	3.9401E+05	5.7109E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	0.0000	10.0800	10.0800	0.0000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
24	-1.5429	-1416.5	-333.96	-13.870	-3.2474	-27.800	-6.2731	-3.2474	-27.800	-6.2731	0.3109	3.9564E+05	5.7967E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	1.0500	10.0800	10.0800	1.0500	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
25	-1.5107	-1387.6	-333.95	-13.602	-3.2511	-27.700	-6.3799	-3.2511	-27.700	-6.3799	0.3196	3.9734E+05	5.8849E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	0.0000	10.0800	10.0800	0.0000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
26	-1.4785	-1358.6	-333.94	-13.333	-3.2546	-27.580	-6.4868	-3.2546	-27.580	-6.4868	0.3283	3.9896E+05	5.9687E+05	11.130
x(FT)	0.0000	10.0800	10.0800	1.6800	0.4200	10.0800	10.0800	0.4200	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
27	-1.4462	-1329.2	-333.78	-12.973	-3.2365	-26.471	-6.3799	-3.2365	-26.471	-6.3799	0.3370	3.9836E+05	5.6166E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.6300	0.0000	10.0800	10.0800	0.0000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
28	-1.4175	-1303.1	-333.66	-12.700	-3.2314	-25.950	-6.3837	-3.2314	-25.950	-6.3837	0.3447	3.9874E+05	5.4648E+05	11.130
x(FT)	0.0000	10.0800	10.0800	0.0000	0.0000	10.0800	10.0800	0.0000	10.0800	10.0800	0.0000	11.1300	11.1300	11.130
29	-1.3875	-1275.9	-343.78	-12.463	-3.3379	-26.633	-6.8959	-3.3379	-26.633	-6.8959	0.4029	4.0288E+05	5.7203E+05	11.130
x(FT)	0.0000	10.0800	10.0800	3.3600	3.3600	10.0800	10.0800	3.3600	10.0800	10.0800	0.0000	11.1300	11.1300	11.130

30	-1.3575	-0.3630	-1248.2	-353.75	-12.158	-3.4271	-26.502	-7.2365	0.4611	4.0443E+05	5.5854E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	3.3600	10.080	10.080	0.0000	11.130	11.130
31	-1.3275	-0.3746	-1220.7	-363.82	-11.993	-3.5552	-27.956	-8.0153	0.5193	4.1032E+05	6.2186E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	2.1000	10.080	10.080	0.0000	11.130	11.130
32	-1.7559	-0.5324	-1592.9	-500.05	-14.499	-4.5446	-28.827	-8.8657	1.0826	3.8805E+05	4.3665E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	3.1500	10.080	10.080	0.0000	11.130	11.130
33	-1.7540	-0.5003	-1560.3	-463.15	-13.877	-4.1137	-23.563	-6.7949	0.9448	3.5066E+05	4.2838E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
34	-1.7521	-0.4681	-1560.5	-435.71	-14.049	-3.9156	-23.533	-6.3707	0.8070	3.4976E+05	4.3142E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.7300	3.3600	10.080	10.080	0.0000	11.130	11.130
35	-1.7502	-0.4360	-1562.6	-408.78	-14.258	-3.7207	-23.709	-6.0098	0.6692	3.5097E+05	4.2621E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.080	3.1500	10.080	10.080	0.0000	11.130	11.130
36	-1.8363	-0.5276	-1661.4	-495.05	-15.122	-4.4984	-29.173	-8.5079	1.0403	3.8251E+05	4.3480E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.7300	3.3600	10.080	10.080	0.0000	11.130	11.130
37	-1.8344	-0.4955	-1624.6	-457.67	-14.459	-4.0673	-23.950	-6.5322	0.9025	3.3853E+05	4.2545E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	0.2100	10.080	10.080	0.0000	11.130	11.130
38	-1.8325	-0.4633	-1624.7	-430.30	-14.639	-3.8691	-23.913	-6.1183	0.7647	3.3737E+05	4.2879E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	0.2100	10.080	10.080	0.0000	11.130	11.130
39	-1.8306	-0.4311	-1631.6	-404.47	-14.947	-3.6948	-24.577	-5.8905	0.6269	3.4427E+05	4.2575E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
Min.	-1.8363	-0.5324	-1661.4	-500.05	-16.082	-4.5446	-29.428	-9.0862	0.2416	3.3737E+05	4.1887E+05
Pile N.	36	32	36	32	16	32	16	15	16	38	3

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		TOTAL		FLEX. RIG.	
	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	STRESS	KIP-IN**2	z-DIR	y-DIR
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1	3.5518E-03	7.8872E-04	37.235	15.488	148.04	34.723	21.327	4.7361	0.7214	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
2	3.7663E-03	8.5055E-04	38.874	16.254	144.88	34.594	20.183	4.5578	0.7335	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
3	4.2313E-03	9.6416E-04	39.092	17.504	141.16	34.277	18.430	4.1995	0.7456	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
4	3.1256E-03	7.3419E-04	33.880	14.730	139.65	34.575	19.779	4.6461	0.7577	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
5	2.9590E-03	7.0500E-04	33.126	14.285	137.23	34.390	19.232	4.5822	0.7698	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
6	2.8885E-03	7.0214E-04	32.745	14.230	134.64	34.306	18.774	4.5636	0.7819	7.1435E+06	7.1435E+06	7.1435E+06

x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
7	2.8164E-03	6.9842E-04	14.155	132.05	34.205	18.305	4.5394	0.7939	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
8	2.7451E-03	6.9473E-04	14.081	129.47	34.103	17.842	4.5154	0.8060	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
9	2.6739E-03	6.9102E-04	14.007	126.89	34.057	17.379	4.4913	0.8181	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
10	2.6025E-03	6.8724E-04	13.932	124.32	34.060	16.915	4.4667	0.8302	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
11	2.5302E-03	6.8313E-04	13.852	121.75	34.065	16.449	4.4411	0.8423	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
12	2.3807E-03	6.5377E-04	13.390	119.71	34.162	15.924	4.3731	0.8544	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
13	2.3482E-03	6.7872E-04	13.808	116.16	34.667	15.381	4.4455	0.9128	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
14	2.3631E-03	7.2157E-04	14.521	113.14	35.457	14.997	4.5794	0.9939	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
15	2.1300E-03	6.7811E-04	14.003	111.79	36.651	14.429	4.5935	1.0751	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.0000
16	3.1674E-03	5.8499E-04	11.844	148.17	29.533	21.123	3.9013	0.3367	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.2100
17	3.2109E-03	6.0755E-04	12.155	145.41	29.549	20.745	3.9254	0.3488	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
18	3.1270E-03	6.0163E-04	12.038	142.57	29.486	20.204	3.8872	0.3608	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
19	3.0529E-03	5.9821E-04	11.969	139.82	29.415	19.725	3.8651	0.3729	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
20	2.9794E-03	5.9386E-04	11.871	137.23	29.315	19.250	3.8369	0.3850	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
21	2.9082E-03	5.9127E-04	11.821	134.63	29.242	18.790	3.8202	0.3971	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
22	2.8351E-03	5.8723E-04	11.732	132.05	29.145	18.318	3.7941	0.4092	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
23	2.7630E-03	5.8307E-04	11.640	129.46	29.045	17.852	3.7673	0.4213	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
24	2.6909E-03	5.7887E-04	11.548	126.88	28.945	17.386	3.7401	0.4334	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000	0.0000
25	2.6187E-03	5.7461E-04	11.455	124.30	28.896	16.920	3.7126	0.4454	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.2100
26	2.5482E-03	5.7083E-04	11.369	121.72	28.886	16.452	3.6855	0.4575	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000	0.2100

27	2.5847E-03	5.9926E-04	34.347	11.762	118.38	28.809	16.021	3.7143	0.4696	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
28	2.5623E-03	6.0970E-04	34.559	11.910	115.80	28.806	15.639	3.7214	0.4804	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.2100
29	2.4024E-03	5.9934E-04	34.639	11.863	113.98	29.747	15.143	3.7779	0.5615	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
30	2.3317E-03	6.1612E-04	34.513	12.238	111.55	30.688	14.714	3.8880	0.6427	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
31	2.0994E-03	5.7643E-04	34.180	11.732	110.18	31.787	14.142	3.8831	0.7238	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
32	3.0011E-03	8.9853E-04	33.952	18.628	143.59	44.643	20.205	6.0494	1.5088	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
33	4.2548E-03	1.1621E-03	39.214	21.085	141.67	41.528	18.354	5.0130	1.3168	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
34	4.2860E-03	1.0985E-03	39.310	19.840	141.67	39.030	18.320	4.6954	1.1247	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
35	4.2479E-03	1.0257E-03	39.175	18.618	141.82	36.656	18.464	4.4581	0.9327	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
36	3.1930E-03	9.0428E-04	35.194	18.707	149.82	44.462	21.497	6.0881	1.4499	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
37	4.6354E-03	1.1878E-03	41.316	21.507	148.38	41.167	18.521	4.7461	1.2578	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
38	4.6718E-03	1.1220E-03	41.446	20.221	148.40	38.664	18.481	4.4386	1.0658	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
39	4.4598E-03	1.0140E-03	40.594	18.637	148.86	36.406	19.050	4.3312	0.8738	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
Max.	4.6718E-03	1.1878E-03	41.446	21.507	149.82	44.643	21.497	6.0881	1.5088	7.1435E+06	7.1435E+06
Pile N.	38	37	38	37	36	32	36	36	32	1	1

LOAD CASE : 4  
CASE NAME : Strength V  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO      P-FACTOR      Y-FACTOR

1	0.8635	1.0000
2	0.8147	1.0000
3	0.7423	1.0000
4	0.8977	1.0000
5	0.9214	1.0000
6	0.9214	1.0000
7	0.9214	1.0000
8	0.9214	1.0000
9	0.9214	1.0000
10	0.9214	1.0000
11	0.9218	1.0000
12	0.9499	1.0000
13	0.9303	1.0000
14	0.9013	1.0000
15	0.9675	1.0000
16	0.9457	1.0000
17	0.9161	1.0000
18	0.9161	1.0000
19	0.9161	1.0000
20	0.9161	1.0000
21	0.9161	1.0000
22	0.9161	1.0000
23	0.9161	1.0000
24	0.9161	1.0000
25	0.9161	1.0000
26	0.9149	1.0000
27	0.8782	1.0000
28	0.8669	1.0000
29	0.8953	1.0000
30	0.8964	1.0000
31	0.9623	1.0000
32	0.9621	1.0000
33	0.7561	1.0000
34	0.7517	1.0000
35	0.7529	1.0000
36	0.9621	1.0000
37	0.7561	1.0000
38	0.7517	1.0000
39	0.7710	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1871.72	-569.100	-189.590
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	11992.7	50750.8

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
0.0107877	-1.72056	-0.55493
ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
9.87617E-04	-5.59963E-06	8.98372E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	0.010199	-1.9164	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
2	0.010401	-1.8808	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
3	0.010603	-1.8453	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
4	0.010804	-1.8097	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
5	0.011006	-1.7742	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
6	0.011207	-1.7386	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
7	0.011409	-1.7031	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
8	0.011610	-1.6675	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
9	0.011812	-1.6320	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
10	0.012014	-1.5964	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05

11	0.012215	-1.5608	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
12	0.012417	-1.5253	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
13	0.013394	-1.4820	-0.5687	9.8762E-04	-5.5996E-06	8.9837E-05
14	0.014752	-1.4488	-0.5816	9.8762E-04	-5.5996E-06	8.9837E-05
15	0.016111	-1.4157	-0.5944	9.8762E-04	-5.5996E-06	8.9837E-05
16	3.7551E-03	-1.9121	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
17	3.9567E-03	-1.8766	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
18	4.1583E-03	-1.8410	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
19	4.3599E-03	-1.8055	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
20	4.5615E-03	-1.7699	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
21	4.7631E-03	-1.7344	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
22	4.9647E-03	-1.6988	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
23	5.1662E-03	-1.6633	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
24	5.3678E-03	-1.6277	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
25	5.5694E-03	-1.5922	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
26	5.7710E-03	-1.5566	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
27	5.9726E-03	-1.5211	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
28	6.1522E-03	-1.4894	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
29	7.5102E-03	-1.4562	-0.5024	9.8762E-04	-5.5996E-06	8.9837E-05
30	8.8685E-03	-1.4231	-0.5153	9.8762E-04	-5.5996E-06	8.9837E-05
31	0.010227	-1.3899	-0.5282	9.8762E-04	-5.5996E-06	8.9837E-05
32	0.023385	-1.8629	-0.7023	9.8762E-04	-5.5996E-06	8.9837E-05
33	0.020169	-1.8607	-0.6668	9.8762E-04	-5.5996E-06	8.9837E-05
34	0.016952	-1.8586	-0.6313	9.8762E-04	-5.5996E-06	8.9837E-05
35	0.013736	-1.8565	-0.5958	9.8762E-04	-5.5996E-06	8.9837E-05
36	0.022400	-1.9516	-0.6970	9.8762E-04	-5.5996E-06	8.9837E-05
37	0.019184	-1.9495	-0.6615	9.8762E-04	-5.5996E-06	8.9837E-05
38	0.015967	-1.9474	-0.6260	9.8762E-04	-5.5996E-06	8.9837E-05
39	0.012751	-1.9452	-0.5905	9.8762E-04	-5.5996E-06	8.9837E-05
MINIMUM	3.7551E-03	-1.9516	-0.7023	9.8762E-04	-5.5996E-06	8.9837E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.023385	-1.3899	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X, KIP	FOR. Y, KIP	FOR. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1	45.932	-16.087	-4.8601	0.0000	0.0000	0.0000
2	46.840	-15.612	-4.8066	0.0000	0.0000	0.0000

3	47.747	-15.023	-4.7179	0.0000	0.0000	0.0000	0.0000
4	48.655	-15.431	-4.9265	0.0000	0.0000	0.0000	0.0000
5	49.563	-15.243	-4.9611	0.0000	0.0000	0.0000	0.0000
6	50.471	-14.970	-4.9695	0.0000	0.0000	0.0000	0.0000
7	51.379	-14.697	-4.9782	0.0000	0.0000	0.0000	0.0000
8	52.287	-14.422	-4.9868	0.0000	0.0000	0.0000	0.0000
9	53.194	-14.134	-4.9914	0.0000	0.0000	0.0000	0.0000
10	54.102	-13.844	-4.9957	0.0000	0.0000	0.0000	0.0000
11	55.010	-13.557	-5.0009	0.0000	0.0000	0.0000	0.0000
12	55.918	-13.339	-5.0320	0.0000	0.0000	0.0000	0.0000
13	60.320	-12.890	-5.0710	0.0000	0.0000	0.0000	0.0000
14	66.437	-12.476	-5.1277	0.0000	0.0000	0.0000	0.0000
15	72.553	-12.291	-5.2759	0.0000	0.0000	0.0000	0.0000
16	16.911	-16.925	-4.4963	0.0000	0.0000	0.0000	0.0000
17	17.819	-16.532	-4.4740	0.0000	0.0000	0.0000	0.0000
18	18.727	-16.255	-4.4820	0.0000	0.0000	0.0000	0.0000
19	19.634	-15.974	-4.4894	3.8236E-27	-6.2444E-11	0.0000	0.0000
20	20.542	-15.692	-4.4968	3.8236E-27	-6.2444E-11	0.0000	0.0000
21	21.450	-15.411	-4.5044	0.0000	0.0000	0.0000	0.0000
22	22.358	-15.129	-4.5124	0.0000	0.0000	0.0000	0.0000
23	23.266	-14.844	-4.5197	-3.8236E-27	6.2444E-11	0.0000	0.0000
24	24.174	-14.546	-4.5238	0.0000	0.0000	0.0000	0.0000
25	25.081	-14.248	-4.5279	0.0000	0.0000	0.0000	0.0000
26	25.989	-13.948	-4.5317	3.8236E-27	-6.2444E-11	0.0000	0.0000
27	26.897	-13.556	-4.5058	0.0000	0.0000	0.0000	0.0000
28	27.706	-13.264	-4.5005	0.0000	0.0000	0.0000	0.0000
29	33.822	-12.985	-4.6160	0.0000	0.0000	0.0000	0.0000
30	39.938	-12.639	-4.7075	0.0000	0.0000	0.0000	0.0000
31	46.055	-12.448	-4.8566	0.0000	0.0000	0.0000	0.0000
32	105.31	-15.015	-5.7951	0.0000	0.0000	0.0000	0.0000
33	90.828	-14.425	-5.3114	0.0000	0.0000	0.0000	0.0000
34	76.344	-14.649	-5.1214	0.0000	0.0000	0.0000	0.0000
35	61.859	-14.898	-4.9306	0.0000	0.0000	0.0000	0.0000
36	100.88	-15.692	-5.7453	0.0000	0.0000	0.0000	-2.4977E-10
37	86.393	-15.062	-5.2618	0.0000	0.0000	0.0000	0.0000
38	71.908	-15.295	-5.0712	0.0000	0.0000	0.0000	0.0000
39	57.423	-15.652	-4.9072	0.0000	0.0000	0.0000	0.0000
MINIMUM	16.911	-16.925	-5.7951	-3.8236E-27	-6.2444E-11	-2.4977E-10	
Pile N.	16	16	32	23	19	36	
MAXIMUM	105.31	-12.291	-4.4740	3.8236E-27	6.2444E-11	0.0000	

THE PILE COORDINATE SYSTEM (LOCAL AXES)

