

**Salem,
Massachusetts
Canal Street Flood
Mitigation Project
Phase II**

Contract A

**Bidding Documents
For Construction**



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Andover, Massachusetts 01810
866.702.6371

woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

**228340.04
City of Salem,
Massachusetts**

January 2017

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SECTION 00 01 07

SEALS PAGE

The engineering material and data contained in these Contract Documents were prepared under the supervision and direction of the undersigned, whose seal as a registered professional engineer is affixed below.



David A White, Jr., P.E.
Vice President
Woodard & Curran, Inc.(Engineer)

January 30, 2017
Date of Issue

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END OF SECTION

SECTION 00 01 15

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NUMBER

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END OF SECTION

SECTION 00 11 16

INVITATION TO BID

The City of Salem (Owner) invites Bidders to submit sealed Bids for Phase II Flood Mitigation Project. The Work includes, but is not limited to: installation of new storm drain PVC pipes varying from 10 inches to 66 inches in diameter and drainage manholes and catch basins; installation of new sanitary sewer utility pipes; installation of new water utility pipes and installation of hydrants and connections to existing water system; temporary bypass of water, sewer and drainage; demolition of existing concession stand and various park features; baseball field and basketball court demolition and reconstruction; Forest River Park reconstruction and grading; pond improvement including wetlands rehabilitation and replication; installation of concrete box culvert; installation of elevated walkway; milling and overlaying existing pavement and construction of asphalt and concrete sidewalks; and all materials and equipment, services and construction inherent to the Work as described in the Specifications and Drawings.

The Work shall be substantially complete by December 1, 2017 and completed and ready for final payment (Final Completion) by December 31, 2017 with the exception of the Forest River Park Ballfield and practice field area shall be substantially complete by December 31, 2017 and ready for final payment by April 28, 2018.

The Project being bid is subject to Massachusetts General Laws, Chapter 30, Section 39M.

A pre Bid conference will not be held.

Sealed Bids will be received until **2:00 PM** local time on February 22, 2016 at the Office of the Purchasing Agent at 93 Washington Street, 2rd Floor Salem, MA 01970. Bids will then and there be publicly opened and read aloud. Bids received after the time of announced opening will not be accepted.

Sets of Bidding Documents may be examined at the following location(s) on or after February 1, 2017, at 8:00 AM.

Issuing Office:

Office of the Purchasing Department
93 Washington St | 3rd Floor
Salem, MA 01970
Attn: Whitney C. Haskell, Purchasing Agent
Contact number: (978) 619-5695
whaskell@salem.com

Engineer's office:
Woodard & Curran
40 Shattuck Rd | Suite 110
Andover, MA 01810

Sets of Bidding Documents may be obtained on or after February 1, 2016 at 8:00 AM:

electronically at no cost by registering at:

City of Salem purchasing website: <http://www.salem.com/purchasing>. Click on "Open Procurements (IFB, RFP, RFQ) tab.

Commonwealth of Massachusetts Operational Services Division website: <http://www.commbuys.com>

in hardcopy from Issuing Office Monday through Wednesday, 8:00 a.m. to 4:00 p.m., Thursday 8:00 a.m. to 7:00 p.m., and Friday 8:00 a.m. to 12:00 p.m., excluding City holidays.

Refundable purchase price for each set of Bidding Documents: \$150 payable by certified check, treasurer's or cashier's check, or money order to City of Salem, Massachusetts.

Non-refundable charge for delivery of Bidding Documents by mail or delivery service: Additional \$25 payable by certified check, treasurer's or cashier's check, or money order to City of Salem, Massachusetts.

Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of the incomplete sets of Bidding Documents or for modifications to the Bidding Documents including electronic conversion.

Bid security in the amount of 5 percent of the Bid must accompany the Bid in accordance with the Instructions to Bidders.

Minimum wage rates as issued by the Executive Office of Labor and Workforce Development, Department of Labor Standards under the provisions of Massachusetts General Laws, Chapter 149, Sections 26 to 27D inclusive, as amended, apply to this Project. It is the responsibility of the Bidders, 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 the resulting Contract.

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Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be eligible or responsible. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project or the public to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

David H. Knowlton, P.E., City Engineer
Whitney C. Haskell, Purchasing Agent

END OF SECTION

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SECTION 00 21 13

INSTRUCTIONS TO BIDDERS

ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions, if any. Additional terms used in these Instructions to Bidders have the meanings indicated below and as may be included in the Supplementary Instructions to Bidders.
- A. *Issuing Office* – The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered identified in the Invitation to Bid.
- B. *Supplements* – Those portions of the Bidding Requirements to be submitted with and made a condition of a Bid including required submittals.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Sets of Bidding Documents may be examined and obtained as stated in the Invitation to Bid.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents, Bidding Documents provided by third parties, or for modifications to the Bidding Documents not made by official Addenda, including electronic conversion.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data requested in the Bidding Documents, and within the time frames stipulated upon Owner's request.
- 3.02 Bidders shall meet minimum criteria regarding experience and qualifications set forth in the General Requirements and the Specifications.

ARTICLE 4 – EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01 *Subsurface and Physical Conditions*

- A. Section 00 73 10 of the Supplementary Conditions identifies:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
- B. Copies of reports and drawings referenced in Section 00 73 10, if any, are included in the Bidding Documents as indicated in Section 00 31 00, if included. Those reports and drawings are not part of the Contract Documents, but the “technical data” contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.02 of the General Conditions, has been identified and established in Section 00 73 10 of the Supplementary Conditions.
- C. Bidder is responsible for any interpretation or conclusion Bidder draws from any “technical data” or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 *Underground Facilities*

- A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

4.03 *Hazardous Environmental Condition*

- A. Copies of reports and drawings referenced in Section 00 73 10, if any, are included in the Bidding Documents as indicated in Section 00 31 00 if included. Those reports and drawings are not part of the Contract Documents, but the “technical data” contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.06 of the General Conditions has been identified and established in Section 00 73 10 of the Supplementary Conditions.
- B. Bidder is responsible for any interpretation or conclusion Bidder draws from any “technical data” or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

- 4.04 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions and Section 00 73 10 of the Supplementary Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 4.06 of the General Conditions and Section 00 73 10 of the Supplementary Conditions.
- 4.05 Upon request, Owner may provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall be responsible for obtaining permission and necessary permits and insurance for access to the Site. Bidder shall clean up and restore the Site to its former condition upon completion of any such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.
- 4.06 Reference is made to Article 7 of the General Conditions and Section 00 73 10 of the Supplementary Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of contract documents (other than portions thereof related to price) for such other work.
- 4.07 It is the responsibility of each Bidder before submitting a Bid to:
- A. examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;
 - B. visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
 - C. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work;

- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Section 00 73 10, as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Section 00 73 10, as containing reliable "technical data";
 - E. consider the information known to Bidder; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;
 - F. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
 - G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
 - H. correlate the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents;
 - I. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and
 - J. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.
- 4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding

Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 – PRE-BID CONFERENCE

5.01 A pre bid conference will not be held.

ARTICLE 6 – SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to the Issuing Office Submission of questions via email is acceptable.