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	0.010199	-1.9164	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
2	0.010401	-1.8808	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
3	0.010603	-1.8453	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
4	0.010804	-1.8097	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
5	0.011006	-1.7742	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
6	0.011207	-1.7386	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
7	0.011409	-1.7031	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
8	0.011610	-1.6675	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
9	0.011812	-1.6320	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
10	0.012014	-1.5964	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
11	0.012215	-1.5608	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
12	0.012417	-1.5253	-0.5607	9.8762E-04	-5.5996E-06	8.9837E-05
13	0.013394	-1.4820	-0.5687	9.8762E-04	-5.5996E-06	8.9837E-05
14	0.014752	-1.4488	-0.5816	9.8762E-04	-5.5996E-06	8.9837E-05
15	0.016111	-1.4157	-0.5944	9.8762E-04	-5.5996E-06	8.9837E-05
16	3.7551E-03	-1.9121	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
17	3.9567E-03	-1.8766	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
18	4.1583E-03	-1.8410	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
19	4.3599E-03	-1.8055	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
20	4.5615E-03	-1.7699	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
21	4.7631E-03	-1.7344	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
22	4.9647E-03	-1.6988	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
23	5.1662E-03	-1.6633	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
24	5.3678E-03	-1.6277	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
25	5.5694E-03	-1.5922	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
26	5.7710E-03	-1.5566	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
27	5.9726E-03	-1.5211	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
28	6.1522E-03	-1.4894	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
29	7.5102E-03	-1.4562	-0.5024	9.8762E-04	-5.5996E-06	8.9837E-05
30	8.8685E-03	-1.4231	-0.5153	9.8762E-04	-5.5996E-06	8.9837E-05
31	0.010227	-1.3899	-0.5282	9.8762E-04	-5.5996E-06	8.9837E-05

32	0.0223385	-1.8629	-0.7023	9.8762E-04	-5.5996E-06	8.9837E-05
33	0.020169	-1.8607	-0.6668	9.8762E-04	-5.5996E-06	8.9837E-05
34	0.016952	-1.8586	-0.6313	9.8762E-04	-5.5996E-06	8.9837E-05
35	0.013736	-1.8565	-0.5958	9.8762E-04	-5.5996E-06	8.9837E-05
36	0.022400	-1.9516	-0.6970	9.8762E-04	-5.5996E-06	8.9837E-05
37	0.019184	-1.9495	-0.6615	9.8762E-04	-5.5996E-06	8.9837E-05
38	0.015967	-1.9474	-0.6260	9.8762E-04	-5.5996E-06	8.9837E-05
39	0.012751	-1.9452	-0.5905	9.8762E-04	-5.5996E-06	8.9837E-05
MINIMUM	3.7551E-03	-1.9516	-0.7023	9.8762E-04	-5.5996E-06	8.9837E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.0223385	-1.3899	-0.4896	9.8762E-04	-5.5996E-06	8.9837E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL,KIP	LAT , Y,KIP	LAT , z,KIP	MOM x,KIP-IN	MOM y,KIP-IN	MOM z,KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	45.932	-16.087	-4.8601	0.0000	0.0000	0.0000
2	46.840	-15.612	-4.8066	0.0000	0.0000	0.0000
3	47.747	-15.023	-4.7179	0.0000	0.0000	0.0000
4	48.655	-15.431	-4.9265	0.0000	0.0000	0.0000
5	49.563	-15.243	-4.9611	0.0000	0.0000	0.0000
6	50.471	-14.970	-4.9695	0.0000	0.0000	0.0000
7	51.379	-14.697	-4.9782	0.0000	0.0000	0.0000
8	52.287	-14.422	-4.9868	0.0000	0.0000	0.0000
9	53.194	-14.134	-4.9914	0.0000	0.0000	0.0000
10	54.102	-13.844	-4.9957	0.0000	0.0000	0.0000
11	55.010	-13.557	-5.0009	0.0000	0.0000	0.0000
12	55.918	-13.339	-5.0320	0.0000	0.0000	0.0000
13	60.320	-12.890	-5.0710	0.0000	0.0000	0.0000
14	66.437	-12.476	-5.1277	0.0000	0.0000	0.0000
15	72.553	-12.291	-5.2759	0.0000	0.0000	0.0000
16	16.911	-16.925	-4.4963	0.0000	0.0000	0.0000
17	17.819	-16.532	-4.4740	0.0000	0.0000	0.0000
18	18.727	-16.255	-4.4820	0.0000	0.0000	0.0000
19	19.634	-15.974	-4.4894	0.0000	-6.2444E-11	0.0000
20	20.542	-15.692	-4.4968	0.0000	-6.2444E-11	0.0000
21	21.450	-15.411	-4.5044	0.0000	0.0000	0.0000
22	22.358	-15.129	-4.5124	0.0000	0.0000	0.0000
23	23.266	-14.844	-4.5197	0.0000	6.2444E-11	0.0000

24	24.174	-14.546	-4.5238	0.0000	0.0000	0.0000	0.0000
25	25.081	-14.248	-4.5279	0.0000	0.0000	0.0000	0.0000
26	25.989	-13.948	-4.5317	0.0000	-6.2444E-11	0.0000	0.0000
27	26.897	-13.556	-4.5058	0.0000	0.0000	0.0000	0.0000
28	27.706	-13.264	-4.5005	0.0000	0.0000	0.0000	0.0000
29	33.822	-12.985	-4.6160	0.0000	0.0000	0.0000	0.0000
30	39.938	-12.639	-4.7075	0.0000	0.0000	0.0000	0.0000
31	46.055	-12.448	-4.8566	0.0000	0.0000	0.0000	0.0000
32	105.31	-15.015	-5.7951	0.0000	0.0000	0.0000	0.0000
33	90.828	-14.425	-5.3114	0.0000	0.0000	0.0000	0.0000
34	76.344	-14.649	-5.1214	0.0000	0.0000	0.0000	0.0000
35	61.859	-14.898	-4.9306	0.0000	0.0000	0.0000	0.0000
36	100.88	-15.692	-5.7453	0.0000	0.0000	-2.4977E-10	0.0000
37	86.393	-15.062	-5.2618	0.0000	0.0000	0.0000	0.0000
38	71.908	-15.295	-5.0712	0.0000	0.0000	0.0000	0.0000
39	57.423	-15.652	-4.9072	0.0000	0.0000	0.0000	0.0000
MINIMUM	16.911	-16.925	-5.7951	0.0000	-6.2444E-11	-2.4977E-10	
Pile N.	16	16	32	1	19	36	
MAXIMUM	105.31	-12.291	-4.4740	0.0000	6.2444E-11	0.0000	
Pile N.	32	15	17	1	23	1	

PILE GROUP STRESS, KIP/IN\*\*2  
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1	0.5180
2	0.5283
3	0.5385
4	0.5488
5	0.5590
6	0.5692
7	0.5795
8	0.5897
9	0.5999
10	0.6102
11	0.6204
12	0.6307
13	0.6803
14	0.7493
15	0.8183
16	0.1907
17	0.2010

18 0.2112  
 19 0.2215  
 20 0.2317  
 21 0.2419  
 22 0.2522  
 23 0.2624  
 24 0.2726  
 25 0.2829  
 26 0.2931  
 27 0.3034  
 28 0.3125  
 29 0.3815  
 30 0.4505  
 31 0.5194  
 32 1.1878  
 33 1.0244  
 34 0.8610  
 35 0.6977  
 36 1.1377  
 37 0.9744  
 38 0.8110  
 39 0.6476  
  
 MINIMUM 0.1907  
 Pile N. 16  
 MAXIMUM 1.1878  
 Pile N. 32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL.		MOMENT		MOMENT		SHEAR		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.					
	y-DIR IN	z-DIR IN	y-DIR KIP	z-DIR KIP	y-DIR KIP-IN	z-DIR KIP-IN	y-DIR KIP	z-DIR KIP	y-DIR KIP/IN	z-DIR KIP/IN	y-DIR KIP	z-DIR KIP	y-DIR KIP/IN	z-DIR KIP/IN	y-DIR KIP-IN**2	z-DIR KIP-IN**2	STRESS KIP/IN**2	STRESS KIP/IN**2	z-DIR KIP-IN**2	y-DIR KIP-IN**2	z-DIR KIP-IN**2	y-DIR KIP-IN**2				
1	-1.9164	-0.5607	-1721.0	-521.39	-16.087	-4.8601	-27.144	-8.0187	0.5180	3.5465E+05	4.2880E+05	11.130	11.130	0.0000	0.0000	0.5283	3.4709E+05	4.2476E+05	11.130	11.130	0.0000	0.0000	0.5385	3.3143E+05	4.1882E+05	
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	2.9400	10.080	10.080	10.080	10.080	10.080	10.080	10.080	10.080	11.130	11.130	0.5283	3.4709E+05	4.2476E+05	11.130	11.130	0.0000	0.0000	0.5385	3.3143E+05	4.1882E+05
2	-1.8808	-0.5607	-1681.9	-519.20	-15.612	-4.8066	-25.739	-7.7338	0.5283	3.4709E+05	4.2476E+05	11.130	11.130	0.0000	0.0000	0.5283	3.4709E+05	4.2476E+05	11.130	11.130	0.0000	0.0000	0.5385	3.3143E+05	4.1882E+05	
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	1.0500	10.080	10.080	10.080	10.080	10.080	10.080	10.080	10.080	11.130	11.130	0.5283	3.4709E+05	4.2476E+05	11.130	11.130	0.0000	0.0000	0.5385	3.3143E+05	4.1882E+05
3	-1.8453	-0.5607	-1636.2	-515.16	-15.023	-4.7179	-23.761	-7.2506	0.5385	3.3143E+05	4.1882E+05	11.130	11.130	0.0000	0.0000	0.5385	3.3143E+05	4.1882E+05	11.130	11.130	0.0000	0.0000	0.5385	3.3143E+05	4.1882E+05	
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	1.0500	10.080	10.080	10.080	10.080	10.080	10.080	10.080	10.080	11.130	11.130	0.5283	3.4709E+05	4.2476E+05	11.130	11.130	0.0000	0.0000	0.5385	3.3143E+05	4.1882E+05



24	-1.6277	-0.4896	-1493.2	-466.15	-14.546	-4.5238	-27.359	-8.3545	0.2726	3.8977E+05	4.4247E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	2.3100	10.080	10.080	0.0000	11.130	11.130
25	-1.5922	-0.4896	-1461.1	-466.06	-14.248	-4.5279	-27.195	-8.4879	0.2829	3.9199E+05	4.4383E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	0.0000	10.080	10.080	0.0000	11.130	11.130
26	-1.5566	-0.4896	-1429.0	-466.01	-13.948	-4.5317	-27.048	-8.6319	0.2931	3.9381E+05	4.4575E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	1.2600	10.080	10.080	0.0000	11.130	11.130
27	-1.5211	-0.4896	-1396.4	-465.73	-13.556	-4.5058	-25.923	-8.4706	0.3034	3.9315E+05	4.3705E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.8400	0.2100	10.080	10.080	0.0000	11.130	11.130
28	-1.4894	-0.4896	-1367.7	-465.62	-13.264	-4.5005	-25.510	-8.5126	0.3125	3.9420E+05	4.3575E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.4700	0.0000	10.080	10.080	0.0000	11.130	11.130
29	-1.4562	-0.5024	-1337.4	-476.94	-12.985	-4.6160	-26.079	-9.1224	0.3815	3.9793E+05	4.4110E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	0.0000	10.080	10.080	0.0000	11.130	11.130
30	-1.4231	-0.5153	-1306.7	-488.09	-12.639	-4.7075	-25.907	-9.5034	0.4505	3.9978E+05	4.3880E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
31	-1.3899	-0.5282	-1276.4	-499.40	-12.448	-4.8566	-27.406	-10.533	0.5194	4.0603E+05	4.5174E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.2100	10.080	10.080	0.0000	11.130	11.130
32	-1.8629	-0.7023	-1678.2	-648.38	-15.015	-5.7951	-28.704	-10.905	1.1878	3.7908E+05	4.2986E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
33	-1.8607	-0.6668	-1641.8	-605.22	-14.425	-5.3114	-23.837	-8.5507	1.0244	3.3326E+05	4.1240E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
34	-1.8586	-0.6313	-1642.5	-575.11	-14.649	-5.1214	-23.836	-8.1103	0.8610	3.3221E+05	4.1387E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	0.4200	10.080	10.080	0.0000	11.130	11.130
35	-1.8565	-0.5958	-1644.5	-545.36	-14.898	-4.9306	-23.970	-7.7174	0.6977	3.3300E+05	4.1661E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
36	-1.9516	-0.6970	-1752.3	-642.36	-15.692	-5.7453	-29.217	-10.515	1.1377	3.7107E+05	4.2771E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
37	-1.9495	-0.6615	-1711.8	-598.82	-15.062	-5.2618	-24.318	-8.2368	0.9744	3.1715E+05	4.1038E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.8400	2.1000	10.080	10.080	0.0000	11.130	11.130
38	-1.9474	-0.6260	-1712.3	-568.78	-15.295	-5.0712	-24.310	-7.8049	0.8110	3.1584E+05	4.1263E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	2.9400	10.080	10.080	0.0000	11.130	11.130
39	-1.9452	-0.5905	-1720.2	-540.61	-15.652	-4.9072	-24.883	-7.5703	0.6476	3.2413E+05	4.1665E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.4200	10.080	10.080	0.0000	11.130	11.130
Min.	-1.9516	-0.7023	-1752.3	-648.38	-16.925	-5.7951	-29.381	-11.557	0.1907	3.1584E+05	4.1038E+05
Pile N.	36	32	36	32	16	32	16	15	16	38	37

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		TOTAL		FLEX. RIG.	
	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	STRESS	KIP-IN**2	FLEX. RIG.	Y-DIR
	IN	IN	KIP-IN	KIP-IN	KIP	KIP	KIP/IN	KIP/IN	KIP/IN**2	KIP-IN**2	KIP-IN**2	KIP-IN**2



21	3.1782E-03	8.8659E-04	34.275	17.964	142.71	41.696	20.380	5.6852	0.3372	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
22	3.0883E-03	8.8031E-04	33.615	17.857	139.59	41.630	19.804	5.6449	0.3514	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
23	3.0003E-03	8.7345E-04	33.117	17.726	136.40	41.525	19.239	5.6010	0.3657	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
24	2.9209E-03	8.6916E-04	32.568	17.642	133.51	41.406	18.730	5.5735	0.3800	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
25	2.8410E-03	8.6510E-04	32.462	17.563	130.64	41.291	18.218	5.5474	0.3942	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
26	2.7644E-03	8.6153E-04	32.394	17.484	127.77	41.164	17.705	5.5177	0.4085	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
27	2.8017E-03	8.9727E-04	33.574	17.908	124.07	41.169	17.223	5.5157	0.4228	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
28	2.7620E-03	9.0573E-04	34.724	17.982	121.31	41.093	16.761	5.4965	0.4355	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
29	2.5930E-03	8.9166E-04	34.466	17.960	119.25	41.947	16.250	5.5880	0.5316	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
30	2.5129E-03	9.0808E-04	34.698	18.319	116.56	42.983	15.768	5.6981	0.6278	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
31	2.2510E-03	8.5278E-04	34.322	17.720	115.11	44.459	15.164	5.7447	0.7239	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
32	3.2808E-03	1.2013E-03	35.683	24.780	152.20	58.549	22.095	8.0897	1.6554	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
33	4.7652E-03	1.5991E-03	42.160	29.170	150.61	54.757	18.388	6.1707	1.4277	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
34	4.7968E-03	1.5261E-03	42.326	27.738	150.67	51.987	18.378	5.8469	1.2000	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
35	4.7771E-03	1.4386E-03	42.207	26.158	150.80	49.262	18.485	5.5668	0.9724	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
36	3.5528E-03	1.2272E-03	37.702	25.258	159.94	58.299	22.920	7.9170	1.5857	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
37	5.2565E-03	1.6474E-03	45.390	29.911	158.21	54.345	18.622	6.0986	1.3580	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
38	5.2987E-03	1.5723E-03	45.632	28.429	158.27	51.562	18.604	5.7819	1.1303	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
39	5.0445E-03	1.4267E-03	44.206	26.238	158.71	49.016	19.094	5.5702	0.9026	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
Max.	5.2987E-03	1.6474E-03	45.632	29.911	159.94	58.549	23.068	8.0897	1.6554	7.1435E+06	7.1435E+06
Pile N.	38	37	38	37	36	32	16	32	32	1	1

LOAD CASE : 5  
CASE NAME : Service I  
LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.8626	1.0000
2	0.8137	1.0000
3	0.7421	1.0000
4	0.8964	1.0000
5	0.9199	1.0000
6	0.9199	1.0000
7	0.9199	1.0000
8	0.9199	1.0000
9	0.9199	1.0000
10	0.9199	1.0000
11	0.9203	1.0000
12	0.9488	1.0000
13	0.9292	1.0000
14	0.9003	1.0000
15	0.9674	1.0000
16	0.9443	1.0000
17	0.9146	1.0000
18	0.9146	1.0000
19	0.9146	1.0000
20	0.9146	1.0000
21	0.9146	1.0000
22	0.9146	1.0000
23	0.9146	1.0000
24	0.9146	1.0000
25	0.9146	1.0000
26	0.9134	1.0000
27	0.8767	1.0000
28	0.8659	1.0000
29	0.8942	1.0000

30	0.8954	1.0000
31	0.9623	1.0000
32	0.9621	1.0000
33	0.7578	1.0000
34	0.7535	1.0000
35	0.7541	1.0000
36	0.9621	1.0000
37	0.7578	1.0000
38	0.7535	1.0000
39	0.7720	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1446.29	-399.340	-141.050
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	7856.52	34869.6

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN	HORIZONTAL Y,IN	HORIZONTAL Z,IN
8.32893E-03	-1.12888	-0.38019
ANGLE ROT. X,RAD	ANGLE ROT. Y,RAD	ANGLE ROT. Z,RAD
5.96536E-04	-3.55652E-06	6.19489E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	7.9837E-03	-1.2472	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
2	8.1117E-03	-1.2257	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
3	8.2397E-03	-1.2042	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
4	8.3678E-03	-1.1827	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
5	8.4958E-03	-1.1613	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
6	8.6238E-03	-1.1398	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
7	8.7519E-03	-1.1183	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
8	8.8799E-03	-1.0968	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
9	9.0079E-03	-1.0754	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
10	9.1360E-03	-1.0539	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
11	9.2640E-03	-1.0324	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
12	9.3921E-03	-1.0109	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
13	0.010053	-0.9848	-0.3885	5.9654E-04	-3.5655E-06	6.1949E-05
14	0.010979	-0.9647	-0.3963	5.9654E-04	-3.5655E-06	6.1949E-05
15	0.011905	-0.9447	-0.4041	5.9654E-04	-3.5655E-06	6.1949E-05
16	3.5386E-03	-1.2446	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
17	3.6667E-03	-1.2231	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
18	3.7947E-03	-1.2017	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
19	3.9227E-03	-1.1802	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
20	4.0508E-03	-1.1587	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
21	4.1788E-03	-1.1372	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
22	4.3068E-03	-1.1158	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
23	4.4349E-03	-1.0943	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
24	4.5629E-03	-1.0728	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
25	4.6910E-03	-1.0513	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
26	4.8190E-03	-1.0299	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
27	4.9470E-03	-1.0084	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
28	5.0611E-03	-0.9892	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
29	5.9873E-03	-0.9692	-0.3485	5.9654E-04	-3.5655E-06	6.1949E-05
30	6.9137E-03	-0.9492	-0.3563	5.9654E-04	-3.5655E-06	6.1949E-05
31	7.8400E-03	-0.9292	-0.3640	5.9654E-04	-3.5655E-06	6.1949E-05
32	0.017060	-1.2148	-0.4692	5.9654E-04	-3.5655E-06	6.1949E-05
33	0.014841	-1.2136	-0.4478	5.9654E-04	-3.5655E-06	6.1949E-05
34	0.012623	-1.2123	-0.4263	5.9654E-04	-3.5655E-06	6.1949E-05
35	0.010404	-1.2110	-0.4049	5.9654E-04	-3.5655E-06	6.1949E-05
36	0.016408	-1.2684	-0.4660	5.9654E-04	-3.5655E-06	6.1949E-05
37	0.014189	-1.2672	-0.4446	5.9654E-04	-3.5655E-06	6.1949E-05
38	0.011971	-1.2659	-0.4231	5.9654E-04	-3.5655E-06	6.1949E-05
39	9.7522E-03	-1.2646	-0.4017	5.9654E-04	-3.5655E-06	6.1949E-05

MINIMUM 3.5386E-03 -1.2684 -0.4692 5.9654E-04 -3.5565E-06 6.1949E-05  
Pile N. 16 36 32 1 1 1  
MAXIMUM 0.017060 -0.9292 -0.3407 5.9654E-04 -3.5565E-06 6.1949E-05  
Pile N. 32 31 16 1 1 1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X, KIP	FOR. Y, KIP	FOR. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1	35.954	-11.239	-3.6190	0.0000	0.0000	0.0000
2	36.530	-10.945	-3.5864	0.0000	0.0000	0.0000
3	37.107	-10.592	-3.5335	0.0000	0.0000	0.0000
4	37.683	-10.777	-3.6544	0.0000	0.0000	0.0000
5	38.260	-10.650	-3.6760	0.0000	0.0000	0.0000
6	38.837	-10.469	-3.6803	0.0000	0.0000	0.0000
7	39.413	-10.288	-3.6846	0.0000	0.0000	0.0000
8	39.990	-10.107	-3.6891	0.0000	0.0000	0.0000
9	40.566	-9.9264	-3.6938	0.0000	0.0000	0.0000
10	41.143	-9.7443	-3.6983	0.0000	0.0000	0.0000
11	41.720	-9.5549	-3.7001	0.0000	0.0000	0.0000
12	42.296	-9.4089	-3.7188	0.0000	0.0000	-1.2489E-10
13	45.272	-9.1246	-3.7436	0.0000	0.0000	0.0000
14	49.443	-8.8688	-3.7814	0.0000	0.0000	0.0000
15	53.615	-8.7574	-3.8791	0.0000	0.0000	0.0000
16	15.936	-11.651	-3.3714	0.0000	0.0000	0.0000
17	16.512	-11.400	-3.3562	0.0000	0.0000	0.0000
18	17.089	-11.216	-3.3597	0.0000	0.0000	0.0000
19	17.666	-11.032	-3.3635	0.0000	0.0000	0.0000
20	18.242	-10.848	-3.3674	0.0000	0.0000	0.0000
21	18.819	-10.664	-3.3713	0.0000	0.0000	0.0000
22	19.395	-10.479	-3.3755	0.0000	0.0000	0.0000
23	19.972	-10.294	-3.3797	0.0000	0.0000	0.0000
24	20.549	-10.110	-3.3842	0.0000	0.0000	0.0000
25	21.125	-9.9213	-3.3876	0.0000	0.0000	0.0000
26	21.702	-9.7255	-3.3881	0.0000	0.0000	1.2489E-10
27	22.278	-9.4728	-3.3694	0.0000	0.0000	1.2489E-10
28	22.792	-9.2839	-3.3649	0.0000	0.0000	0.0000
29	26.963	-9.1138	-3.4390	0.0000	0.0000	0.0000
30	31.135	-8.9019	-3.4979	0.0000	0.0000	0.0000
31	35.307	-8.7875	-3.5946	0.0000	0.0000	0.0000

32	76.827	-10.708	-4.2661	0.0000	0.0000	0.0000	0.0000
33	66.836	-10.352	-3.9553	0.0000	0.0000	0.0000	0.0000
34	56.844	-10.450	-3.8182	0.0000	0.0000	0.0000	0.0000
35	46.853	-10.561	-3.6817	0.0000	0.0000	0.0000	0.0000
36	73.891	-11.161	-4.2351	0.0000	0.0000	0.0000	0.0000
37	63.900	-10.796	-3.9275	0.0000	0.0000	0.0000	0.0000
38	53.909	-10.898	-3.7899	0.0000	0.0000	0.0000	0.0000
39	43.918	-11.058	-3.6676	0.0000	0.0000	0.0000	0.0000
MINIMUM	15.936	-11.651	-4.2661	0.0000	0.0000	-1.2489E-10	
Pile N.	16	16	32	1	1	12	
MAXIMUM	76.827	-8.7574	-3.3562	0.0000	0.0000	1.2489E-10	
Pile N.	32	15	17	1	1	26	

THE PILE COORDINATE SYSTEM (LOCAL AXES)

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
*****	*****	*****	*****	*****	*****	*****
1	7.9837E-03	-1.2472	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
2	8.1177E-03	-1.2257	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
3	8.2397E-03	-1.2042	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
4	8.3678E-03	-1.1827	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
5	8.4958E-03	-1.1613	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
6	8.6238E-03	-1.1398	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
7	8.7519E-03	-1.1183	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
8	8.8799E-03	-1.0968	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
9	9.0079E-03	-1.0754	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
10	9.1360E-03	-1.0539	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
11	9.2640E-03	-1.0324	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
12	9.3921E-03	-1.0109	-0.3837	5.9654E-04	-3.5655E-06	6.1949E-05
13	0.010053	-0.9848	-0.3885	5.9654E-04	-3.5655E-06	6.1949E-05
14	0.010979	-0.9647	-0.3963	5.9654E-04	-3.5655E-06	6.1949E-05
15	0.011905	-0.9447	-0.4041	5.9654E-04	-3.5655E-06	6.1949E-05
16	3.5386E-03	-1.2446	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
17	3.6667E-03	-1.2231	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
18	3.7947E-03	-1.2017	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
19	3.9227E-03	-1.1802	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05

20	4.0508E-03	-1.1.1587	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
21	4.1788E-03	-1.1.1372	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
22	4.3068E-03	-1.1.1158	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
23	4.4349E-03	-1.1.0943	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
24	4.5629E-03	-1.1.0728	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
25	4.6910E-03	-1.1.0513	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
26	4.8190E-03	-1.1.0299	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
27	4.9470E-03	-1.1.0084	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
28	5.0611E-03	-0.9892	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
29	5.9873E-03	-0.9692	-0.3485	5.9654E-04	-3.5655E-06	6.1949E-05
30	6.9137E-03	-0.9492	-0.3563	5.9654E-04	-3.5655E-06	6.1949E-05
31	7.8400E-03	-0.9292	-0.3640	5.9654E-04	-3.5655E-06	6.1949E-05
32	0.017060	-1.2148	-0.4692	5.9654E-04	-3.5655E-06	6.1949E-05
33	0.014841	-1.2136	-0.4478	5.9654E-04	-3.5655E-06	6.1949E-05
34	0.012623	-1.2123	-0.4263	5.9654E-04	-3.5655E-06	6.1949E-05
35	0.010404	-1.2110	-0.4049	5.9654E-04	-3.5655E-06	6.1949E-05
36	0.016408	-1.2684	-0.4660	5.9654E-04	-3.5655E-06	6.1949E-05
37	0.014189	-1.2672	-0.4446	5.9654E-04	-3.5655E-06	6.1949E-05
38	0.011971	-1.2659	-0.4231	5.9654E-04	-3.5655E-06	6.1949E-05
39	9.7522E-03	-1.2646	-0.4017	5.9654E-04	-3.5655E-06	6.1949E-05
MINIMUM	3.5386E-03	-1.2684	-0.4692	5.9654E-04	-3.5655E-06	6.1949E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.017060	-0.9292	-0.3407	5.9654E-04	-3.5655E-06	6.1949E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL,KIP	LAT. Y,KIP	LAT. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	35.954	-11.239	-3.6190	0.0000	0.0000	0.0000
2	36.530	-10.945	-3.5864	0.0000	0.0000	0.0000
3	37.107	-10.592	-3.5335	0.0000	0.0000	0.0000
4	37.683	-10.777	-3.6544	0.0000	0.0000	0.0000
5	38.260	-10.650	-3.6760	0.0000	0.0000	0.0000
6	38.837	-10.469	-3.6803	0.0000	0.0000	0.0000
7	39.413	-10.288	-3.6846	0.0000	0.0000	0.0000
8	39.990	-10.107	-3.6891	0.0000	0.0000	0.0000
9	40.566	-9.9264	-3.6938	0.0000	0.0000	0.0000
10	41.143	-9.7443	-3.6983	0.0000	0.0000	0.0000
11	41.720	-9.5549	-3.7001	0.0000	0.0000	0.0000

12	42.296	-9.4089	-3.7188	0.0000	0.0000	-1.2489E-10
13	45.272	-9.1246	-3.7436	0.0000	0.0000	0.0000
14	49.443	-8.8688	-3.7814	0.0000	0.0000	0.0000
15	53.615	-8.7574	-3.8791	0.0000	0.0000	0.0000
16	15.936	-11.651	-3.3714	0.0000	0.0000	0.0000
17	16.512	-11.400	-3.3562	0.0000	0.0000	0.0000
18	17.089	-11.216	-3.3597	0.0000	0.0000	0.0000
19	17.666	-11.032	-3.3635	0.0000	0.0000	0.0000
20	18.242	-10.848	-3.3674	0.0000	0.0000	0.0000
21	18.819	-10.664	-3.3713	0.0000	0.0000	0.0000
22	19.395	-10.479	-3.3755	0.0000	0.0000	0.0000
23	19.972	-10.294	-3.3797	0.0000	0.0000	0.0000
24	20.549	-10.110	-3.3842	0.0000	0.0000	0.0000
25	21.125	-9.9213	-3.3876	0.0000	0.0000	0.0000
26	21.702	-9.7255	-3.3881	0.0000	0.0000	1.2489E-10
27	22.278	-9.4728	-3.3694	0.0000	0.0000	1.2489E-10
28	22.792	-9.2839	-3.3649	0.0000	0.0000	0.0000
29	26.963	-9.1138	-3.4390	0.0000	0.0000	0.0000
30	31.135	-8.9019	-3.4979	0.0000	0.0000	0.0000
31	35.307	-8.7875	-3.5946	0.0000	0.0000	0.0000
32	76.827	-10.708	-4.2661	0.0000	0.0000	0.0000
33	66.836	-10.352	-3.9553	0.0000	0.0000	0.0000
34	56.844	-10.450	-3.8182	0.0000	0.0000	0.0000
35	46.853	-10.561	-3.6817	0.0000	0.0000	0.0000
36	73.891	-11.161	-4.2351	0.0000	0.0000	0.0000
37	63.900	-10.796	-3.9275	0.0000	0.0000	0.0000
38	53.909	-10.898	-3.7899	0.0000	0.0000	0.0000
39	43.918	-11.058	-3.6676	0.0000	0.0000	0.0000
MINIMUM	15.936	-11.651	-4.2661	0.0000	0.0000	-1.2489E-10
Pile N.	16	16	32	1	1	12
MAXIMUM	76.827	-8.7574	-3.3562	0.0000	0.0000	1.2489E-10
Pile N.	32	15	17	1	1	26

PILE GROUP STRESS, KIP/IN\*\*2  
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 \*\*\*\*\*

- 1 0.4055
- 2 0.4120
- 3 0.4185
- 4 0.4250
- 5 0.4315

6	0.4380
7	0.4445
8	0.4510
9	0.4575
10	0.4640
11	0.4705
12	0.4770
13	0.5106
14	0.5576
15	0.6047
16	0.1797
17	0.1862
18	0.1927
19	0.1992
20	0.2057
21	0.2122
22	0.2188
23	0.2253
24	0.2318
25	0.2383
26	0.2448
27	0.2513
28	0.2571
29	0.3041
30	0.3512
31	0.3982
32	0.8665
33	0.7538
34	0.6411
35	0.5284
36	0.8334
37	0.7207
38	0.6080
39	0.4953

MINIMUM  
Pile N. 16  
MAXIMUM  
Pile N. 32

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		DISPL. Z-DIR IN	MOMENT		MOMENT Y-DIR KIP-IN	SHEAR		SHEAR Z-DIR KIP	SOIL REACT		SOIL REACT Y-DIR KIP/IN	SOIL REACT		TOTAL STRESS KIP/IN**2	FLEX. RIG.		FLEX. RIG. Y-DIR KIP-IN**2	
	Y-DIR IN	Z-DIR IN		Z-DIR KIP-IN	Y-DIR KIP		Y-DIR KIP/IN	Z-DIR KIP/IN		Z-DIR KIP/IN**2	Z-DIR KIP-IN**2								
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	
1	-1.2472	-0.3837	-1149.7	-371.96	-11.239	-3.6190	-24.897	-7.8087	0.4055	4.0723E+05	5.1477E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	0.2100	10.080	10.080	0.4120	4.0454E+05	4.8975E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
2	-1.2257	-0.3837	-1129.5	-371.72	-10.945	-3.5864	-23.528	-7.5181	0.4185	4.0016E+05	4.5552E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.4250	4.1326E+05	5.5980E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
3	-1.2042	-0.3837	-1108.0	-371.05	-10.592	-3.5335	-21.555	-7.0285	0.4315	4.1655E+05	6.0851E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.8400	10.080	10.080	0.4380	4.1818E+05	6.1839E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
4	-1.1827	-0.3837	-1092.3	-372.20	-10.777	-3.6544	-25.503	-8.4110	0.4445	4.1986E+05	6.2865E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.8400	10.080	10.080	0.4510	4.2112E+05	6.4652E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
5	-1.1613	-0.3837	-1073.4	-372.39	-10.650	-3.6760	-26.093	-8.7436	0.4575	4.2206E+05	6.6710E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	2.9400	10.080	10.080	0.4640	4.2473E+05	6.9084E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
6	-1.1398	-0.3837	-1054.2	-372.44	-10.469	-3.6803	-25.991	-8.8701	0.4705	4.2533E+05	7.1239E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	2.1000	10.080	10.080	0.4770	4.2874E+05	7.3951E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
7	-1.1183	-0.3837	-1034.9	-372.50	-10.288	-3.6846	-25.887	-9.0006	0.4800	4.2882E+05	7.6092E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	2.9400	10.080	10.080	0.4875	4.2882E+05	7.8242E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
8	-1.0968	-0.3837	-1015.7	-372.58	-10.107	-3.6891	-25.779	-9.1317	0.4900	4.2882E+05	8.0392E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	0.0000	10.080	10.080	0.4975	4.2882E+05	8.2542E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
9	-1.0754	-0.3837	-996.54	-372.67	-9.9264	-3.6938	-25.667	-9.2660	0.5000	4.2882E+05	8.4692E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.5075	4.2882E+05	8.6842E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
10	-1.0539	-0.3837	-977.17	-372.70	-9.7443	-3.6983	-25.490	-9.3813	0.5106	4.2882E+05	8.9042E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	3.1500	10.080	10.080	0.5175	4.2882E+05	9.1192E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
11	-1.0324	-0.3837	-956.69	-372.78	-9.5549	-3.7001	-24.942	-9.3773	0.5200	4.2882E+05	9.3342E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	1.8900	10.080	10.080	0.5275	4.2882E+05	9.5492E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
12	-1.0109	-0.3837	-934.71	-371.31	-9.4089	-3.7188	-24.542	-9.4145	0.5300	4.2882E+05	9.7642E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.5375	4.2882E+05	9.9792E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
13	-0.9848	-0.3885	-910.64	-375.35	-9.1246	-3.7436	-23.754	-9.4780	0.5400	4.2882E+05	10.1942E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.5475	4.2882E+05	10.4092E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
14	-0.9647	-0.3963	-892.74	-382.18	-8.8688	-3.7814	-23.076	-9.5975	0.5500	4.2882E+05	10.6242E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.5575	4.2882E+05	10.8392E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
15	-0.9447	-0.4041	-869.82	-386.88	-8.5744	-3.8791	-22.896	-9.8919	0.5600	4.2882E+05	11.0542E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.5675	4.2882E+05	11.2692E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
16	-1.2446	-0.3407	-1151.6	-335.86	-11.651	-3.3714	-27.341	-7.5918	0.5700	4.2882E+05	11.4842E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	0.0000	10.080	10.080	0.5775	4.2882E+05	11.6992E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
17	-1.2231	-0.3407	-1132.1	-335.82	-11.400	-3.3562	-26.469	-7.4975	0.5800	4.2882E+05	11.9092E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	2.5200	10.080	10.080	0.5875	4.2882E+05	12.1242E+05	0.0000	11.130	0.0000	11.130	0.0000	11.130	0.0000	11.130