City of Salem Purchasing Department
Whitney Haskell, Purchasing Agent
93 Washington Street
Salem, MA 01970
Telephone 978-619-5695
Email: whaskell@salem.com

7.02 Interpretations or clarifications considered necessary in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than 7 days prior to the date for opening of Bids will not be answered. Only answers in the Addenda will be binding. Oral statements, interpretations, and clarifications may not be relied upon and will not be binding or legally effective.

7.03 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer, will be available for examination at the Issuing Office and will be mailed or faxed to all parties recorded as having received the Bidding Documents and posted on the websites indicated in the Invitation to Bid.

ARTICLE 8 – BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price and in the form of a certified check, treasurer's or cashier's check, or money order, or a Bid bond on or consistent with the form included

in the Bidding Documents in Section 00 43 13 issued by a surety meeting the requirements of Paragraphs 5.01 and 5.02 of the General and Supplementary Conditions, if any.

- 8.02 The Bid security of the Successful Bidder will be retained until such Bidder has furnished the required contract security, met the conditions of the Notice of Intent to Award (if any) and Notice of Award, and executed the Agreement, whereupon the Bid security will be returned. If the Successful Bidder fails to comply with the conditions set forth in the Notice of Intent to Award (if any) and Notice of Award within the time specified therein, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Agreement or 91 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. See Supplementary Instructions to Bidders (if any) for additional information.
- 8.03 Bid security of other Bidders whom Owner believes do not have a reasonable chance of receiving the award will be returned within 5 days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS

- 11.01 The Contract, if awarded, will be on the basis of materials and equipment and construction methods or procedures specified or described in the Bidding Documents, or those substitute or “or-equal” materials and equipment and construction methods or procedures as defined in Paragraph 6.05 of the General and Supplementary Conditions, approved by Engineer and identified by Addendum, **for proprietary items specified only.**
- A. The materials and equipment and construction methods or procedures specified for proprietary items in the Bidding Documents establish a standard of required type, function and quality to be met by any proposed substitute or “or-equal” item. No item of material or equipment and construction methods or procedures will be considered by Engineer as a substitute or “or-equal” item unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids.

- B. Each such request shall conform to the requirements of Paragraph 6.05 of the General and Supplementary Conditions.
- 11.02 The burden of proof of the merit of the proposed item is upon the Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS AND OTHERS

- 12.01 The Bidding Documents may require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner with the Bid.
- 12.02 As required in the Bidding Documents, or within 5 days after Bid opening if requested by Owner, Bidder shall submit a listing and experience statement with pertinent information regarding similar projects and other evidence of qualification for each Subcontractor, Supplier, individual, or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute without an increase in the Bid.
- 12.03 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest responsible Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06 of the General and Supplementary Conditions, if any.
- 12.04 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form and Supplements are included with the Bidding Documents.
- 13.02 Bids are to be submitted as indicated in the Bid Form. All blanks on the Bid Form shall be completed in ink or typewritten and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form.
- 13.03 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The

- corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.
- 13.04 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.
- 13.05 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
- 13.06 A Bid by an individual shall show the Bidder's name and official address.
- 13.07 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.
- 13.08 All names shall be printed in ink below the signatures.
- 13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.10 Postal and e-mail addresses and telephone numbers for communications regarding the Bid shall be shown.
- 13.11 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form. See Supplementary Instructions to Bidders for additional requirements, if any.
- 13.12 Bidders are advised to carefully review those portions of the Bid Form and Supplements requiring Bidder's representations and certifications that are to be submitted with a Bid or subsequent to the Bid opening, and made a condition of the Bid.
- 13.13 Substitutions and "or-equal" items **for proprietary items specified only** must be summarized and fully explained in with Section 00 43 25 of the Bidding Documents in accordance with Article 11 above. Bids that do not comply with the requirements of Section 00 43 25 may be considered non responsive and may be rejected at the discretion of the Owner.

ARTICLE 14 – BASIS OF BID; COMPARISON OF BIDS

14.01 *Bid Pricing*

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed on the Unit Prices Form in Section 00 43 22. Bid prices shall be stated in both words and figures.
- B. The total of all estimated prices will be the sum of the products of the estimated quantity of each item and the corresponding unit price included on the Unit Prices Form in Section 00 43 22. The final quantities and Contract Price will be determined in accordance with Paragraph 11.03 of the General and Supplementary Conditions, if any.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between prices written in words and prices written in figures will be resolved in favor of prices written in words.

14.02 *Alternates (if any)*

- A. Bidders shall include a separate price for each alternate described in the Bidding Documents as provided for in the Bid Form and Supplements, if any. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate and will be applied in the same order as listed in the Bid form.

14.03 *Completion Time Comparisons*

- A. Bid prices will be compared after adjusting for exceptions taken by Bidders for the number of days or dates set for Substantial Completion per Article 9 above. The adjusting amount will be determined at the rate set forth in the Agreement for liquidated damages for failing to achieve Substantial Completion.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 With each copy of the Bidding Documents, a Bidder is furnished a copy of the Bid Form, the Bid Security Form and Supplements. An original signed hard copy of the Bid Form, the original of the Bid security, Supplements (as listed in the Bid Submittal Checklist), and the Bid Submittal Checklist are to be completed and submitted.
- 15.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Invitation to Bid and shall be enclosed in a plainly marked, sealed package with the Project title, the name and address of Bidder, and shall be accompanied by the Bid security and other required documents.