18	-1.2017	-0.3407	-1112.8	-335.86	-11.216	-3.3597	-26.383	-7.6008	0.1927	4.1361E+05	7.2130E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	3.3600	10.080	10.080	0.0000	11.130	11.130
19	-1.1802	-0.3407	-1093.5	-335.93	-11.032	-3.3635	-26.295	-7.7040	0.1992	4.1470E+05	7.4694E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.1000	3.1500	10.080	10.080	0.0000	11.130	11.130
20	-1.1587	-0.3407	-1074.2	-335.98	-10.848	-3.3674	-26.203	-7.8141	0.2057	4.1627E+05	7.6505E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	0.4200	10.080	10.080	0.0000	11.130	11.130
21	-1.1372	-0.3407	-1054.9	-336.04	-10.664	-3.3713	-26.109	-7.9294	0.2122	4.1793E+05	7.8011E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	2.5200	10.080	10.080	0.0000	11.130	11.130
22	-1.1158	-0.3407	-1035.7	-336.13	-10.479	-3.3755	-26.013	-8.0420	0.2188	4.1962E+05	8.1481E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	2.5200	10.080	10.080	0.0000	11.130	11.130
23	-1.0943	-0.3407	-1016.5	-336.21	-10.294	-3.3797	-25.914	-8.1620	0.2253	4.2100E+05	8.4005E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	0.0000	10.080	10.080	0.0000	11.130	11.130
24	-1.0728	-0.3407	-997.21	-336.30	-10.110	-3.3842	-25.811	-8.2820	0.2318	4.2196E+05	8.8019E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	0.0000	10.080	10.080	0.0000	11.130	11.130
25	-1.0513	-0.3407	-977.36	-336.22	-9.9213	-3.3876	-25.484	-8.3285	0.2383	4.2457E+05	9.3566E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
26	-1.0299	-0.3407	-956.89	-335.81	-9.7255	-3.3881	-24.925	-8.3375	0.2448	4.2509E+05	8.6114E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	0.0000	10.080	10.080	0.0000	11.130	11.130
27	-1.0084	-0.3407	-938.19	-336.04	-9.4728	-3.3694	-24.163	-8.2818	0.2513	4.2378E+05	7.6423E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	0.0000	10.080	10.080	0.0000	11.130	11.130
28	-0.9892	-0.3407	-920.43	-335.89	-9.2839	-3.3649	-23.611	-8.2557	0.2571	4.2458E+05	7.4282E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
29	-0.9692	-0.3485	-899.59	-341.67	-9.1138	-3.4390	-23.247	-8.4777	0.3041	4.2664E+05	7.3532E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	2.3100	10.080	10.080	0.0000	11.130	11.130
30	-0.9492	-0.3563	-880.09	-347.93	-8.9019	-3.4979	-22.728	-8.6454	0.3512	4.2867E+05	7.1646E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	1.4700	10.080	10.080	0.0000	11.130	11.130
31	-0.9292	-0.3640	-857.09	-352.77	-8.7875	-3.5946	-22.544	-8.9302	0.3982	4.2688E+05	7.4568E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
32	-1.2148	-0.4692	-1115.0	-445.34	-10.708	-4.2661	-26.882	-10.490	0.8665	4.1639E+05	5.1315E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130
33	-1.2136	-0.4478	-1112.2	-425.77	-10.352	-3.9553	-21.683	-8.1354	0.7538	4.0110E+05	4.3729E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	11.130
34	-1.2123	-0.4263	-1112.5	-407.48	-10.450	-3.8182	-21.676	-7.7640	0.6411	4.0076E+05	4.4488E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	3.3600	10.080	10.080	0.0000	11.130	11.130
35	-1.2110	-0.4049	-1112.9	-389.24	-10.561	-3.6817	-21.796	-7.4376	0.5284	4.0089E+05	4.5162E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
36	-1.2084	-0.4660	-1163.2	-442.56	-11.161	-4.2351	-27.174	-10.097	0.8334	4.1340E+05	5.0327E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.8400	1.2600	10.080	10.080	0.0000	11.130	11.130
37	-1.2072	-0.4446	-1160.2	-422.94	-10.796	-3.9275	-21.914	-7.8241	0.7207	3.9794E+05	4.3534E+05
x(FT)	0.0000	0.0000	10.080	10.080	2.7300	3.1500	10.080	10.080	0.0000	11.130	11.130
38	-1.2059	-0.4231	-1160.5	-404.64	-10.898	-3.7899	-21.898	-7.4614	0.6080	3.9765E+05	4.4257E+05



15	1.3784E-03	5.8010E-04	29.474	11.915	78.489	34.051	9.3346	3.9285	0.8428	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
16	1.9842E-03	5.1319E-04	32.873	10.181	103.67	28.953	13.116	3.3922	0.2505	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
17	2.0151E-03	5.3775E-04	32.225	10.575	101.45	28.923	12.902	3.4430	0.2596	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
18	1.9692E-03	5.3321E-04	31.951	10.472	99.736	28.913	12.608	3.4139	0.2686	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
19	1.9232E-03	5.2737E-04	31.659	10.333	98.018	28.888	12.313	3.3765	0.2777	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
20	1.8757E-03	5.2272E-04	31.684	10.228	96.299	28.880	12.009	3.3467	0.2868	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
21	1.8281E-03	5.1852E-04	31.742	10.138	94.579	28.880	11.704	3.3199	0.2958	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
22	1.7808E-03	5.1189E-04	31.767	9.9774	92.861	28.850	11.402	3.2774	0.3049	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
23	1.7331E-03	5.0663E-04	32.050	9.8576	91.146	28.840	11.096	3.2437	0.3139	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
24	1.6843E-03	4.9980E-04	32.728	9.6935	89.431	28.811	10.784	3.2000	0.3230	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
25	1.6400E-03	4.9246E-04	32.966	9.5014	87.630	28.734	10.500	3.1530	0.3321	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
26	1.6065E-03	5.0056E-04	32.551	9.7285	85.764	28.809	10.272	3.2005	0.3411	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
27	1.6389E-03	5.3129E-04	32.468	10.216	83.633	28.809	10.058	3.2604	0.3502	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
28	1.6248E-03	5.3976E-04	32.476	10.339	81.895	28.781	9.8484	3.2717	0.3583	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
29	1.5390E-03	5.3485E-04	31.304	10.434	80.352	29.449	9.6332	3.3479	0.4238	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
30	1.5024E-03	5.4658E-04	30.580	10.698	78.599	30.041	9.4167	3.4257	0.4894	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
31	1.3664E-03	5.1580E-04	29.122	10.433	77.287	30.750	9.2047	3.4747	0.5550	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
32	1.8709E-03	7.1733E-04	32.441	14.844	100.66	39.463	12.600	4.8311	1.2076	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
33	2.4491E-03	9.0930E-04	32.302	16.976	96.765	36.864	12.992	4.8236	1.0506	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.710	11.130	11.130	11.130	0.0000	0.0000
34	2.4626E-03	8.7183E-04	32.377	16.194	96.703	35.236	12.988	4.5983	0.8935	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.710	10.710	11.130	11.130	11.130	0.0000	0.0000
35	2.4593E-03	8.2936E-04	32.355	15.385	96.752	33.612	12.982	4.3780	0.7365	7.1435E+06	7.1435E+06



18	0.9219	1.0000
19	0.9219	1.0000
20	0.9219	1.0000
21	0.9219	1.0000
22	0.9219	1.0000
23	0.9219	1.0000
24	0.9219	1.0000
25	0.9219	1.0000
26	0.9212	1.0000
27	0.8843	1.0000
28	0.8712	1.0000
29	0.8997	1.0000
30	0.9007	1.0000
31	0.9623	1.0000
32	0.9618	1.0000
33	0.7489	1.0000
34	0.7443	1.0000
35	0.7477	1.0000
36	0.9618	1.0000
37	0.7489	1.0000
38	0.7443	1.0000
39	0.7669	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS	HOR. LOAD Y,KIPS	HOR. LOAD Z,KIPS
1281.55	-368.920	-103.810
MOMENT X ,KIP-IN	MOMENT Y,KIP-IN	MOMENT Z,KIP-IN
0.00000	3426.36	24914.0

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN                      HORIZONTAL Y,IN                      HORIZONTAL Z,IN  
 7.36716E-03                      -1.02522                      -0.26465  
  
 ANGLE ROT. X,RAD                      ANGLE ROT. Y,RAD                      ANGLE ROT. Z,RAD  
 5.18030E-04                      -2.43631E-06                      4.50033E-05

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

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 \* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****	*****
1	7.1456E-03	-1.1279	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
2	7.2333E-03	-1.1093	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
3	7.3210E-03	-1.0906	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
4	7.4087E-03	-1.0720	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
5	7.4964E-03	-1.0533	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
6	7.5841E-03	-1.0347	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
7	7.6718E-03	-1.0160	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
8	7.7595E-03	-0.9974	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
9	7.8472E-03	-0.9787	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
10	7.9349E-03	-0.9601	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
11	8.0226E-03	-0.9414	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
12	8.1103E-03	-0.9228	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
13	8.5839E-03	-0.9001	-0.2719	5.1803E-04	-2.4363E-06	4.5003E-05
14	9.2519E-03	-0.8827	-0.2786	5.1803E-04	-2.4363E-06	4.5003E-05
15	9.9198E-03	-0.8653	-0.2854	5.1803E-04	-2.4363E-06	4.5003E-05
16	3.9158E-03	-1.1257	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
17	4.0035E-03	-1.1071	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
18	4.0912E-03	-1.0884	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
19	4.1789E-03	-1.0698	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
20	4.2666E-03	-1.0511	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
21	4.3543E-03	-1.0325	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
22	4.4420E-03	-1.0138	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
23	4.5297E-03	-0.9952	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
24	4.6175E-03	-0.9765	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
25	4.7051E-03	-0.9579	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
26	4.7929E-03	-0.9392	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
27	4.8806E-03	-0.9206	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05

28	4.9587E-03	-0.9040	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
29	5.6266E-03	-0.8866	-0.2371	5.1803E-04	-2.4363E-06	4.5003E-05
30	6.2947E-03	-0.8692	-0.2439	5.1803E-04	-2.4363E-06	4.5003E-05
31	6.9626E-03	-0.8518	-0.2506	5.1803E-04	-2.4363E-06	4.5003E-05
32	0.013731	-1.0999	-0.3419	5.1803E-04	-2.4363E-06	4.5003E-05
33	0.012119	-1.0987	-0.3233	5.1803E-04	-2.4363E-06	4.5003E-05
34	0.010507	-1.0976	-0.3047	5.1803E-04	-2.4363E-06	4.5003E-05
35	8.8949E-03	-1.0965	-0.2861	5.1803E-04	-2.4363E-06	4.5003E-05
36	0.013271	-1.1464	-0.3392	5.1803E-04	-2.4363E-06	4.5003E-05
37	0.011659	-1.1453	-0.3205	5.1803E-04	-2.4363E-06	4.5003E-05
38	0.010047	-1.1442	-0.3019	5.1803E-04	-2.4363E-06	4.5003E-05
39	8.4346E-03	-1.1431	-0.2833	5.1803E-04	-2.4363E-06	4.5003E-05
MINIMUM	3.9158E-03	-1.1464	-0.3419	5.1803E-04	-2.4363E-06	4.5003E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.013731	-0.8518	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	32.179	-10.360	-2.6787	0.0000	0.0000	0.0000
2	32.574	-10.095	-2.6541	0.0000	0.0000	0.0000
3	32.969	-9.7670	-2.6120	0.0000	0.0000	0.0000
4	33.364	-9.9683	-2.7056	0.0000	0.0000	0.0000
5	33.759	-9.8435	-2.7173	0.0000	0.0000	0.0000
6	34.154	-9.6789	-2.7188	0.0000	0.0000	0.0000
7	34.549	-9.5139	-2.7205	0.0000	0.0000	0.0000
8	34.944	-9.3489	-2.7221	0.0000	0.0000	1.2489E-10
9	35.339	-9.1839	-2.7239	0.0000	0.0000	0.0000
10	35.734	-9.0185	-2.7259	0.0000	0.0000	0.0000
11	36.129	-8.8537	-2.7279	0.0000	0.0000	0.0000
12	36.524	-8.7277	-2.7412	0.0000	0.0000	0.0000
13	38.657	-8.4819	-2.7680	0.0000	0.0000	0.0000
14	41.665	-8.2630	-2.8087	0.0000	0.0000	0.0000
15	44.673	-8.1737	-2.8909	0.0000	0.0000	0.0000
16	17.634	-10.684	-2.4277	0.0000	0.0000	0.0000
17	18.029	-10.463	-2.4179	0.0000	0.0000	0.0000
18	18.424	-10.301	-2.4200	0.0000	0.0000	0.0000
19	18.819	-10.133	-2.4214	0.0000	0.0000	0.0000

20	19.214	-9.9659	-2.4228	0.0000	0.0000	0.0000	0.0000	0.0000
21	19.609	-9.7989	-2.4243	0.0000	0.0000	0.0000	0.0000	0.0000
22	20.004	-9.6314	-2.4258	0.0000	0.0000	0.0000	0.0000	0.0000
23	20.399	-9.4641	-2.4273	0.0000	0.0000	0.0000	-1.2489E-10	0.0000
24	20.794	-9.2965	-2.4290	0.0000	0.0000	0.0000	1.2489E-10	0.0000
25	21.189	-9.1290	-2.4306	0.0000	0.0000	0.0000	0.0000	0.0000
26	21.584	-8.9604	-2.4321	0.0000	0.0000	0.0000	0.0000	0.0000
27	21.979	-8.7369	-2.4199	0.0000	0.0000	0.0000	0.0000	0.0000
28	22.331	-8.5683	-2.4164	0.0000	0.0000	0.0000	0.0000	0.0000
29	25.339	-8.4322	-2.4832	0.0000	0.0000	0.0000	0.0000	0.0000
30	28.347	-8.2553	-2.5390	-1.9118E-27	3.1222E-11	3.1222E-11	0.0000	0.0000
31	31.356	-8.1639	-2.6195	-1.9118E-27	3.1222E-11	3.1222E-11	0.0000	0.0000
32	61.836	-9.9965	-3.2830	0.0000	0.0000	0.0000	0.0000	0.0000
33	54.576	-9.6107	-3.0103	0.0000	0.0000	0.0000	0.0000	0.0000
34	47.317	-9.6699	-2.8770	0.0000	0.0000	0.0000	0.0000	0.0000
35	40.057	-9.7478	-2.7470	0.0000	0.0000	0.0000	0.0000	0.0000
36	59.763	-10.397	-3.2557	0.0000	0.0000	0.0000	0.0000	0.0000
37	52.504	-9.9945	-2.9832	0.0000	0.0000	0.0000	0.0000	0.0000
38	45.244	-10.056	-2.8498	0.0000	0.0000	0.0000	0.0000	0.0000
39	37.984	-10.184	-2.7317	0.0000	0.0000	0.0000	0.0000	0.0000
MINIMUM	17.634	-10.684	-3.2830	-1.9118E-27	0.0000	0.0000	-1.2489E-10	0.0000
Pile N.	16	16	32	30	1	1	23	23
MAXIMUM	61.836	-8.1639	-2.4164	0.0000	0.0000	3.1222E-11	1.2489E-10	0.0000
Pile N.	32	31	28	1	30	8	8	8

THE PILE COORDINATE SYSTEM (LOCAL AXES)

\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
1	7.1456E-03	-1.1279	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
2	7.2333E-03	-1.1093	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
3	7.3210E-03	-1.0906	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
4	7.4087E-03	-1.0720	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
5	7.4964E-03	-1.0533	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
6	7.5841E-03	-1.0347	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
7	7.6718E-03	-1.0160	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05

8	7.7595E-03	-0.9974	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
9	7.8472E-03	-0.9787	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
10	7.9349E-03	-0.9601	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
11	8.0226E-03	-0.9414	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
12	8.1103E-03	-0.9228	-0.2677	5.1803E-04	-2.4363E-06	4.5003E-05
13	8.5839E-03	-0.9001	-0.2719	5.1803E-04	-2.4363E-06	4.5003E-05
14	9.2519E-03	-0.8827	-0.2786	5.1803E-04	-2.4363E-06	4.5003E-05
15	9.9198E-03	-0.8653	-0.2854	5.1803E-04	-2.4363E-06	4.5003E-05
16	3.9158E-03	-1.1257	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
17	4.0035E-03	-1.1071	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
18	4.0912E-03	-1.0884	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
19	4.1789E-03	-1.0698	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
20	4.2666E-03	-1.0511	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
21	4.3543E-03	-1.0325	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
22	4.4420E-03	-1.0138	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
23	4.5297E-03	-0.9952	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
24	4.6175E-03	-0.9765	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
25	4.7051E-03	-0.9579	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
26	4.7929E-03	-0.9392	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
27	4.8806E-03	-0.9206	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
28	4.9587E-03	-0.9040	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
29	5.6266E-03	-0.8866	-0.2371	5.1803E-04	-2.4363E-06	4.5003E-05
30	6.2947E-03	-0.8692	-0.2439	5.1803E-04	-2.4363E-06	4.5003E-05
31	6.9626E-03	-0.8518	-0.2506	5.1803E-04	-2.4363E-06	4.5003E-05
32	0.013731	-1.0999	-0.3419	5.1803E-04	-2.4363E-06	4.5003E-05
33	0.012119	-1.0987	-0.3233	5.1803E-04	-2.4363E-06	4.5003E-05
34	0.010507	-1.0976	-0.3047	5.1803E-04	-2.4363E-06	4.5003E-05
35	8.8949E-03	-1.0965	-0.2861	5.1803E-04	-2.4363E-06	4.5003E-05
36	0.013271	-1.1464	-0.3392	5.1803E-04	-2.4363E-06	4.5003E-05
37	0.011659	-1.1453	-0.3205	5.1803E-04	-2.4363E-06	4.5003E-05
38	0.010047	-1.1442	-0.3019	5.1803E-04	-2.4363E-06	4.5003E-05
39	8.4346E-03	-1.1431	-0.2833	5.1803E-04	-2.4363E-06	4.5003E-05
MINIMUM	3.9158E-03	-1.1464	-0.3419	5.1803E-04	-2.4363E-06	4.5003E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.013731	-0.8518	-0.2304	5.1803E-04	-2.4363E-06	4.5003E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP AXIAL,KIP LAT. y,KIP LAT. z,KIP MOM x,KIP-IN MOM y,KIP-IN MOM z,KIP-IN



MINIMUM	17.634	-10.684	-3.2830	0.0000	0.0000	-1.2489E-10
Pile N.	16	16	32	1	1	23
MAXIMUM	61.836	-8.1639	-2.4164	0.0000	3.1222E-11	1.2489E-10
Pile N.	32	31	28	1	30	8

PILE GROUP STRESS, KIP/IN\*\*2  
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1	0.3629
2	0.3674
3	0.3718
4	0.3763
5	0.3807
6	0.3852
7	0.3897
8	0.3941
9	0.3986
10	0.4030
11	0.4075
12	0.4119
13	0.4360
14	0.4699
15	0.5038
16	0.1989
17	0.2033
18	0.2078
19	0.2122
20	0.2167
21	0.2212
22	0.2256
23	0.2301
24	0.2345
25	0.2390
26	0.2434
27	0.2479
28	0.2519
29	0.2858
30	0.3197
31	0.3536
32	0.6974
33	0.6155
34	0.5337



12	-0.9228	-0.2677	-849.67	-270.23	-8.7277	-2.7412	-22.280	-6.5949	0.4119	4.2671E+05	1.3727E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130
13	-0.9001	-0.2719	-828.96	-273.77	-8.4819	-2.7680	-21.600	-6.6401	0.4360	4.2638E+05	1.3653E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	0.2100	10.080	10.080	0.0000	11.130	11.130
14	-0.8827	-0.2786	-813.82	-279.63	-8.2630	-2.8087	-21.008	-6.7439	0.4699	4.2991E+05	1.2412E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
15	-0.8653	-0.2854	-793.69	-283.81	-8.1737	-2.8909	-20.843	-6.9560	0.5038	4.2097E+05	1.3707E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
16	-1.1257	-0.2304	-1045.3	-241.64	-10.684	-2.4277	-27.565	-5.8903	0.1989	4.2199E+05	1.3784E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.8400	10.080	10.080	0.0000	11.130	11.130
17	-1.1071	-0.2304	-1028.5	-241.73	-10.463	-2.4179	-26.715	-5.7955	0.2033	4.2131E+05	1.3777E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	2.1000	10.080	10.080	0.0000	11.130	11.130
18	-1.0884	-0.2304	-1011.3	-241.65	-10.301	-2.4200	-26.454	-5.8397	0.2078	4.2211E+05	1.3779E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.2100	10.080	10.080	0.0000	11.130	11.130
19	-1.0698	-0.2304	-993.46	-241.45	-10.133	-2.4214	-25.969	-5.8329	0.2122	4.2332E+05	1.3779E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130
20	-1.0511	-0.2304	-975.62	-241.26	-9.9659	-2.4228	-25.487	-5.8265	0.2167	4.2469E+05	1.3778E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	1.2600	10.080	10.080	0.0000	11.130	11.130
21	-1.0325	-0.2304	-957.78	-241.04	-9.7989	-2.4243	-25.002	-5.8189	0.2212	4.2525E+05	1.3779E+06
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
22	-1.0138	-0.2304	-939.93	-240.83	-9.6314	-2.4258	-24.518	-5.8113	0.2256	4.2579E+05	1.3779E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	2.3100	10.080	10.080	0.0000	11.130	11.130
23	-0.9952	-0.2304	-922.11	-240.60	-9.4641	-2.4273	-24.032	-5.8036	0.2301	4.2791E+05	1.3780E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	3.3600	10.080	10.080	0.0000	11.130	11.130
24	-0.9765	-0.2304	-904.29	-240.40	-9.2965	-2.4290	-23.554	-5.7969	0.2345	4.2860E+05	1.3773E+06
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
25	-0.9579	-0.2304	-886.47	-240.16	-9.1290	-2.4306	-23.074	-5.7887	0.2390	4.2914E+05	1.3776E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.4200	10.080	10.080	0.0000	11.130	11.130
26	-0.9392	-0.2304	-868.70	-239.94	-8.9604	-2.4321	-22.588	-5.7792	0.2434	4.3115E+05	1.3778E+06
x(FT)	0.0000	0.0000	10.080	10.080	8.7369	0.2100	10.080	10.080	0.0000	11.130	11.130
27	-0.9206	-0.2304	-852.79	-240.25	-8.7369	-2.4199	-21.928	-5.7138	0.2479	4.2899E+05	1.3762E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.2100	3.3600	10.080	10.080	0.0000	11.130	11.130
28	-0.9040	-0.2304	-837.58	-240.23	-8.5683	-2.4164	-21.440	-5.6854	0.2519	4.2905E+05	1.3758E+06
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
29	-0.8866	-0.2371	-819.29	-245.24	-8.4322	-2.4832	-21.131	-5.8602	0.2858	4.3165E+05	1.3763E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.4700	0.2100	10.080	10.080	0.0000	11.130	11.130
30	-0.8692	-0.2439	-802.44	-250.61	-8.2553	-2.5390	-20.691	-5.9900	0.3197	4.2820E+05	1.3753E+06
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	1.0500	10.080	10.080	0.0000	11.130	11.130
31	-0.8518	-0.2506	-782.26	-254.87	-8.1639	-2.6195	-20.517	-6.2131	0.3536	4.2111E+05	1.3775E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	0.0000	10.080	10.080	0.0000	11.130	11.130
32	-1.0999	-0.3419	-1014.6	-335.21	-9.9965	-3.2830	-26.773	-8.3807	0.6974	4.2498E+05	1.0294E+06

x(FT)	0.0000	0.0000	10.080	10.080	2.7300	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130
33	-1.0987	-0.3233	-1012.5	-318.65	-3.0103	-21.611	-6.5551	0.6155	4.0763E+05	5.3310E+05	0.0000	11.130	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130
34	-1.0976	-0.3047	-1012.4	-303.01	-2.8770	-21.574	-6.1937	0.5337	4.0727E+05	5.6406E+05	0.0000	11.130	11.130
x(FT)	0.0000	0.0000	10.080	10.080	2.7300	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130
35	-1.0965	-0.2861	-1012.6	-287.51	-2.7470	-21.745	-5.8811	0.4518	4.0770E+05	6.1548E+05	0.0000	11.130	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130
36	-1.1464	-0.3392	-1057.2	-333.12	-3.2557	-27.364	-8.1328	0.6740	4.2158E+05	1.1065E+06	0.0000	11.130	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130
37	-1.1453	-0.3205	-1054.0	-316.17	-2.9832	-21.795	-6.2944	0.5922	4.0458E+05	5.2928E+05	0.0000	11.130	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130
38	-1.1442	-0.3019	-1053.9	-300.50	-2.8498	-21.751	-5.9447	0.5103	4.0432E+05	5.5532E+05	0.0000	11.130	11.130
x(FT)	0.0000	0.0000	10.080	10.080	2.1000	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130
39	-1.1431	-0.2833	-1054.8	-285.19	-2.7317	-22.432	-5.7628	0.4284	4.0615E+05	6.3490E+05	0.0000	11.130	11.130
x(FT)	0.0000	0.0000	10.080	10.080	1.2600	10.080	10.080	0.0000	11.130	11.130	0.0000	11.130	11.130
Min.	-1.1464	-0.3419	-1057.2	-335.21	-3.2830	-27.565	-8.3807	0.1989	4.0432E+05	5.2928E+05	0.0000	11.130	11.130
Pile N.	36	32	36	32	32	16	32	16	38	38	16	38	37

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.	
	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	KIP-IN**2	STRESS	z-DIR	y-DIR
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1	1.9150E-03	3.9376E-04	30.546	6.9639	22.525	11.626	2.3904	0.5058	7.1435E+06	7.1435E+06	0.5058	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
2	2.0057E-03	4.4417E-04	30.054	7.8663	22.608	11.495	2.5456	0.5120	7.1435E+06	7.1435E+06	0.5120	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
3	2.1842E-03	5.2333E-04	30.423	9.1209	22.577	11.364	2.7227	0.5182	7.1435E+06	7.1435E+06	0.5182	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
4	1.6952E-03	3.7575E-04	32.588	6.8959	22.811	10.716	2.3753	0.5244	7.1435E+06	7.1435E+06	0.5244	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
5	1.6183E-03	3.6704E-04	32.004	6.8592	22.872	10.506	2.3828	0.5307	7.1435E+06	7.1435E+06	0.5307	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
6	1.5858E-03	3.6664E-04	32.037	6.8518	22.850	10.295	2.3802	0.5369	7.1435E+06	7.1435E+06	0.5369	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
7	1.5538E-03	3.6625E-04	31.942	6.8447	22.829	10.087	2.3777	0.5431	7.1435E+06	7.1435E+06	0.5431	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000
8	1.5226E-03	3.6586E-04	31.416	6.8376	22.808	9.8844	2.3751	0.5493	7.1435E+06	7.1435E+06	0.5493	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000

9	1.4929E-03	3.6545E-04	30.812	6.8302	81.175	22.786	9.6919	2.3725	0.5555	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
10	1.4634E-03	3.6662E-04	30.169	6.8652	79.574	22.788	9.5005	2.3801	0.5617	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
11	1.4321E-03	3.6556E-04	29.551	6.8409	77.951	22.758	9.2995	2.3738	0.5679	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
12	1.3647E-03	3.5525E-04	28.899	6.7678	76.539	22.798	9.1204	2.3741	0.5741	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
13	1.3587E-03	3.6640E-04	28.265	6.8895	74.464	23.020	8.8916	2.3978	0.6076	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
14	1.3728E-03	3.9108E-04	28.092	7.2761	72.766	23.489	8.7045	2.4797	0.6549	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
15	1.2608E-03	3.6870E-04	27.124	7.0896	71.643	24.022	8.5406	2.4975	0.7022	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
16	1.6996E-03	3.1906E-04	33.021	6.0575	94.291	20.346	11.322	2.1254	0.2772	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
17	1.7298E-03	3.2799E-04	32.291	6.0929	92.374	20.227	11.164	2.1167	0.2834	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
18	1.6903E-03	3.2725E-04	32.981	6.0850	90.821	20.234	10.909	2.1120	0.2896	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
19	1.6590E-03	3.2696E-04	32.513	6.0798	89.194	20.218	10.706	2.1101	0.2958	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
20	1.6280E-03	3.2668E-04	31.941	6.0749	87.572	20.203	10.507	2.1083	0.3020	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
21	1.5954E-03	3.2636E-04	31.969	6.0691	85.953	20.185	10.296	2.1062	0.3082	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.550	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
22	1.5630E-03	3.2604E-04	31.924	6.0634	84.332	20.167	10.087	2.1041	0.3145	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
23	1.5314E-03	3.2572E-04	31.521	6.0576	82.700	20.149	9.8834	2.1020	0.3207	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
24	1.5023E-03	3.2544E-04	30.610	6.0529	81.090	20.133	9.6955	2.1003	0.3269	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
25	1.4716E-03	3.2509E-04	30.254	6.0465	79.476	20.114	9.4969	2.0980	0.3331	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
26	1.4419E-03	3.2496E-04	29.673	6.0410	77.849	20.093	9.2981	2.0954	0.3393	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
27	1.4726E-03	3.3627E-04	29.817	6.0768	76.017	19.971	9.1157	2.0817	0.3455	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
28	1.4667E-03	3.4028E-04	29.519	6.0836	74.503	19.915	8.9443	2.0751	0.3510	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
29	1.3902E-03	3.3845E-04	28.357	6.1923	73.170	20.454	8.7555	2.1315	0.3983	7.1435E+06	7.1435E+06

x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
30	1.3620E-03	3.4549E-04	27.815	20.909	8.5872	2.1783	0.4456	7.1435E+06	7.1435E+06	0.4456	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
31	1.2495E-03	3.3276E-04	26.748	21.523	8.4169	2.2416	0.4929	7.1435E+06	7.1435E+06	0.4929	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.2100
32	1.6243E-03	4.6155E-04	33.130	28.770	10.936	3.1076	0.9720	7.1435E+06	7.1435E+06	0.9720	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.2100
33	2.1838E-03	6.4588E-04	30.443	26.964	11.448	3.3859	0.8579	7.1435E+06	7.1435E+06	0.8579	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
34	2.1965E-03	6.1020E-04	30.469	25.507	11.444	3.1792	0.7438	7.1435E+06	7.1435E+06	0.7438	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
35	2.1840E-03	5.6541E-04	30.441	24.073	11.431	2.9592	0.6297	7.1435E+06	7.1435E+06	0.6297	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
36	1.7152E-03	4.5497E-04	32.987	28.454	11.548	3.0632	0.9394	7.1435E+06	7.1435E+06	0.9394	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.2100
37	2.3002E-03	6.4714E-04	31.138	26.813	12.058	3.3925	0.8253	7.1435E+06	7.1435E+06	0.8253	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.2100
38	2.3135E-03	6.1218E-04	31.210	25.411	12.054	3.1895	0.7112	7.1435E+06	7.1435E+06	0.7112	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.710	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.2100
39	2.2403E-03	5.4797E-04	30.773	23.906	12.027	2.9417	0.5971	7.1435E+06	7.1435E+06	0.5971	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000
Max.	2.3135E-03	6.4714E-04	33.130	28.770	12.058	3.3925	0.9720	7.1435E+06	7.1435E+06	0.9720	7.1435E+06	7.1435E+06
Pile N.	38	37	32	32	37	37	32	37	37	32	1	1

LOAD CASE : 7

CASE NAME : Extreme II

LOAD TYPE : Dead, DL

REDUCTION FACTORS FOR CLOSELY-SPACED PILE GROUPS, COMBINED Y AND Z DIRECTIONS  
ESTIMATED USING MOVEMENT IN THE DIRECTION OF PILE CAP DISPLACEMENTS

GROUP NO	P-FACTOR	Y-FACTOR
1	0.7942	1.0000
2	0.7387	1.0000
3	0.7250	1.0000
4	0.7966	1.0000
5	0.8068	1.0000

6	0.8068	1.0000
7	0.8068	1.0000
8	0.8068	1.0000
9	0.8068	1.0000
10	0.8068	1.0000
11	0.8097	1.0000
12	0.8609	1.0000
13	0.8443	1.0000
14	0.8177	1.0000
15	0.9638	1.0000
16	0.8337	1.0000
17	0.8045	1.0000
18	0.8045	1.0000
19	0.8045	1.0000
20	0.8045	1.0000
21	0.8045	1.0000
22	0.8045	1.0000
23	0.8045	1.0000
24	0.8045	1.0000
25	0.8045	1.0000
26	0.7954	1.0000
27	0.7604	1.0000
28	0.7877	1.0000
29	0.8130	1.0000
30	0.8161	1.0000
31	0.9624	1.0000
32	0.9660	1.0000
33	0.8742	1.0000
34	0.8727	1.0000
35	0.8400	1.0000
36	0.9660	1.0000
37	0.8742	1.0000
38	0.8727	1.0000
39	0.8401	1.0000

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

VERT. LOAD,KIPS      HOR. LOAD Y,KIPS      HOR. LOAD Z,KIPS  
 478.060              -97.2500              -129.940  
 MOMENT X ,KIP-IN    MOMENT Y,KIP-IN    MOMENT Z,KIP-IN  
 0.00000              7798.80              5406.96

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

VERTICAL ,IN                      HORIZONTAL Y,IN                      HORIZONTAL Z,IN  
 2.76028E-03                      -0.22364                      -0.31056  
 ANGLE ROT. X,RAD                  ANGLE ROT. Y,RAD                  ANGLE ROT. Z,RAD  
 1.27519E-04                      1.46790E-06                      8.18058E-06

THE GLOBAL STRUCTURAL COORDINATE SYSTEM

-----  
 \* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	3.0989E-03	-0.2489	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
2	3.0460E-03	-0.2443	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
3	2.9932E-03	-0.2397	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
4	2.9403E-03	-0.2352	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
5	2.8875E-03	-0.2306	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
6	2.8347E-03	-0.2260	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
7	2.7818E-03	-0.2214	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
8	2.7290E-03	-0.2168	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
9	2.6761E-03	-0.2122	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
10	2.6233E-03	-0.2076	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
11	2.5704E-03	-0.2030	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
12	2.5176E-03	-0.1984	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
13	2.5198E-03	-0.1928	-0.3123	1.2752E-04	1.4679E-06	8.1806E-06
14	2.5771E-03	-0.1886	-0.3140	1.2752E-04	1.4679E-06	8.1806E-06
15	2.6344E-03	-0.1843	-0.3157	1.2752E-04	1.4679E-06	8.1806E-06