- 15.03 If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation “BID ENCLOSED.” **A Bid sent by mail or courier shall be sent to Owner at the Issuing Office as indicated in the Invitation to Bid.**
- 15.04 Bidders shall be responsible to confirm the ability of overnight mailing or courier services to deliver to the Owner at the Issuing Office.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.
- 16.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is re-Bid, that Bidder will be disqualified from submitting a Bid on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the Invitation to Bid and, unless obviously non-responsive, read aloud publicly.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible or eligible or does not meet the specified qualification or quality requirements, based on poor references or otherwise. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project or public to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate Contract terms with the Successful Bidder.
- 19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder

has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

- 19.03 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data as may be requested in the Bid Form or prior to the Notice of Award.
- 19.04 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities are submitted.
- A. Owner may also consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.
- 19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work in accordance with the Contract Documents.
- A. Owner may conduct reference checks for the projects listed by the Bidder. Poor references may be a basis for deeming Bidder as not responsible. Reference questions will include, but are not limited to, product quality and durability, overall work quality, performance, timely delivery/completion, customer service, and general customer satisfaction.
- 19.06 Proposed substitutes and “or-equal” items for proprietary items specified as set forth in Section 00 43 25, may be rejected or accepted unilaterally by Owner its sole discretion. Requests that are general, make reference to Bidder’s standard terms and conditions, are a wholesale substitution of the terms and conditions of the Bidding Documents, or that make reference to Bidder’s descriptive information as a whole are not acceptable.
- 19.07 If the Contract is to be awarded, Owner may award the Contract to the responsive, responsible, and eligible Bidder, offering the lowest price for the Bid and whose Bid is in the best interests of the Project or public.

ARTICLE 20 – CONTRACT SECURITY AND INSURANCE

- 20.01 Article 5 of the General Conditions and Supplementary Conditions, if any, set forth Owner’s requirements as to performance and payment bonds and insurance. The Successful Bidder shall deliver such bonds and evidence of insurance coverage within 10 days of receipt of the Notice of Award.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 The Owner will issue a Notice Award to the Successful Bidder in the form included in Bidding Documents. Within 10 days of receipt of the Notice of Award, the Successful Bidder shall comply with the conditions set forth therein and provide requested information.
- 21.02 Based on required reviews and approvals, Owner will thereafter provide the required number of counterparts of the Agreement and other Contract Documents which are identified in the Agreement. The Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and other Contract Documents to Owner within the time specified by the Owner. After obtaining required reviews and approvals for Contract execution, Owner shall return one fully signed counterpart the Agreement and other Contract Documents.

ARTICLE 22 – RETAINAGE

- 22.01 Provisions concerning retainage are set forth in the Agreement.

ARTICLE 23 – CONTRACTOR’S WARRANTY AND GUARANTEES; CORRECTION PERIOD

- 23.01 Provisions concerning Contractor’s general warranty and guarantees and correction period are set forth in Articles 6.19, 13.06, and 13.07 of the General and Supplementary Conditions, if any.

ARTICLE 24 – SAFETY AND HEALTH REGULATIONS

- 24.01 This Project is subject to the Safety and Health Regulations of the U.S. Department of Labor set forth in Title 29 CFR, Part 1926 and to all subsequent amendments and other requirements identified in Section 00 73 19 of the Supplementary Conditions.

ARTICLE 25 – SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

- 25.01 Supplementary Instructions to Bidders, if any, are included in Section 00 22 13 and may include certain provisions required by Laws and Regulations and funding agencies. Bidders are solely responsible to determine, obtain, review and interpret the full text of applicable Laws and Regulations.

END OF SECTION

SECTION 00 22 13

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The following supplement or modify the Instructions to Bidders pursuant to Article 26 therein. This section does not represent or reflect all applicable Laws and Regulations and may only include excerpts, portions, and para-phrasing of certain Laws and Regulations. Bidders are solely responsible to determine, obtain, review and interpret the full text of applicable Laws and Regulations.

1.01 Applicable Laws for Bid and Award; General

- A. This Contract is being bid under the provisions of Massachusetts General Law (MGL) Chapter 30, Section 39M, *Contracts for construction and materials; manner of awarding*.

1.02 Additional Defined Terms

- A. *Bid security* – Also “bid deposit” as used in MGL Chapter 30, Section 39M.
- B. *Lowest Responsible and Eligible Bidder* – the Successful 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 its ability to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the Work; who shall certify that all employees to be employed at the Work Site 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 (if awarded a Contract); and who obtains within 10 days of the Notice of Award, the bonds required by the General Conditions and Supplementary Conditions, if any (consistent with the security by bond required under MGL Chapter 149 Section 29), provided that for the purposes of this Section the term “security by bond” shall mean the bond of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Owner and if there is more than 1 surety company, the surety companies shall be jointly and severally liable, in accordance with the provisions of Chapter 30, Section 39M.

1.03 Other Requirements of the MGL Applicable to the Project

- A. **Foreign Corporations:** The provisions of MGL Chapter 30, Section 39L, *Public construction work by foreign corporations; restrictions and reports*, apply to this Project. If a Bidder is a foreign corporation, it shall provide with its Bid, a certificate from the Commonwealth of Massachusetts Secretary of State stating that the corporation has complied with requirements of Section 15.03 of

subdivision A of Part 15 of MGL 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 further, will provide such certificate for each Subcontractor that is a foreign corporation if it receives a Notice of Award. See Section 00 45 05 of the Bidding Requirements.

- B. **Taxes:** Bidder shall submit with its Bid, a “Certificate of Good Standing” with respect to all returns due and taxes from the Commonwealth of Massachusetts Department of Revenue certifying Bidder has complied with all laws relating to taxes, reporting of employees and contractors, and withholding and remitting of child support. Bidder will provide such certificate for each Subcontractor if it receives a Notice of Award. Bidders are encouraged to obtain such Certificate of Good Standing online at <http://www.mass.gov/dor/businesses/programs-and-services/certificate-of-good-standing.html>. See explanation and instructions at the end of this Section.
- C. **Debarment:** A Bidder is ineligible to bid or enter into a public contract in the Commonwealth of Massachusetts if it has been debarred from bidding on or entering into a public contract under the provisions of MGL Chapter 29, Section 29F, *Debarment from bidding; definitions; lists; notice; affiliates; mitigating circumstances*, or any other applicable debarment provisions of any other chapter of the MGL or any rule or regulations promulgated thereunder.
- D. **Financial Statements:** If Bidder receives a Notice of Award, the following shall be submitted prior to execution of the Agreement in accordance with MGL Chapter 30, Section 39R *Definitions; contract provisions; management and financial statements; enforcement*.
- A statement by management on internal accounting controls;
 - A statement prepared by an independent certified public accountant regarding management’s statement; and
 - An audited financial statement for the most recent completed fiscal year.
- E. **Labor Preferences and Work Hours**
1. The provisions of MGL Chapter 149, Section 26, *Public works; preference to veterans and citizens; wages*, apply to this Project whereby employment in the construction of public works is subject to preference being given to citizens of the Commonwealth of Massachusetts, citizens of the town or city where the Project is located, veterans and service-disabled veterans, and citizens of the United States, and the provisions of MGL Chapter 149, Section 179A, *Preference to citizens in awarding public work contracts, violations*, apply to this Project whereby award of contracts for public work is subject to preference being given to persons who are citizens of the United States.