16	2.5036E-03	-0.2484	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
17	2.4507E-03	-0.2438	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
18	2.3979E-03	-0.2392	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
19	2.3450E-03	-0.2346	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
20	2.2922E-03	-0.2300	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
21	2.2393E-03	-0.2254	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
22	2.1865E-03	-0.2208	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
23	2.1337E-03	-0.2162	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
24	2.0808E-03	-0.2117	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
25	2.0280E-03	-0.2071	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
26	1.9751E-03	-0.2025	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
27	1.9223E-03	-0.1979	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
28	1.8752E-03	-0.1938	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
29	1.9325E-03	-0.1895	-0.3038	1.2752E-04	1.4679E-06	8.1806E-06
30	1.9898E-03	-0.1852	-0.3054	1.2752E-04	1.4679E-06	8.1806E-06
31	2.0471E-03	-0.1809	-0.3071	1.2752E-04	1.4679E-06	8.1806E-06
32	4.1924E-03	-0.2420	-0.3296	1.2752E-04	1.4679E-06	8.1806E-06
33	3.8953E-03	-0.2417	-0.3250	1.2752E-04	1.4679E-06	8.1806E-06
34	3.5981E-03	-0.2415	-0.3204	1.2752E-04	1.4679E-06	8.1806E-06
35	3.3010E-03	-0.2412	-0.3158	1.2752E-04	1.4679E-06	8.1806E-06
36	4.2804E-03	-0.2535	-0.3289	1.2752E-04	1.4679E-06	8.1806E-06
37	3.9833E-03	-0.2532	-0.3243	1.2752E-04	1.4679E-06	8.1806E-06
38	3.6861E-03	-0.2529	-0.3197	1.2752E-04	1.4679E-06	8.1806E-06
39	3.3890E-03	-0.2526	-0.3151	1.2752E-04	1.4679E-06	8.1806E-06
MINIMUM	1.8752E-03	-0.2535	-0.3296	1.2752E-04	1.4679E-06	8.1806E-06
Pile N.	28	36	32	1	1	1
MAXIMUM	4.2804E-03	-0.1809	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
Pile N.	36	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1	13.955	-2.7176	-3.2978	0.0000	0.0000	-3.1222E-11
2	13.718	-2.6435	-3.2566	0.0000	0.0000	3.1222E-11
3	13.480	-2.5945	-3.2482	0.0000	0.0000	0.0000
4	13.242	-2.5965	-3.3079	0.0000	0.0000	0.0000
5	13.004	-2.5618	-3.3187	0.0000	0.0000	0.0000
6	12.766	-2.5208	-3.3214	0.0000	0.0000	0.0000
7	12.528	-2.4796	-3.3242	0.0000	0.0000	0.0000

8	12.290	-2.4379	-3.3270	0.0000	0.0000	0.0000	0.0000
9	12.052	-2.3961	-3.3297	0.0000	0.0000	0.0000	0.0000
10	11.814	-2.3539	-3.3325	0.0000	0.0000	0.0000	0.0000
11	11.576	-2.3129	-3.3376	0.0000	0.0000	0.0000	0.0000
12	11.338	-2.2963	-3.3801	0.0000	0.0000	0.0000	0.0000
13	11.348	-2.2341	-3.3792	0.0000	0.0000	0.0000	0.0000
14	11.606	-2.1776	-3.3741	0.0000	0.0000	0.0000	0.0000
15	11.864	-2.2021	-3.5003	0.0000	0.0000	0.0000	0.0000
16	11.275	-2.7469	-3.2547	0.0000	0.0000	-3.1222E-11	0.0000
17	11.037	-2.6882	-3.2356	0.0000	0.0000	0.0000	0.0000
18	10.799	-2.6469	-3.2384	0.0000	0.0000	0.0000	0.0000
19	10.561	-2.6063	-3.2412	0.0000	0.0000	0.0000	0.0000
20	10.323	-2.5656	-3.2440	0.0000	0.0000	0.0000	0.0000
21	10.085	-2.5245	-3.2468	0.0000	0.0000	0.0000	0.0000
22	9.8467	-2.4831	-3.2496	0.0000	0.0000	0.0000	0.0000
23	9.6087	-2.4413	-3.2524	0.0000	0.0000	0.0000	0.0000
24	9.3707	-2.3993	-3.2552	0.0000	0.0000	0.0000	0.0000
25	9.1327	-2.3570	-3.2580	0.0000	0.0000	0.0000	0.0000
26	8.8948	-2.3095	-3.2536	0.0000	0.0000	0.0000	0.0000
27	8.6568	-2.2483	-3.2285	0.0000	0.0000	0.0000	0.0000
28	8.4447	-2.2246	-3.2528	0.0000	0.0000	0.0000	0.0000
29	8.7027	-2.1945	-3.2885	0.0000	0.0000	0.0000	0.0000
30	8.9608	-2.1522	-3.3068	0.0000	0.0000	0.0000	0.0000
31	9.2189	-2.1766	-3.4309	0.0000	0.0000	0.0000	0.0000
32	18.880	-2.7313	-3.5774	0.0000	0.0000	0.0000	0.0000
33	17.542	-2.6840	-3.4729	0.0000	0.0000	0.0000	0.0000
34	16.204	-2.6859	-3.4353	0.0000	0.0000	0.0000	0.0000
35	14.866	-2.6700	-3.3739	0.0000	0.0000	0.0000	0.0000
36	19.276	-2.8371	-3.5643	0.0000	0.0000	0.0000	0.0000
37	17.938	-2.7879	-3.4603	0.0000	0.0000	0.0000	0.0000
38	16.600	-2.7899	-3.4227	0.0000	0.0000	-3.1222E-11	0.0000
39	15.262	-2.7736	-3.3615	0.0000	0.0000	0.0000	0.0000
MINIMUM	8.4447	-2.8371	-3.5774	0.0000	0.0000	-3.1222E-11	0.0000
Pile N.	28	36	32	1	1	1	1
MAXIMUM	19.276	-2.1522	-3.2285	0.0000	0.0000	3.1222E-11	2
Pile N.	36	30	27	1	1	2	2

THE PILE COORDINATE SYSTEM (LOCAL AXES)

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\* PILE TOP DISPLACEMENTS \*

PILE GROUP	DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
1	3.0989E-03	-0.2489	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
2	3.0460E-03	-0.2443	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
3	2.9932E-03	-0.2397	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
4	2.9403E-03	-0.2352	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
5	2.8875E-03	-0.2306	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
6	2.8347E-03	-0.2260	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
7	2.7818E-03	-0.2214	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
8	2.7290E-03	-0.2168	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
9	2.6761E-03	-0.2122	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
10	2.6233E-03	-0.2076	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
11	2.5704E-03	-0.2030	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
12	2.5176E-03	-0.1984	-0.3113	1.2752E-04	1.4679E-06	8.1806E-06
13	2.5198E-03	-0.1928	-0.3123	1.2752E-04	1.4679E-06	8.1806E-06
14	2.5771E-03	-0.1886	-0.3140	1.2752E-04	1.4679E-06	8.1806E-06
15	2.6344E-03	-0.1843	-0.3157	1.2752E-04	1.4679E-06	8.1806E-06
16	2.5036E-03	-0.2484	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
17	2.4507E-03	-0.2438	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
18	2.3979E-03	-0.2392	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
19	2.3450E-03	-0.2346	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
20	2.2922E-03	-0.2300	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
21	2.2393E-03	-0.2254	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
22	2.1865E-03	-0.2208	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
23	2.1337E-03	-0.2162	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
24	2.0808E-03	-0.2117	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
25	2.0280E-03	-0.2071	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
26	1.9751E-03	-0.2025	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
27	1.9223E-03	-0.1979	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
28	1.8752E-03	-0.1938	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
29	1.9325E-03	-0.1895	-0.3038	1.2752E-04	1.4679E-06	8.1806E-06
30	1.9898E-03	-0.1852	-0.3054	1.2752E-04	1.4679E-06	8.1806E-06
31	2.0471E-03	-0.1809	-0.3071	1.2752E-04	1.4679E-06	8.1806E-06
32	4.1924E-03	-0.2420	-0.3296	1.2752E-04	1.4679E-06	8.1806E-06
33	3.8953E-03	-0.2417	-0.3250	1.2752E-04	1.4679E-06	8.1806E-06
34	3.5981E-03	-0.2415	-0.3204	1.2752E-04	1.4679E-06	8.1806E-06
35	3.3010E-03	-0.2412	-0.3158	1.2752E-04	1.4679E-06	8.1806E-06
36	4.2804E-03	-0.2535	-0.3289	1.2752E-04	1.4679E-06	8.1806E-06

37	3.9833E-03	-0.2532	-0.3243	1.2752E-04	1.4679E-06	8.1806E-06
38	3.6861E-03	-0.2529	-0.3197	1.2752E-04	1.4679E-06	8.1806E-06
39	3.3890E-03	-0.2526	-0.3151	1.2752E-04	1.4679E-06	8.1806E-06
MINIMUM	1.8752E-03	-0.2535	-0.3296	1.2752E-04	1.4679E-06	8.1806E-06
Pile N.	28	36	32	1	1	1
MAXIMUM	4.2804E-03	-0.1809	-0.3021	1.2752E-04	1.4679E-06	8.1806E-06
Pile N.	36	31	16	1	1	1

\* PILE TOP REACTIONS \*

PILE GROUP	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
*****	*****	*****	*****	*****	*****	*****
1	13.955	-2.7176	-3.2978	0.0000	0.0000	-3.1222E-11
2	13.718	-2.6435	-3.2566	0.0000	0.0000	3.1222E-11
3	13.480	-2.5945	-3.2482	0.0000	0.0000	0.0000
4	13.242	-2.5965	-3.3079	0.0000	0.0000	0.0000
5	13.004	-2.5618	-3.3187	0.0000	0.0000	0.0000
6	12.766	-2.5208	-3.3214	0.0000	0.0000	0.0000
7	12.528	-2.4796	-3.3242	0.0000	0.0000	0.0000
8	12.290	-2.4379	-3.3270	0.0000	0.0000	0.0000
9	12.052	-2.3961	-3.3297	0.0000	0.0000	0.0000
10	11.814	-2.3539	-3.3325	0.0000	0.0000	0.0000
11	11.576	-2.3129	-3.3376	0.0000	0.0000	0.0000
12	11.338	-2.2963	-3.3801	0.0000	0.0000	0.0000
13	11.348	-2.2341	-3.3792	0.0000	0.0000	0.0000
14	11.606	-2.1776	-3.3741	0.0000	0.0000	0.0000
15	11.864	-2.2021	-3.5003	0.0000	0.0000	0.0000
16	11.275	-2.7469	-3.2547	0.0000	0.0000	-3.1222E-11
17	11.037	-2.6882	-3.2356	0.0000	0.0000	0.0000
18	10.799	-2.6469	-3.2384	0.0000	0.0000	0.0000
19	10.561	-2.6063	-3.2412	0.0000	0.0000	0.0000
20	10.323	-2.5656	-3.2440	0.0000	0.0000	0.0000
21	10.085	-2.5245	-3.2468	0.0000	0.0000	0.0000
22	9.8467	-2.4831	-3.2496	0.0000	0.0000	0.0000
23	9.6087	-2.4413	-3.2524	0.0000	0.0000	0.0000
24	9.3707	-2.3993	-3.2552	0.0000	0.0000	0.0000
25	9.1327	-2.3570	-3.2580	0.0000	0.0000	0.0000
26	8.8948	-2.3095	-3.2536	0.0000	0.0000	0.0000
27	8.6568	-2.2483	-3.2285	0.0000	0.0000	0.0000
28	8.4447	-2.2246	-3.2528	0.0000	0.0000	0.0000

29	8.7027	-2.1945	-3.2885	0.0000	0.0000	0.0000	0.0000
30	8.9608	-2.1522	-3.3068	0.0000	0.0000	0.0000	0.0000
31	9.2189	-2.1766	-3.4309	0.0000	0.0000	0.0000	0.0000
32	18.880	-2.7313	-3.5774	0.0000	0.0000	0.0000	0.0000
33	17.542	-2.6840	-3.4729	0.0000	0.0000	0.0000	0.0000
34	16.204	-2.6859	-3.4353	0.0000	0.0000	0.0000	0.0000
35	14.866	-2.6700	-3.3739	0.0000	0.0000	0.0000	0.0000
36	19.276	-2.8371	-3.5643	0.0000	0.0000	0.0000	0.0000
37	17.938	-2.7879	-3.4603	0.0000	0.0000	0.0000	0.0000
38	16.600	-2.7899	-3.4227	0.0000	0.0000	-3.1222E-11	0.0000
39	15.262	-2.7736	-3.3615	0.0000	0.0000	0.0000	0.0000
MINIMUM	8.4447	-2.8371	-3.5774	0.0000	0.0000	-3.1222E-11	0.0000
Pile N.	28	36	32	1	1	1	1
MAXIMUM	19.276	-2.1522	-3.2285	0.0000	0.0000	3.1222E-11	3.1222E-11
Pile N.	36	30	27	1	1	2	2

PILE GROUP \* STRESS, KIP/IN\*\*2  
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1	0.1574
2	0.1547
3	0.1520
4	0.1494
5	0.1467
6	0.1440
7	0.1413
8	0.1386
9	0.1359
10	0.1332
11	0.1306
12	0.1279
13	0.1280
14	0.1309
15	0.1338
16	0.1272
17	0.1245
18	0.1218
19	0.1191
20	0.1164
21	0.1137
22	0.1111

23 0.1084  
 24 0.1057  
 25 0.1030  
 26 0.1003  
 27 0.097636  
 28 0.095244  
 29 0.098154  
 30 0.1011  
 31 0.1040  
 32 0.2129  
 33 0.1978  
 34 0.1828  
 35 0.1677  
 36 0.2174  
 37 0.2023  
 38 0.1872  
 39 0.1721

MINIMUM 0.095244  
 Pile N. 28  
 MAXIMUM 0.2174  
 Pile N. 36

\* EFFECTS FOR Laterally Loaded Pile \*

\* MINIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SHEAR		SOIL REACT		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.	
	Y-DIR IN	Z-DIR IN	Y-DIR KIP-IN	Z-DIR KIP-IN	Y-DIR KIP	Z-DIR KIP	Y-DIR KIP/IN	Z-DIR KIP/IN	Y-DIR KIP/IN	Z-DIR KIP/IN	Y-DIR KIP/IN**2	Z-DIR KIP/IN**2	Y-DIR KIP/IN**2	Z-DIR KIP/IN**2	Y-DIR KIP/IN**2	Z-DIR KIP/IN**2	Y-DIR KIP/IN**2	Z-DIR KIP/IN**2
1	-0.2489	-0.3113	-245.06	-294.79	-2.7176	-3.2978	-5.5316	-6.8202	0.1574	1.3749E+06	8.9911E+05	1.3749E+06	8.9911E+05	0.0000	11.130	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.1547	1.3725E+06	7.3683E+05	1.3725E+06	7.3683E+05	0.0000	11.130	11.130	0.0000	11.130
2	-0.2443	-0.3113	-242.81	-296.29	-2.6435	-3.2566	-5.3675	-6.7879	0.1520	1.3727E+06	7.0962E+05	1.3727E+06	7.0962E+05	0.0000	11.130	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	1.8900	0.4200	10.080	10.080	0.1494	1.3761E+06	9.2215E+05	1.3761E+06	9.2215E+05	0.0000	11.130	11.130	0.0000	11.130
3	-0.2397	-0.3113	-239.30	-296.55	-2.5945	-3.2482	-5.2595	-6.7724	0.1467	1.3768E+06	9.7345E+05	1.3768E+06	9.7345E+05	0.0000	11.130	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	2.5200	10.080	10.080	0.1467	1.3768E+06	9.7345E+05	1.3768E+06	9.7345E+05	0.0000	11.130	11.130	0.0000	11.130
4	-0.2352	-0.3113	-233.58	-294.27	-2.5965	-3.3079	-5.2686	-6.8016	0.1467	1.3768E+06	9.7345E+05	1.3768E+06	9.7345E+05	0.0000	11.130	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.1467	1.3768E+06	9.7345E+05	1.3768E+06	9.7345E+05	0.0000	11.130	11.130	0.0000	11.130
5	-0.2306	-0.3113	-229.61	-293.80	-2.5618	-3.3187	-5.1937	-6.7958	0.1467	1.3768E+06	9.7345E+05	1.3768E+06	9.7345E+05	0.0000	11.130	11.130	0.0000	11.130
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.1467	1.3768E+06	9.7345E+05	1.3768E+06	9.7345E+05	0.0000	11.130	11.130	0.0000	11.130