2. The provisions of MGL Chapter 149, Sections 26, 27, and 27A through 27D, as amended, covering minimum wage rates as issued by the Executive Office of Labor and Workforce Development, Department of Labor Standards apply to this Project. It is the responsibility of the Bidders, 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 the resulting Contract. See Supplementary Conditions.
 3. The provisions of MGL Chapter 149, Section 30, *Eight hour day and six day week; emergencies; work on highways*, and Section 34, *Public contracts; stipulation as to hours and days of work; void contracts*, apply to this Project which regulate work hours for public construction.
- F. **Sales Tax Exemption:** MGL Chapter 64H, Section 6, *Exemptions*, subsection (f), exempts building materials and supplies to be used in the Project from Commonwealth of Massachusetts sales tax and Bidder shall not include any amount therefor. The words “building materials and supplies” shall include all materials and supplies consumed, employed or expended in the construction, reconstruction, alteration, remodeling or repair of any building, structure, public highway, bridge, or other such public work, as well as such materials and supplies physically incorporated therein. Said words shall also include rental charges for construction vehicles, equipment and machinery rented specifically for use on the Project Site, or while being used exclusively for the transportation of materials for the Project.
- G. **Safety and Health:** This Project is subject to Massachusetts Department of Labor and Industries, Division of Occupational Safety 454 CMR 10.00 et seq. “*Construction Industry Rules and Regulations*”; Massachusetts Department of Public Safety 520 CMR 14.00 et seq. “*Excavation and Trench Safety*”; MGL Chapter 82, *The Laying Out, Alteration, Relocation and Discontinuance Of Public Ways and Specific Repairs Thereon*; MGL Chapter 82A, *Excavation and Trench Safety*, and MGL Chapter 149 Section 129A, *Shoring Trenches for local governments*.
- H. **Special Licensing**
1. Work involving the removal, containment, or encapsulation of asbestos or material containing asbestos must be performed by a contractor licensed in accordance with MGL Chapter 149, Section 6B.
 2. Sheet metal work must be performed by a contractor licensed in accordance with 271 CMR 1.00, et seq. governing licensing, permitting, and sheet metal work in Massachusetts.

228340.04

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Contract A
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Salem, Massachusetts

- I. **Price Adjustments for Certain Materials:** As required by Chapter 150 of the Acts of 2013, the provisions of MGL Chapter 30, Section 38A, *Price adjustment clause in contracts for road, bridge, water and sewer projects awarded under Sec. 39M*, apply to this Project. Base Prices are established in Section 00 73 73, SC-12.01.

<http://www.mass.gov/dor/businesses/programs-and-services/certificate-of-good-standing>.



The Official Website of the Department of Revenue (DOR)

Department of Revenue

About DOR

[Home](#) [Businesses](#) [Programs & Services](#) [Certificate of Good Standing](#)

Certificate of Good Standing

Corporations and other organizations often need proof that they are in good standing with the Commonwealth, i.e., that all tax liabilities have been met in order to obtain financing, sell their business, renew licenses or enter into other business transactions.

The fastest and easiest way to obtain a Certificate is via our [online application](#). Both taxpayers and authorized practitioners can use this program to obtain a Certificate within a few days. Before beginning this process, make sure that key authenticating data is readily available, including the entity's id number, a list of tax types filed with DOR and the dates when the entity was first required to collect and submit these taxes.

Once the applicant has been authenticated, a search will be made of our databases to identify any returns that need to be filed or bills that remain unpaid. Since this process takes up to 48 hours, users will be given an application number and asked to come back to the program in a couple of days. At that time, fully compliant taxpayers will be able to print a Certificate or request that it be mailed to the address of record. If bills are identified, an opportunity will be given to pay the amount owed via EFW. A Certificate will then be issued. Taxpayers with nonfiled Trustee tax returns (Sales, Meals, Withholding, Room Occupancy), can file and pay within the application and obtain their Certificate. Taxpayers with nonfiled Income and Corporate returns will be given instructions on how to file on paper and obtain a Certificate.

Please note:

Taxpayers responsible for certain taxes such as Alcoholic Beverage Excise, Cigarette Excise, Sales Tax on Boats, International Fuels Tax Agreement, Smokeless Tobacco or Ferry Embarkation will need to file a paper application. This [form](#) can be printed from this site. **Paper applications can take 4 to 6 weeks.**

Paper applications are also required in order to obtain a Waiver of Corporate Tax lien.

Dissolutions: Corporations have not been required to obtain a Certificate of Good Standing prior to a voluntary dissolution since March 1992.

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END OF SECTION

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SECTION 00 31 00

AVAILABLE PROJECT INFORMATION

INFORMATION	LOCATION
Order of Conditions	Section 01 15 30
Easements, Permits, Rights-of-Way	Available from Owner
Environmental and Geotechnical Assessment	Section 01 70 00
Subsurface Explorations and Laboratory Testing	Section 01 70 00
MassDEP Chapter 91 Waterway License Modification	Section 01 70 00
Record of Environmental Considerations	Section 01 70 00

END OF SECTION

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SECTION 00 41 01

BID FORM

ARTICLE 1 – DEFINED TERMS

- 1.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions and Supplementary Conditions, if any.

ARTICLE 2 – BID RECIPIENT

- 2.01 This Bid is submitted to:

**City of Salem, Massachusetts
Office of the Purchasing Agent
93 Washington Street, 2nd Floor
Salem, Massachusetts 01970
Attn: Whitney C. Haskell, Purchasing Agent**

- 2.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 3 – BIDDER'S ACKNOWLEDGEMENTS

- 3.01 Bidder accepts all of the terms and conditions of the Bidding Documents including, without limitation:
- A. those dealing with disposition of Bid security;
 - B. those included in the Supplementary Instructions to Bidders;
 - C. insurance and bonding requirements (Payment Bond and Performance Bond each equal to 100% of the total Contract Price) set forth in the General Conditions and Supplementary Conditions, if any;
 - D. Contract Times as set forth in the Agreement; and
 - E. provisions for liquidated damages as set forth in the Agreement.

- 3.02 This Bid will remain subject to acceptance for 90 days after the Bid opening or for such longer period of time that Bidder may agree to in writing upon request of Owner.
- 3.03 Bidder acknowledges receipt of the following Addenda.

<u>Addendum No.</u>	<u>Addendum Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- 3.04 Bidder acknowledges the representations and certifications included in Section 00 45 05 are made a condition of the Bid.

ARTICLE 4 – BASIS OF BID

- 4.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s) **based on unit prices included in Section 00 43 22. Bidder must complete all items.**

BID PRICES SHALL EXCLUDE SALES AND USE TAX.

TOTAL BID PRICE (based on Unit Prices Form)

_____ Dollars and _____ Cents
(Use words)

\$ _____
(Use figures)

- 4.02 Unit Prices have been computed in accordance with Paragraph 11.03.A of the General Conditions and Supplementary Conditions, if any.
- 4.03 Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for unit price items will be based on actual quantities determined and based on the unit prices included in Section 00 43 22, as provided in the General Conditions and Supplementary Conditions, if any.

4.04 Contract Price Adjustments

- A. Per MGL c30s38A, Base Prices for diesel fuel, gasoline, liquid asphalt, and portland cement in cast-in-place concrete to be used for Contract Price Adjustments are established in Section 00 73 73, SC-12.01.

ARTICLE 5 – TIME OF COMPLETION

5.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions and Supplementary Conditions, if any, on or before the dates or within the number of calendar days indicated in the Agreement.

5.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 6 – ATTACHMENTS TO THIS BID

6.01 The following documents are submitted with and made a condition of this Bid:

00 43 13 Bid Bond – Penal Sum Form

OR

Required Bid security in the form of _____

Supplements:

00 43 22 Unit Prices Form

00 43 25 Substitution Request Form (During Procurement)

00 43 40 Information, Schedules and Data

00 43 93 Bid Submittal Checklist

00 45 05 Bidder's Representations and Certifications **including required submittals, certifications, compliance statements and forms**

00 45 13 Bidder's Qualifications

00 45 19 Non-collusion Affidavit

ARTICLE 7 – BID SUBMITTAL

7.01 This Bid is submitted by:

A Corporation

Corporation Name: _____

State of incorporation: _____

Type: _____
(General Business, Professional, Service, other)

By: _____
(Signature – attach evidence of authority to sign)

Name *(typed or printed)*: _____

Title: _____

(CORPORATE SEAL)
Attest:

(Signature of Corporate Secretary)

Business Address: _____

Phone & Facsimile Nos: _____

Email address: _____

Date of qualification to do business as out-of-state corporation: _____

A Limited Liability Company (LLC)

LLC Name: _____

State in which organized: _____

By: _____
(Signature – attach evidence of authority to sign)

Name *(typed or printed)*: _____

Title: _____

Business Address: _____

Phone & Facsimile Nos: _____

Email address: _____

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Contract A
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A Joint Venture

First Joint Venturer Name: _____

By: _____
(Signature – attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business Address: _____

Phone & Facsimile Nos: _____

Email address: _____

Second Joint Venturer Name: _____

By: _____
(Signature – attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business Address: _____

Phone & Facsimile Nos: _____

Email address: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, corporation and limited liability company that is a party to the joint venture should be in the manner indicated above.)

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Contract A
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A Partnership

Partnership Name: _____(SEAL)

By: _____
(Signature of general partner – attach evidence of authority to sign)

Name (typed or printed): _____

Business Address: _____

Phone & Facsimile Nos: _____

Email address: _____

An Individual

Name (typed or printed): _____

By: _____
(Individual's signature)

Doing business as: _____

Business Address: _____

Phone & Facsimile Nos: _____

Email address: _____

228340.04
Issue Date: January 2017

Contract A
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SUBMITTED ON:
EIN/FEIN:

Communications concerning this Bid shall be addressed to:

Name: _____

Title: _____

Business Address: _____

Phone & Facsimile Nos: _____

Email address: _____

END OF SECTION

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BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER (*Name and Address*):

SURETY (*Name and Address of Principal Place of Business*):

OWNER (*Name and Address*):

BID

Bid Due Date:

Description (*Project Name and Include Location*):

BOND

Bond Number:

Date (*Not earlier than Bid due date*):

Penal sum _____ \$ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00 43 22

UNIT PRICES FORM

Provide unit pricing for each Bid item in both words and figures. Provide Bid item totals in figures. Discrepancies between prices written in words and prices written in figures will be resolved in favor of prices written in words. Discrepancies between the multiplication of estimated quantities and unit prices will be resolved in favor of the unit prices.

BID PRICES SHALL EXCLUDE SALES AND USE TAX.