6	-0.2260	-0.3113	-225.88	-293.65	-2.5208	-3.3214	-5.1069	-6.7902	0.1440	1.3771E+06	9.7512E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	3.1500	10.080	10.080	0.0000	11.130	11.130
7	-0.2214	-0.3113	-222.13	-293.49	-2.4796	-3.3242	-5.0200	-6.7845	0.1413	1.3775E+06	9.7678E+05
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	3.3600	10.080	10.080	0.0000	11.130	11.130
8	-0.2168	-0.3113	-218.36	-293.34	-2.4379	-3.3270	-4.9323	-6.7789	0.1386	1.3778E+06	9.7845E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
9	-0.2122	-0.3113	-214.57	-293.18	-2.3961	-3.3297	-4.8440	-6.7732	0.1359	1.3782E+06	9.8011E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130
10	-0.2076	-0.3113	-210.77	-293.02	-2.3539	-3.3325	-4.7557	-6.7676	0.1332	1.3786E+06	9.8176E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	3.3600	10.080	10.080	0.0000	11.130	11.130
11	-0.2030	-0.3113	-206.87	-292.77	-2.3129	-3.3376	-4.6703	-6.7632	0.1306	1.3790E+06	9.9345E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.1500	0.8400	10.080	10.080	0.0000	11.130	11.130
12	-0.1984	-0.3113	-201.89	-290.85	-2.2963	-3.3801	-4.6346	-6.7670	0.1279	1.3805E+06	1.2309E+06
x(FT)	0.0000	0.0000	10.080	9.8700	0.0000	0.2100	10.080	10.080	0.0000	11.130	11.130
13	-0.1928	-0.3123	-197.69	-292.10	-2.2341	-3.3792	-4.5123	-6.7781	0.1280	1.3806E+06	1.1551E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	3.3600	10.080	10.080	0.0000	11.130	11.130
14	-0.1886	-0.3140	-194.59	-294.27	-2.1776	-3.3741	-4.4017	-6.8105	0.1309	1.3803E+06	1.0039E+06
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
15	-0.1843	-0.3157	-187.84	-291.91	-2.2021	-3.5003	-4.4453	-6.9202	0.1338	1.3835E+06	1.3744E+06
x(FT)	0.0000	0.0000	9.6600	9.2400	0.8400	0.0000	10.080	10.080	0.0000	11.130	11.130
16	-0.2484	-0.3021	-243.20	-285.92	-2.7469	-3.2547	-5.5625	-6.6107	0.1272	1.3761E+06	1.1900E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	0.2100	10.080	10.080	0.0000	11.130	11.130
17	-0.2438	-0.3021	-240.23	-286.69	-2.6882	-3.2356	-5.4372	-6.5970	0.1245	1.3757E+06	1.0543E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.4700	0.6300	10.080	10.080	0.0000	11.130	11.130
18	-0.2392	-0.3021	-236.40	-286.53	-2.6469	-3.2384	-5.3477	-6.5910	0.1218	1.3760E+06	1.0573E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.0000	10.080	10.080	0.0000	11.130	11.130
19	-0.2346	-0.3021	-232.69	-286.38	-2.6063	-3.2412	-5.2602	-6.5850	0.1191	1.3764E+06	1.0602E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.2600	0.2100	10.080	10.080	0.0000	11.130	11.130
20	-0.2300	-0.3021	-228.99	-286.22	-2.5656	-3.2440	-5.1730	-6.5790	0.1164	1.3768E+06	1.0632E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.5200	3.1500	10.080	10.080	0.0000	11.130	11.130
21	-0.2254	-0.3021	-225.25	-286.06	-2.5245	-3.2468	-5.0864	-6.5729	0.1137	1.3771E+06	1.0667E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	1.6800	10.080	10.080	0.0000	11.130	11.130
22	-0.2208	-0.3021	-221.49	-285.91	-2.4831	-3.2496	-4.9994	-6.5667	0.1111	1.3775E+06	1.0705E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	1.0500	10.080	10.080	0.0000	11.130	11.130
23	-0.2162	-0.3021	-217.72	-285.75	-2.4413	-3.2524	-4.9116	-6.5607	0.1084	1.3779E+06	1.0736E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.0000	0.2100	10.080	10.080	0.0000	11.130	11.130
24	-0.2117	-0.3021	-213.94	-285.59	-2.3993	-3.2552	-4.8233	-6.5548	0.1057	1.3782E+06	1.0760E+06
x(FT)	0.0000	0.0000	10.080	10.080	0.4200	0.0000	10.080	10.080	0.0000	11.130	11.130
25	-0.2071	-0.3021	-210.13	-285.44	-2.3570	-3.2580	-4.7350	-6.5490	0.1030	1.3786E+06	1.0784E+06
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	3.3600	10.080	10.080	0.0000	11.130	11.130
26	-0.2025	-0.3021	-206.52	-285.56	-2.3095	-3.2536	-4.6366	-6.5436	0.1003	1.3787E+06	1.0298E+06

x(FT)	0.0000	0.0000	10.080	10.080	1.4700	10.080	10.080	10.080	0.0000	0.0000	0.0000	11.130	11.130
27	-0.1979	-0.3021	-203.47	-286.48	-3.2285	-4.5093	-6.5338	-6.5338	-2.2483	-2.2483	-3.2285	1.3783E+06	8.7769E+05
x(FT)	0.0000	0.0000	10.080	10.080	0.6300	10.080	10.080	10.080	0.0000	0.0000	0.0000	11.130	11.130
28	-0.1938	-0.3021	-199.47	-285.51	-3.2528	-4.4634	-6.5322	-6.5322	-2.2246	-2.2246	-3.2528	1.3792E+06	9.9657E+05
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	10.080	1.0500	1.0500	0.0000	11.130	11.130
29	-0.1895	-0.3038	-195.27	-285.93	-3.2885	-4.4076	-6.5675	-6.5675	-2.1945	-2.1945	-3.2885	1.3802E+06	1.1062E+06
x(FT)	0.0000	0.0000	10.080	10.080	3.3600	10.080	10.080	10.080	2.7300	2.7300	0.0000	11.130	11.130
30	-0.1852	-0.3054	-191.46	-287.07	-3.3068	-4.3266	-6.6019	-6.6019	-2.1522	-2.1522	-3.3068	1.3806E+06	1.1025E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	10.080	10.080	10.080	0.0000	0.0000	0.0000	11.130	11.130
31	-0.1809	-0.3071	-184.84	-284.73	-3.4309	-4.3694	-6.7308	-6.7308	-2.1766	-2.1766	-3.4309	1.3838E+06	1.3758E+06
x(FT)	0.0000	0.0000	9.6600	9.2400	2.9400	10.080	10.080	10.080	0.0000	0.0000	0.0000	11.130	11.130
32	-0.2420	-0.3296	-234.96	-304.74	-3.5774	-5.5923	-7.3005	-7.3005	-2.7313	-2.7313	-3.5774	1.3797E+06	1.3714E+06
x(FT)	0.0000	0.0000	9.6600	9.4500	3.1500	10.080	10.080	10.080	0.8400	0.8400	0.0000	11.130	11.130
33	-0.2417	-0.3250	-237.08	-303.35	-3.4729	-5.4960	-7.1494	-7.1494	-2.6840	-2.6840	-3.4729	1.3776E+06	1.1052E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.6800	10.080	10.080	10.080	0.4200	0.4200	0.0000	11.130	11.130
34	-0.2415	-0.3204	-236.77	-299.58	-3.4353	-5.4848	-7.0381	-7.0381	-2.6859	-2.6859	-3.4353	1.3776E+06	1.1646E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.3100	10.080	10.080	10.080	0.0000	0.0000	0.0000	11.130	11.130
35	-0.2412	-0.3158	-237.39	-296.87	-3.3739	-5.4397	-6.9242	-6.9242	-2.6700	-2.6700	-3.3739	1.3768E+06	1.0598E+06
x(FT)	0.0000	0.0000	10.080	10.080	1.0500	10.080	10.080	10.080	2.7300	2.7300	0.0000	11.130	11.130
36	-0.2535	-0.3289	-244.31	-304.47	-3.5643	-5.8245	-7.3012	-7.3012	-2.8371	-2.8371	-3.5643	1.3790E+06	1.3714E+06
x(FT)	0.0000	0.0000	9.6600	9.4500	3.3600	10.080	10.080	10.080	2.9400	2.9400	0.0000	11.130	11.130
37	-0.2532	-0.3243	-246.50	-303.18	-3.4603	-5.7215	-7.1485	-7.1485	-2.7879	-2.7879	-3.4603	1.3768E+06	1.1067E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	10.080	10.080	10.080	0.8400	0.8400	0.0000	11.130	11.130
38	-0.2529	-0.3197	-246.20	-299.42	-3.4227	-5.7106	-7.0372	-7.0372	-2.7899	-2.7899	-3.4227	1.3768E+06	1.1666E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	10.080	10.080	10.080	3.1500	3.1500	0.0000	11.130	11.130
39	-0.2526	-0.3151	-246.84	-296.69	-3.3615	-5.6635	-6.9230	-6.9230	-2.7736	-2.7736	-3.3615	1.3759E+06	1.0619E+06
x(FT)	0.0000	0.0000	10.080	10.080	2.9400	10.080	10.080	10.080	3.3600	3.3600	0.0000	11.130	11.130
Min.	-0.2535	-0.3296	-246.84	-304.74	-3.5774	-5.8245	-7.3012	-7.3012	-2.8371	-2.8371	-3.5774	1.3725E+06	7.0962E+05
Pile N.	36	32	39	32	32	36	36	36	36	36	28	2	3

\* MAXIMUM VALUES AND LOCATIONS \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		TOTAL		FLEX. RIG.		FLEX. RIG.	
	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	y-DIR	z-DIR	STRESS	KIP/IN**2	z-DIR	y-DIR	z-DIR	y-DIR
1	3.7168E-04	4.8774E-04	6.2093	8.6822	24.647	2.0663	2.7115	7.1435E+06	0.2194	7.1435E+06	7.1435E+06	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.2100	0.0000	0.2100
2	3.8941E-04	5.4287E-04	6.3066	9.4836	24.748	2.0136	2.8071	7.1435E+06	0.2156	7.1435E+06	7.1435E+06	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.970	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.0000	0.0000	0.0000	0.0000

3	3.8921E-04	5.5621E-04	6.2738	9.6549	19.200	24.748	1.9754	2.8229	0.2119	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.970	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
4	3.5346E-04	4.8300E-04	5.9177	8.5860	19.076	24.584	1.9710	2.6934	0.2081	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
5	3.4407E-04	4.7186E-04	5.8181	8.3970	18.794	24.528	1.9431	2.6647	0.2044	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
6	3.3849E-04	4.7142E-04	5.7232	8.3874	18.488	24.513	1.9116	2.6623	0.2007	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
7	3.3288E-04	4.7098E-04	5.6278	8.3778	18.179	24.498	1.8799	2.6598	0.1969	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.2100	0.2100
8	3.2725E-04	4.7055E-04	5.5319	8.3682	17.870	24.483	1.8481	2.6573	0.1932	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.2100	0.0000
9	3.2160E-04	4.7011E-04	5.4358	8.3587	17.559	24.468	1.8161	2.6549	0.1894	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
10	3.1592E-04	4.6967E-04	5.3392	8.3492	17.246	24.453	1.7841	2.6524	0.1857	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
11	3.0920E-04	4.6667E-04	5.2404	8.3034	16.938	24.432	1.7526	2.6452	0.1820	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.2100	0.2100
12	2.8753E-04	4.2213E-04	5.1055	7.6187	16.718	24.271	1.7327	2.5438	0.1782	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.2100	0.0000
13	2.8595E-04	4.3621E-04	5.0041	7.8303	16.310	24.370	1.6900	2.5781	0.1784	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
14	2.8866E-04	4.6422E-04	4.9285	8.3036	15.958	24.588	1.6523	2.6572	0.1824	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
15	2.4375E-04	3.7512E-04	4.6761	7.2129	15.857	24.551	1.6445	2.5307	0.1865	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
16	3.5502E-04	4.2912E-04	6.1613	7.6020	20.034	23.754	2.0720	2.5044	0.1772	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
17	3.6070E-04	4.5403E-04	6.0878	7.9739	19.658	23.813	2.0312	2.5568	0.1735	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.0000
18	3.5495E-04	4.5350E-04	5.9904	7.9616	19.343	23.797	1.9989	2.5538	0.1697	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.2100	0.0000
19	3.4940E-04	4.5297E-04	5.8960	7.9493	19.038	23.780	1.9676	2.5508	0.1660	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.2100	0.0000
20	3.4388E-04	4.5243E-04	5.8019	7.9369	18.734	23.764	1.9365	2.5478	0.1623	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.2100	0.0000
21	3.3827E-04	4.5186E-04	5.7068	7.9235	18.427	23.747	1.9049	2.5446	0.1585	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.0000	0.2100
22	3.3264E-04	4.5126E-04	5.6112	7.9092	18.118	23.730	1.8732	2.5412	0.1548	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	11.760	10.500	10.500	11.130	11.130	11.130	0.2100	0.2100
23	3.2699E-04	4.5072E-04	5.5154	7.8966	17.809	23.714	1.8414	2.5382	0.1510	7.1435E+06	7.1435E+06

x(FT)	11.130	11.130	11.760	10.500	11.130	11.130	11.130	11.130	11.130	0.2100	0.0000
24	3.2132E-04	4.5025E-04	5.4191	17.497	7.8860	7.8860	7.8860	7.8860	7.8860	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.760	11.130	0.0000	0.2100
25	3.1562E-04	4.4977E-04	5.3224	17.185	7.8755	7.8755	7.8755	7.8755	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
26	3.1297E-04	4.5851E-04	5.2291	16.852	8.0167	8.0167	8.0167	8.0167	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
27	3.1924E-04	4.9354E-04	5.2119	16.462	8.5632	8.5632	8.5632	8.5632	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
28	3.0460E-04	4.6520E-04	5.0480	16.245	8.1173	8.1173	8.1173	8.1173	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.2100	0.2100
29	2.9096E-04	4.4431E-04	4.9455	15.997	7.8108	7.8108	7.8108	7.8108	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
30	2.8443E-04	4.4497E-04	4.8487	15.696	7.8476	7.8476	7.8476	7.8476	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
31	2.4005E-04	3.6614E-04	4.6010	15.596	7.0326	7.0326	7.0326	7.0326	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
32	3.0405E-04	3.9254E-04	5.8450	19.852	7.5600	7.5600	7.5600	7.5600	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.2100	0.0000
33	3.3334E-04	4.4429E-04	5.9900	19.699	8.2063	8.2063	8.2063	8.2063	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.2100
34	3.3334E-04	4.3486E-04	5.9828	19.667	7.9743	7.9743	7.9743	7.9743	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.2100
35	3.4457E-04	4.5328E-04	6.0126	19.581	8.1954	8.1954	8.1954	8.1954	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.2100
36	3.1609E-04	3.9242E-04	6.0774	20.646	7.5574	7.5574	7.5574	7.5574	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
37	3.4654E-04	4.4399E-04	6.2284	20.484	8.1990	8.1990	8.1990	8.1990	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.2100
38	3.4658E-04	4.3453E-04	6.2215	20.453	7.9661	7.9661	7.9661	7.9661	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
39	3.5822E-04	4.5281E-04	6.2526	20.364	8.1853	8.1853	8.1853	8.1853	7.1435E+06	7.1435E+06	7.1435E+06
x(FT)	11.130	11.130	11.760	10.500	11.760	11.760	11.760	11.130	11.130	0.0000	0.0000
Max.	3.8941E-04	5.5621E-04	6.3066	20.646	9.6549	9.6549	9.6549	9.6549	2.1375	7.1435E+06	7.1435E+06
Pile N.	2	3	2	36	3	3	3	3	1	1	1

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SUMMARY FOR LOAD CASES AND COMBINATIONS

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\*\*\*\*\* LOAD CASES RESULTS \*\*\*\*\*

LOAD CASE : 1

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*  
 LOAD X,KIP    LOAD Y,KIP    LOAD Z,KIP    MOM X,KIP-IN    MOM Y,KIP-IN    MOM Z,KIP-IN  
 1937.61    -568.160    -198.370    0.00000    12803.9    52786.9

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

DISP X,IN    DISP Y,IN    DISP Z,IN    ROT X,RAD    ROT Y,RAD    ROT Z,RAD  
 0.0111686    -1.72276    -0.58341    9.96703E-04    -5.77419E-06    9.33524E-05

\* PILE TOP DISPLACEMENTS, GLOBAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
3.8695E-03	-1.9559	-0.7321	9.9670E-04	-5.7742E-06	9.3352E-05
Pile N. 16	36	32	1	1	1
MAXIMUM	0.024265	-1.3891	9.9670E-04	-5.7742E-06	9.3352E-05
Pile N. 32	31	16	1	1	1

\* PILE TOP REACTIONS, GLOBAL \*

FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
17.426	-16.929	-6.0002	0.0000	0.0000	-2.4977E-10
Pile N. 16	16	32	1	1	36
MAXIMUM	109.28	-12.242	0.0000	0.0000	0.0000
Pile N. 32	15	17	1	1	1

\* PILE TOP DISPLACEMENTS, LOCAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
3.8695E-03	-1.9559	-0.7321	9.9670E-04	-5.7742E-06	9.3352E-05
Pile N. 16	36	32	1	1	1
MAXIMUM	0.024265	-1.3891	9.9670E-04	-5.7742E-06	9.3352E-05
Pile N. 32	31	16	1	1	1

\* PILE TOP REACTIONS, LOCAL \*

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AXIAL,KIP      LAT. Y,KIP  LAT. Z,KIP  MOM X,KIP-IN  MOM Y,KIP-IN  MOM Z,KIP-IN
*****      *****      *****      *****      *****      *****
MINIMUM      17.426      -16.929      -6.0002      0.0000      0.0000      -2.4977E-10
Pile N.      16      16      32      1      36
MAXIMUM      109.28      -12.242      -4.7066      0.0000      0.0000      0.0000
Pile N.      32      15      17      1      1

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\* EFFECTS FOR Laterally Loaded Pile \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		SOIL REACT		TOTAL STRESS KIP/IN**2
	Y-DIR IN	Z-DIR IN	Y-DIR KIP-IN	Z-DIR KIP-IN	Y-DIR KIP	Z-DIR KIP	Y-DIR KIP/IN	Z-DIR KIP/IN	Y-DIR KIP/IN	Z-DIR KIP/IN	
Min.	-1.9559	-0.7321	-1754.4	-674.43	-16.929	-6.0002	-29.286	-12.034	16	15	0.1965
Pile N.	36	32	36	32	16	32	16	15	16	15	16
Max.	5.3230E-03	1.7229E-03	45.813	31.314	160.26	60.962	22.973	8.4390	22.973	8.4390	1.7177
Pile N.	38	37	38	37	36	32	16	32	16	32	32