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
1	Mobilization and Demobilization	1				
	@ _____ _____dollars and _____cents PER LUMP SUM	LS				
2a	6-inch PVC Sewer Pipe	5				
	@ _____ _____dollars and _____cents PER LINEAR FOOT	LF				
2b	8-inch PVC Sewer Pipe	25				
	@ _____ _____dollars and _____cents PER LINEAR FOOT	LF				
2c	15-inch PVC Sewer Pipe	373				
	@ _____ _____dollars and _____cents PER LINEAR FOOT	LF				
3	4-inch PVC Sewer Service	105				
	@ _____ _____dollars and _____cents PER LINEAR FOOT	LF				
4	4-foot Diameter Sewer Manhole	1				
	@ _____ _____dollars and _____cents PER EACH	EA				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
5	Sewer Manhole Frame and Cover @ _____ _____dollars and _____cents PER EACH	1				
		EA				
6a	6-inch PVC Drain Pipe @ _____ _____dollars and _____cents PER LINEAR FOOT	99				
		LF				
6b	12-inch PVC Drain Pipe @ _____ _____dollars and _____cents PER LINEAR FOOT	1,241				
		LF				
6c	18-inch PVC Drain Pipe @ _____ _____dollars and _____cents PER LINEAR FOOT	280				
		LF				
6d	42-inch Class III RCP Drain Pipe @ _____ _____dollars and _____cents PER LINEAR FOOT	531				
		LF				
6e	48-inch Class III RCP Drain Pipe @ _____ _____dollars and _____cents PER LINEAR FOOT	106				
		LF				
7	30-inch Cement Lined Ductile Iron Drain Pipe @ _____ _____dollars and _____cents PER LINEAR FOOT	1,006				
		LF				
8	Forest River Park Pre-Cast Concrete Box Culvert Area @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				
9	4-foot Diameter Catch Basin @ _____ _____dollars and _____cents PER EACH	16				
		EA				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
10a	4-foot Diameter Drainage Manhole @ _____ _____dollars and _____cents PER EACH	4				
		EA				
10b	5-foot Diameter Drainage Manhole @ _____ _____dollars and _____cents PER EACH	1				
		EA				
10c	6-foot Diameter Drainage Manhole @ _____ _____dollars and _____cents PER EACH	1				
		EA				
10d	8-foot Diameter Drainage Manhole @ _____ _____dollars and _____cents PER EACH	5				
		EA				
11	Catch Basin Frame and Grate @ _____ _____dollars and _____cents PER EACH	16				
		EA				
12a	Drainage Manhole Frame and Cover @ _____ _____dollars and _____cents PER EACH	10				
		EA				
12b	Bolted Drainage Manhole Frame and Cover @ _____ _____dollars and _____cents PER EACH	1				
		EA				
13	Plunge Pool @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				
14	Grassed Channel & Forest River Park Grading @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
15	Remove & Reinstall Masonry Wall @ _____ _____ dollars and _____ cents PER LUMP SUM	1				
		LS				
16	8-inch Cement Lined Ductile Iron Manhole Vent @ _____ _____ dollars and _____ cents PER LUMP SUM	1				
		LS				
17a	6-inch Cement Lined Ductile Iron Water Pipe @ _____ _____ dollars and _____ cents PER LINEAR FOOT	497				
		LF				
17b	8-inch Cement Lined Ductile Iron Water Pipe @ _____ _____ dollars and _____ cents PER LINEAR FOOT	2,140				
		LF				
17c	12-inch Cement Lined Ductile Iron Water Pipe @ _____ _____ dollars and _____ cents PER LINEAR FOOT	400				
		LF				
18a	6-inch Gate Valve & Box @ _____ _____ dollars and _____ cents PER EACH	8				
		EA				
18b	8-inch Gate Valve & Box @ _____ _____ dollars and _____ cents PER EACH	23				
		EA				
18c	12-inch Gate Valve & Box @ _____ _____ dollars and _____ cents PER EACH	6				
		EA				
19	Hydrants @ _____ _____ dollars and _____ cents PER EACH	6				
		EA				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
20a	3/4-inch Type K Copper Service Tubing @ _____ _____ dollars and _____ cents PER LINEAR FOOT	26				
		LF				
20b	1-inch Type K Copper Service Tubing @ _____ _____ dollars and _____ cents PER LINEAR FOOT	662				
		LF				
21a	3/4-inch Corporation Stop @ _____ _____ dollars and _____ cents PER EACH	1				
		EA				
21b	1-inch Corporation Stop @ _____ _____ dollars and _____ cents PER EACH	28				
		EA				
21c	3/4-inch Curb Stop and Box @ _____ _____ dollars and _____ cents PER EACH	1				
		EA				
21d	1-inch Curb Stop and Box @ _____ _____ dollars and _____ cents PER EACH	28				
		EA				
22a	Cement Lined Ductile Iron Fittings – Force Main @ _____ _____ dollars and _____ cents PER POUND	2,400				
		LBS				
22b	Cement Lined Ductile Iron Fittings – Water Distribution @ _____ _____ dollars and _____ cents PER POUND	3,555				
		LBS				
23	Forest River Park Meter Vault and Piping @ _____ _____ dollars and _____ cents PER LUMP SUM	1				
		LS				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
24	Disinfection, Pressure and Bacteria Testing of Water Mains @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				
25a	2-inch Temporary Bypass Water Main @ _____ _____dollars and _____cents PER LINEAR FOOT	1,660				
		LF				
25b	6-inch Temporary Bypass Water Main @ _____ _____dollars and _____cents PER LINEAR FOOT	2,280				
		LF				
26	Control Density Fill @ _____ _____dollars and _____cents PER CUBIC YARD	20				
		CY				
27	Granite Curb Returns @ _____ _____dollars and _____cents PER EACH	54				
		EA				
28a	Remove and Reset Granite Curb @ _____ _____dollars and _____cents PER LINEAR FOOT	2,376				
		LF				
28b	Granite Curb (New) @ _____ _____dollars and _____cents PER LINEAR FOOT	254				
		LF				
28c	Remove and Reuse Granite Curb @ _____ _____dollars and _____cents PER LINEAR FOOT	263				
		LF				
28d	Granite Curb Filler (New) @ _____ _____dollars and _____cents PER LINEAR FOOT	30				
		LF				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
29	Bituminous Curb @ _____ _____dollars and _____cents PER LINEAR FOOT	238				
		LF				
30	Remove Existing Sidewalk @ _____ _____dollars and _____cents PER SQUARE YARD	2,522				
		SY				
31	Concrete Sidewalk @ _____ _____dollars and _____cents PER SQUARE YARD	2,522				
		SY				
32	Bituminous Asphalt Concrete Sidewalk @ _____ _____dollars and _____cents PER SQUARE YARD	167				
		SY				
33	Accessible Curb Ramps (Type A, B, C, D, E, F) @ _____ _____dollars and _____cents PER EACH	40				
		EA				
34	Detectable Warning Panel @ _____ _____dollars and _____cents PER EACH	2				
		EA				
35	Concrete Driveway Aprons @ _____ _____dollars and _____cents PER EACH	27				
		EA				
36	Temporary Trench Pavement @ _____ _____dollars and _____cents PER TON	1,100				
		TON				
37	Permanent Trench Pavement @ _____ _____dollars and _____cents PER SQUARE YARD	340				
		SY				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
38a	Forest Ave/Clifton Ave Area Mill and Overlay	7,643				
	@ _____ _____dollars and _____cents PER SQUARE YARD	SY				
38b	Forest Park Drive Area Mill and Overlay	2,006				
	@ _____ _____dollars and _____cents PER SQUARE YARD	SY				
39	Pavement Marking	1				
	@ _____ _____dollars and _____cents PER LUMP SUM	LS				
40a	Full Depth Pavement and Road Subbase – Forest River Park Ballfield Access Roadway	606				
	@ _____ _____dollars and _____cents PER SQUARE YARD	SY				
40b	Full Depth Pavement and Road Subbase – Clifton Ave Roadway Widening	125				
	@ _____ _____dollars and _____cents PER SQUARE YARD	SY				
41	Pavement Overlay – Forest River Park Roadway	2,655				
	@ _____ _____dollars and _____cents PER SQUARE YARD	SY				
42	Remove and Reset Bollards	2				
	@ _____ _____dollars and _____cents PER EACH	EA				
43	6-Foot High Wooden Stockade Fence at Forest River Park	415				
	@ _____ _____dollars and _____cents PER LINEAR FOOT	LF				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
44	6-Foot High, 10-Foot Wide Wooden Stockade Fence Gate at Forest River Park @ _____ _____dollars and _____cents PER EACH	1				
		EA				
45	6-Foot High Chain-Link Fence at Forest River Park Outfall @ _____ _____dollars and _____cents PER LINEAR FOOT	146				
		LF				
46	6-Foot High, 12-Foot Wide Chain-Link Fence Gate at Forest River Park Outfall @ _____ _____dollars and _____cents PER EACH	1				
		EA				
47	Tree Removal and Disposal @ _____ _____dollars and _____cents PER EACH	9				
		EA				
48	Forest River Park Benches @ _____ _____dollars and _____cents PER EACH	2				
		EA				
49	Forest River Park Baseball Field Area Improvements @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				
50	Pond Area Site Improvements @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				
51	Forest River Basketball Court Area Improvements @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				