LOAD CASE : 2

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

LOAD X,KIP	LOAD Y,KIP	LOAD Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1649.32	-555.480	-148.440	0.00000	7409.52	41508.5

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

DISP X,IN	DISP Y,IN	DISP Z,IN	ROT X,RAD	ROT Y,RAD	ROT Z,RAD
9.49594E-03	-1.65355	-0.42183	9.10466E-04	-4.82378E-06	7.41663E-05

\* PILE TOP DISPLACEMENTS, GLOBAL \*

MINIMUM	DISP. X,IN		DISP. Y,IN		DISP. Z,IN		ROT. X,RAD		ROT. Y,RAD		ROT. Z,RAD	
	16	36	16	36	16	36	16	36	16	36	16	36
3.6511E-03	-1.8665	-0.5577	9.1047E-04	-4.8238E-06	7.4166E-05	1	1	1	1	1	1	1
Pile N.	16	36	16	36	16	36	16	36	16	36	16	36
MAXIMUM	0.019867	-1.3488	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05	1	1	1	1	1	1
Pile N.	32	31	16	16	16	16	16	16	16	16	16	16

\* PILE TOP REACTIONS, GLOBAL \*

FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****

MINIMUM	16.443	-16.377	-4.7710	0.0000	0.0000	0.0000	0.0000
Pile N.	16	16	32	1	1	1	1
MAXIMUM	89.469	-12.125	-3.4151	0.0000	0.0000	0.0000	0.0000
Pile N.	32	15	17	1	1	1	1

\* PILE TOP DISPLACEMENTS, LOCAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****
3.6511E-03	-1.8665	-0.5577	9.1047E-04	-4.8238E-06	7.4166E-05
Pile N.	16	32	1	1	1
MAXIMUM	0.019867	-0.3616	9.1047E-04	-4.8238E-06	7.4166E-05
Pile N.	32	16	1	1	1

\* PILE TOP REACTIONS, LOCAL \*

AXIAL,KIP	LAT. Y,KIP	LAT. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****
16.443	-16.377	-4.7710	0.0000	0.0000	0.0000
Pile N.	16	32	1	1	1
MAXIMUM	89.469	-3.4151	0.0000	0.0000	0.0000
Pile N.	32	17	1	1	1

\* EFFECTS FOR LATERALLY LOADED PILE \*

PILE	DISPL. Y-DIR IN	DISPL. Z-DIR IN	MOMENT Y-DIR KIP-IN	MOMENT Z-DIR KIP-IN	SHEAR Y-DIR KIP	SHEAR Z-DIR KIP	SOIL REACT Y-DIR KIP/IN	SOIL REACT Z-DIR KIP/IN	TOTAL STRESS KIP/IN**2
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
Min.	-1.8665	-0.5577	-1687.7	-522.58	-16.377	-4.7710	-29.471	-9.4142	0.1855
Pile N.	36	32	36	32	16	32	16	15	16
Max.	4.8337E-03	1.2607E-03	42.500	22.836	152.69	46.824	22.055	6.4303	1.4064
Pile N.	38	37	38	37	36	32	36	36	32

LOAD CASE : 3

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

LOAD X,KIP	LOAD Y,KIP	LOAD Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1858.44	-544.890	-140.510	0.00000	6269.76	42152.3

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*



Min.	-1.8363	-0.5324	-1661.4	-500.05	-16.082	-4.5446	-29.428	-9.0862	0.2416
Pile N.	36	32	36	32	16	32	16	15	16
Max.	4.6718E-03	1.1878E-03	41.446	21.507	149.82	44.643	21.497	6.0881	1.5088
Pile N.	38	37	38	37	36	32	36	36	32

LOAD CASE : 4

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

LOAD X,KIP	LOAD Y,KIP	LOAD Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
1871.72	-569.100	-189.590	0.00000	11992.7	50750.8

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

DISP X,IN	DISP Y,IN	DISP Z,IN	ROT X,RAD	ROT Y,RAD	ROT Z,RAD
0.0107877	-1.72056	-0.55493	9.87617E-04	-5.59963E-06	8.98372E-05

\* PILE TOP DISPLACEMENTS, GLOBAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****
MINIMUM	3.7551E-03	-1.9516	-0.7023	9.8762E-04	-5.5996E-06
Pile N.	16	36	32	1	1
MAXIMUM	0.023385	-1.3899	-0.4896	9.8762E-04	-5.5996E-06
Pile N.	32	31	16	1	1

\* PILE TOP REACTIONS, GLOBAL \*

FOR. X,KIP	FOR. Y,KIP	FOR. Z,KIP	MOM X,KIP-IN	MOM Y,KIP-IN	MOM Z,KIP-IN
*****	*****	*****	*****	*****	*****
MINIMUM	16.911	-16.925	-5.7951	-3.8236E-27	-6.2444E-11
Pile N.	16	16	32	23	19
MAXIMUM	105.31	-12.291	-4.4740	3.8236E-27	6.2444E-11
Pile N.	32	15	17	19	23

\* PILE TOP DISPLACEMENTS, LOCAL \*

DISP. X,IN	DISP. Y,IN	DISP. Z,IN	ROT. X,RAD	ROT. Y,RAD	ROT. Z,RAD
*****	*****	*****	*****	*****	*****
MINIMUM	3.7551E-03	-1.9516	-0.7023	9.8762E-04	-5.5996E-06
Pile N.	16	36	32	1	1
MAXIMUM	0.023385	-1.3899	-0.4896	9.8762E-04	-5.5996E-06
Pile N.	32	31	16	1	1

\* PILE TOP REACTIONS, LOCAL \*

	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
MINIMUM	16.911	-16.925	-5.7951	0.0000	-6.2444E-11	-2.4977E-10
Pile N.	16	16	32	1	19	36
MAXIMUM	105.31	-12.291	-4.4740	0.0000	6.2444E-11	0.0000
Pile N.	32	15	17	1	23	1

\* EFFECTS FOR Laterally Loaded Pile \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		SOIL REACT		TOTAL STRESS KIP/IN**2
	Y-DIR IN	Z-DIR IN	Z-DIR KIP-IN	Y-DIR KIP-IN	Y-DIR KIP	Z-DIR KIP	Y-DIR KIP/IN	Z-DIR KIP/IN	Y-DIR KIP/IN	Z-DIR KIP/IN	
Min.	-1.9516	-0.7023	-1752.3	-648.38	-16.925	-5.7951	-29.381	-11.557	0.1907	16	
Pile N.	36	32	36	32	16	32	16	15	16	16	
Max.	5.2987E-03	1.6474E-03	45.632	29.911	159.94	58.549	23.068	8.0897	1.6554	32	
Pile N.	38	37	38	37	36	32	16	32	32	32	

LOAD CASE : 5

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

LOAD X, KIP	LOAD Y, KIP	LOAD Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
1446.29	-399.340	-141.050	0.00000	7856.52	34869.6

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

DISP X, IN	DISP Y, IN	DISP Z, IN	ROT X, RAD	ROT Y, RAD	ROT Z, RAD
8.32893E-03	-1.12888	-0.38019	5.96536E-04	-3.55652E-06	6.19489E-05

\* PILE TOP DISPLACEMENTS, GLOBAL \*

	DISP. X, IN	DISP. Y, IN	DISP. Z, IN	ROT. X, RAD	ROT. Y, RAD	ROT. Z, RAD
MINIMUM	3.5386E-03	-1.2684	-0.4692	5.9654E-04	-3.5565E-06	6.1949E-05
Pile N.	16	36	32	1	1	1
MAXIMUM	0.017060	-0.9292	-0.3407	5.9654E-04	-3.5565E-06	6.1949E-05
Pile N.	32	31	16	1	1	1

\* PILE TOP REACTIONS, GLOBAL \*

FOR. X, KIP FOR. Y, KIP FOR. Z, KIP MOM X, KIP-IN MOM Y, KIP-IN MOM Z, KIP-IN

```

*****
MINIMUM 15.936 -11.651 -4.2661 0.0000 0.0000 -1.2489E-10 *****
Pile N. 16 16 32 1 12
MAXIMUM 76.827 -8.7574 -3.3562 0.0000 0.0000 1.2489E-10
Pile N. 32 15 17 1 26

```

\* PILE TOP DISPLACEMENTS, LOCAL \*

```

DISP. X,IN DISP. Y,IN DISP. Z,IN ROT. X,RAD ROT. Y,RAD ROT. Z,RAD
*****
3.5386E-03 -1.2684 -0.4692 5.9654E-04 -3.5565E-06 6.1949E-05
Pile N. 16 36 32 1 1
MAXIMUM 0.017060 -0.9292 -0.3407 5.9654E-04 -3.5565E-06 6.1949E-05
Pile N. 32 31 16 1 1

```

\* PILE TOP REACTIONS, LOCAL \*

```

AXIAL,KIP LAT. Y,KIP LAT. Z,KIP MOM X,KIP-IN MOM Y,KIP-IN MOM Z,KIP-IN
*****
15.936 -11.651 -4.2661 0.0000 0.0000 -1.2489E-10
Pile N. 16 16 32 1 12
MAXIMUM 76.827 -8.7574 -3.3562 0.0000 0.0000 1.2489E-10
Pile N. 32 15 17 1 26

```

\* EFFECTS FOR LATERALLY LOADED PILE \*

PILE	DISPL.	DISPL.	MOMENT	MOMENT	SHEAR	SHEAR	SOIL REACT	SOIL REACT	TOTAL
	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	Y-DIR	Z-DIR	STRESS
	IN	IN	KIP-IN	KIP-IN	KIP	KIP	KIP/IN	KIP/IN	KIP/IN**2
Min.	-1.2684	-0.4692	-1163.2	-445.34	-11.651	-4.2661	-27.341	-10.490	0.1797
Pile N.	36	32	36	32	16	32	16	32	16
Max.	2.5968E-03	9.1127E-04	33.351	16.997	105.00	39.463	13.699	4.8689	1.2076
Pile N.	38	37	38	37	36	32	37	36	32

LOAD CASE : 6

\* TABLE L \* COMPUTATION ON PILE CAP

```

* EQUIVALENT CONCENTRATED LOAD AT ORIGIN *
LOAD X,KIP 1281.55
LOAD Y,KIP -368.920
LOAD Z,KIP -103.810
MOM X,KIP-IN 0.00000
MOM Y,KIP-IN 3426.36
MOM Z,KIP-IN 24914.0

```

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*  
 DISP X,IN DISP Y,IN DISP Z,IN ROT X,RAD ROT Y,RAD ROT Z,RAD  
 7.36716E-03 -1.02522 -0.26465 5.18030E-04 -2.43631E-06 4.50033E-05

\* PILE TOP DISPLACEMENTS, GLOBAL \*  
 DISP. X,IN DISP. Y,IN DISP. Z,IN ROT. X,RAD ROT. Y,RAD ROT. Z,RAD  
 \*\*\*\*\*  
 MINIMUM 3.9158E-03 -1.1464 -0.3419 5.1803E-04 -2.4363E-06 4.5003E-05  
 Pile N. 16 36 32 1 1 1  
 MAXIMUM 0.013731 -0.8518 -0.2304 5.1803E-04 -2.4363E-06 4.5003E-05  
 Pile N. 32 31 16 1 1 1

\* PILE TOP REACTIONS, GLOBAL \*  
 FOR. X,KIP FOR. Y,KIP FOR. Z,KIP MOM X,KIP-IN MOM Y,KIP-IN MOM Z,KIP-IN  
 \*\*\*\*\*  
 MINIMUM 17.634 -10.684 -3.2830 -1.9118E-27 0.0000 -1.2489E-10  
 Pile N. 16 16 32 30 1 23  
 MAXIMUM 61.836 -8.1639 -2.4164 0.0000 3.1222E-11 1.2489E-10  
 Pile N. 32 31 28 1 30 8

\* PILE TOP DISPLACEMENTS, LOCAL \*  
 DISP. X,IN DISP. Y,IN DISP. Z,IN ROT. X,RAD ROT. Y,RAD ROT. Z,RAD  
 \*\*\*\*\*  
 MINIMUM 3.9158E-03 -1.1464 -0.3419 5.1803E-04 -2.4363E-06 4.5003E-05  
 Pile N. 16 36 32 1 1 1  
 MAXIMUM 0.013731 -0.8518 -0.2304 5.1803E-04 -2.4363E-06 4.5003E-05  
 Pile N. 32 31 16 1 1 1

\* PILE TOP REACTIONS, LOCAL \*  
 AXIAL,KIP LAT. Y,KIP LAT. Z,KIP MOM X,KIP-IN MOM Y,KIP-IN MOM Z,KIP-IN  
 \*\*\*\*\*  
 MINIMUM 17.634 -10.684 -3.2830 0.0000 0.0000 -1.2489E-10  
 Pile N. 16 16 32 1 1 23  
 MAXIMUM 61.836 -8.1639 -2.4164 0.0000 3.1222E-11 1.2489E-10  
 Pile N. 32 31 28 1 30 8

\* EFFECTS FOR Laterally Loaded Pile \*  
 PILE DISPL. DISPL. MOMENT MOMENT SHEAR SHEAR SOIL REACT SOIL REACT TOTAL  
 Y-DIR Z-DIR Z-DIR Z-DIR Y-DIR Z-DIR Y-DIR Z-DIR KIP/IN\*\*2  
 IN IN KIP-IN KIP-IN KIP KIP KIP/IN KIP/IN

```

*****
Min.      -1.1464      -0.3419      -1057.2      -335.21      -10.684      -3.2830      -27.565      -8.3807      0.1989
Pile N.   36           32           36           32           16           32           16           32           16
Max.      2.3135E-03    6.4714E-04    33.130      11.757      95.494      28.770      12.058      3.3925      0.9720
Pile N.   38           37           32           37           36           32           37           37           32
*****

```

LOAD CASE : 7

\* TABLE L \* COMPUTATION ON PILE CAP

\* EQUIVALENT CONCENTRATED LOAD AT ORIGIN \*

```

LOAD X,KIP  LOAD Y,KIP  LOAD Z,KIP  MOM X,KIP-IN  MOM Y,KIP-IN  MOM Z,KIP-IN
478.060    -97.2500    -129.940    0.00000      7798.80      5406.96

```

\* DISPLACEMENT OF GROUPED PILE FOUNDATION AT ORIGIN \*

```

DISP X,IN  DISP Y,IN  DISP Z,IN  ROT X,RAD  ROT Y,RAD  ROT Z,RAD
2.76028E-03 -0.22364    -0.31056    1.27519E-04  1.46790E-06  8.18058E-06

```

\* PILE TOP DISPLACEMENTS, GLOBAL \*

```

DISP. X,IN  DISP. Y,IN  DISP. Z,IN  ROT. X,RAD  ROT. Y,RAD  ROT. Z,RAD
*****
MINIMUM      1.8752E-03    -0.2535    -0.3296    1.2752E-04    1.4679E-06    8.1806E-06
Pile N.      28           36           32           1           1           1
MAXIMUM      4.2804E-03    -0.1809    -0.3021    1.2752E-04    1.4679E-06    8.1806E-06
Pile N.      36           31           16           1           1           1

```

\* PILE TOP REACTIONS, GLOBAL \*

```

FOR. X,KIP  FOR. Y,KIP  FOR. Z,KIP  MOM X,KIP-IN  MOM Y,KIP-IN  MOM Z,KIP-IN
*****
MINIMUM      8.4447    -2.8371    -3.5774    0.0000    0.0000    -3.1222E-11
Pile N.      28           36           32           1           1           1
MAXIMUM      19.276    -2.1522    -3.2285    0.0000    0.0000    3.1222E-11
Pile N.      36           30           27           1           1           2

```

\* PILE TOP DISPLACEMENTS, LOCAL \*

```

DISP. X,IN  DISP. Y,IN  DISP. Z,IN  ROT. X,RAD  ROT. Y,RAD  ROT. Z,RAD
*****
MINIMUM      1.8752E-03    -0.2535    -0.3296    1.2752E-04    1.4679E-06    8.1806E-06
Pile N.      28           36           32           1           1           1
MAXIMUM      4.2804E-03    -0.1809    -0.3021    1.2752E-04    1.4679E-06    8.1806E-06
Pile N.      36           31           16           1           1           1

```

\* PILE TOP REACTIONS, LOCAL \*

	AXIAL, KIP	LAT. Y, KIP	LAT. Z, KIP	MOM X, KIP-IN	MOM Y, KIP-IN	MOM Z, KIP-IN
MINIMUM	8.4447	-2.8371	-3.5774	0.0000	0.0000	-3.1222E-11
Pile N.	28	36	32	1	1	1
MAXIMUM	19.276	-2.1522	-3.2285	0.0000	0.0000	3.1222E-11
Pile N.	36	30	27	1	1	2

\* EFFECTS FOR Laterally Loaded Pile \*

PILE	DISPL.		MOMENT		SHEAR		SOIL REACT		SOIL REACT		TOTAL STRESS KIP/IN**2
	y-DIR IN	z-DIR IN	y-DIR KIP-IN	z-DIR KIP-IN	y-DIR KIP	z-DIR KIP	y-DIR KIP/IN	z-DIR KIP/IN	y-DIR KIP/IN	z-DIR KIP/IN	
Min.	-0.2535	-0.3296	-246.84	-304.74	-2.8371	-3.5774	-5.8245	-7.3012	-5.8245	-7.3012	0.095244
Pile N.	36	32	39	32	36	32	36	36	36	36	28
Max.	3.8941E-04	5.5621E-04	6.3066	9.6549	20.646	25.753	2.1375	2.8229	2.1375	2.8229	0.3030
Pile N.	2	3	2	3	36	32	36	3	36	3	36