Item No.	Item Description with Unit Price in Written Words	Estimated Quantity & Unit	Unit Bid Price		Total Bid Item Price	
			Dollars	Cents	Dollars	Cents
52	Geotechnical Instrumentation and Monitoring @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				
53	Unsuitable Material Excavation and Replacement Below Normal Grade @ _____ _____dollars and _____cents PER CUBIC YARD	20				
		CY				
54	Rock/Boulder Excavation @ _____ _____dollars and _____cents PER CUBIC YARD	625				
		CY				
55	Forest River Park Electrical @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				
56	Conformed to Construction Record Drawings and As-Builts @ _____ _____dollars and _____cents PER LUMP SUM	1				
		LS				
57	Additional Hours of Work Fee (Deduction) @ ONE-HUNDRED THIRTY dollars and ZERO cents PER HOUR	0				
		HR	(\$130.00)		(\$0.00)	
58	Owner's Contingency Allowance for Temporary Signage (per Paragraph 11.02 of the General Conditions) @ THIRTY THOUSAND dollars and ZERO cents NOT TO EXCEED	1				
		NTE	\$30,000.00		\$30,000.00	
59	Owner's Contingency Allowance for Materials Escalation (Statutory) (per Paragraph 11.02 of the General Conditions) @ FIFTY-FOUR THOUSAND dollars and ZERO cents NOT TO EXCEED	1				
		NTE	\$54,000.00		\$54,000.00	

END OF SECTION

SECTION 00 43 25

SUBSTITUTION REQUEST FORM (DURING PROCUREMENT)

PROPOSED SUBSTITUTIONS, INCLUDING PROPOSED “OR-EQUAL” ITEMS, MAY ONLY BE SUBMITTED FOR PROPRIETARY ITEMS SPECIFIED ONLY ON THIS FORM AND MAY BE ACCEPTED OR REJECTED UNILATERALLY BY OWNER, IN ITS SOLE DISCRETION.

Each proposed substitution for proprietary items specified (including any “or-equal” items to be submitted for consideration prior to receipt of Bids and excluding priced options or alternates specified in the Bid Form) must be summarized and additively or deductively priced below with specific details included or attached in accordance with the instructions below. The summary must include a reference to the section(s) of the Bidding Documents affected by the proposed exception or deviation.

Bids that do not comply with these requirements for the presentation of substitutions and or-equal items may be considered non responsive and may be rejected at the discretion of the Owner.

Presentation of Specific Details of Substitutions and “Or-Equal” Items for Proprietary Items Specified Only

1. Identify proposed substitutes and “or-equal” items and submit requests for consideration in accordance with Article 11 of the Instructions to Bidders.
2. Describe specific details of substitutions and “or-equal” items by referencing the applicable section number, section title, page number, heading(s), and paragraph(s) of the Bidding Documents. Include this information directly in "Description" column of table below and/or include a separate attachment if necessary, referencing the attachment in the "Description" column.
3. Present proposed deletions by setting off in brackets, thus: [delete this language], and present proposed substitute or new language by underlining, thus: substitute this language.
4. Each substitution and “or-equal” item is to be separately priced. Zero may be used.

SUMMARY OF SUBSTITUTIONS AND “OR-EQUAL” ITEMS

Description	Price Adjustment Amount (Indicate deductions in parentheses)

END OF SECTION

SECTION 00 43 40

INFORMATION, SCHEDULES AND DATA

SCHEDULE

Provide a proposed Project Schedule based on a Notice to Proceed issued approximately April 3, 2017, Substantial Completion by December 1, 2017 and ready for final payment by December 31, 2017. The Forest River Park portion of the Work must be completed as stated in specification section 01 11 00. The schedule shall be presented in sufficient detail for the Owner to evaluate the Bidder's ability to perform the Work within the Contract Times and shall include:

- milestones related to submittal schedules, procurement, construction, and checkout & functional testing;
- special requirements and special sequencing required by and the Conservation Commission.

WORK PLAN

Submit a narrative work plan describing the Bidder's approach to the successful execution of the Work to accommodate the proposed Project Schedule and provide for special requirements. Allow for review of submittals, coordination, and development of detailed construction sequencing and coordination; and compliance with special requirements.

Describe:

- how schedule progress will be measured and tracked;
- how the Schedule of Values and cash flow will be determined and how progress for payment will be determined; and
- how documents will be controlled to assure that the appropriate revision is used in design, procurement, and construction/installation.

CONSUMABLES, SPARE PARTS AND SPECIAL TOOLS

Submit a complete list of recommended consumables, spare parts and special tools and pricing for the equipment to be furnished and installed by Contractor f.o.b. Site, exclusive of sales tax. The recommended consumables, spare parts and special tools listed may be purchased at Owner's option and are not included in the Bid Prices.

END OF SECTION

SECTION 00 43 93

BID SUBMITTAL CHECKLIST

Bidder confirms that the following documents are fully completed, included in and made part of its Bid.

- 00 41 01 Bid Form
- 00 43 13 Bid Bond – Penal Sum Form
- OR*
- Required Bid security in the form of _____

Supplements

- 00 43 22 Unit Prices Form
- 00 43 25 Substitution Request Form (During Procurement)
- 00 43 40 Information, Schedules and Data
- 00 45 05 Bidder’s Representations and Certifications
 - including required submittals, certifications, compliance statements and forms**
- 00 45 13 Bidder's Qualifications
- 00 45 19 Non-collusion Affidavit
- One hardcopy, signed original (with original Bid security) has been submitted to the Owner in accordance with Section 00 21 13.

CONFIRMED BY BIDDER ON:
By:
<i>Authorized person per Bid Form</i>

END OF SECTION

This page intentionally left blank

SECTION 00 45 05

BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

The undersigned, under the penalties of perjury, represents and certifies the following which is made a condition of the Bid.

1.01 Bidder's Representations

- A. Bidder has examined and carefully studied the Bidding Documents and other related data identified in the Bidding Documents.
- B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Section 00 73 10 of the Supplementary Conditions Paragraph 4.02 as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Section 00 73 10 of the Supplementary Conditions Paragraph 4.06 as containing reliable "technical data."
- E. Bidder has considered the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs.
- F. Based on the information and observations referred to in Paragraph E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of the Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which the Bid is submitted.

1.02 Bidder's Certifications

- A. The Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid and has not solicited or induced any individual or entity to refrain from bidding.
- C. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish Bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.
- D. Bidder will comply with the requirements of the Safety and Health provisions in the Contract Documents, and if Bidder is awarded a Contract, it shall incorporate these provisions into all subcontracts and Purchase Orders so that such provisions will be binding upon each Subcontractor or Supplier.

- E. Bidder will comply with the requirements of the Equal Employment Opportunity, Anti-discrimination, and Affirmative Action Program provisions in the Contract Documents, and if Bidder is awarded a Contract, it shall incorporate these provisions into all subcontracts and Purchase Orders so that such provisions will be binding upon each Subcontractor or Supplier.
- F. Bidder or Subcontractor performing the Work possess the following certifications and have submitted evidence thereof.
 - 1. Utility pipe installation and paving: MassDOT pre-qualification.

1.03 Bidder's Certifications Required by Massachusetts General Law (MGL)

- A. The Bid is in all respects bona fide, fair and made without collusion or fraud with any other person. "Person" here means any natural person, joint venture, partnership, corporation or other business or legal entity.
- B. Bidder has submitted a certificate from the Secretary of State of the Commonwealth of Massachusetts that the corporation has complied with requirements of Section 15.03 of subdivision A of Part 15 of MGL 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 if Bidder is a foreign corporation. Bidder certifies it will provide such certificate for each Subcontractor that is a foreign corporation if it receives a Notice of Award.
- C. Bidder certifies, under the penalties of perjury, to the best of its knowledge and belief, that all state tax returns have been filed and all state taxes paid pursuant to MGL Chapter 62C, Section 49A, and has submitted a Certificate of Good Standing with respect to all returns due and taxes from the Commonwealth of Massachusetts Department of Revenue certifying Bidder has complied with all laws relating to taxes, reporting of employees and contractors, and withholding and remitting of child support. Bidder certifies it will provide such certificate for each Subcontractor if it receives a Notice of Award.
- D. Bidder certifies that if awarded the Contract, the following will be submitted prior to execution of the Agreement in accordance with MGL Chapter 30, Section 39R *Definitions; contract provisions; management and financial statements; enforcement*.
 - A statement by management on internal accounting controls;
 - A statement prepared by an independent certified public accountant regarding management's statement; and
 - An audited financial statement for the most recent completed fiscal year.

- E. Bidder certifies that if awarded the Contract, any Work involving the removal, containment, or encapsulation of asbestos or material containing asbestos will only be performed by a licensed contractor in accordance with MGL Chapter 149, Section 6BA.
- F. Bidder 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 further certifies that all employees to be employed at the Work Site 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 if Bidder is awarded a Contract, shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.
- G. Bidder is not presently debarred from bidding on or entering into a public contract Commonwealth of Massachusetts under the provisions of MGL Chapter 29, Section 29F, or any other applicable debarment provisions of any other chapter of the MGL or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

SUBMITTED ON:
By:
<i>Authorized person per Bid Form</i>

END OF SECTION

SECTION 00 45 13

BIDDER'S QUALIFICATIONS

The following data, statements of experience, personnel, equipment and general qualifications are submitted as a part of the Bid and the Bidder represents and guarantees the truthfulness and accuracy thereof and **its ability to meet the qualifications requirements specified in Section 01 43 05 and the Specifications**. Attach additional sheets as necessary properly cross referenced. **Failure to provide complete and truthful information requested may be considered a non-responsive Bid by the Owner.**

1.01 GENERAL

- A. Bidder's organization is a _____
(entity type) and has been in business continuously from the year _____.
- B. Bidder has operated under the same business name and organization structure for the last 5 years on at least 5 projects yes no
- C. If no, indicate other business names: _____

Bidder's organization has had experience in construction comparable to that required by the Contract Documents as a prime contractor for _____ years and as a subcontractor for _____ years.

Bidder or Subcontractor performing the Work must submit the following.

1. Utility pipe installation and paving: MassDOT pre-qualification.

1.02 CONTRACTOR EXPERIENCE

A. Identify at least 5 projects with a total value in excess of \$5 million within the past 10 years.

Client/Owner Name/Address	Project Name/Location	CURRENT Contact Name, Phone, Email	Contract Value	Time Period

- B. Submit detailed information for each person or firm evidencing qualifications and experience and ability to meet the requirements specified in Section 01 43 05 and the Specifications for the following.
1. Sewage or stormwater bypass pumping: provided, operated, and maintained by a firm that has been regularly engaged in providing bypass pumping for the last 10 years and with at least 20 successful projects.
 2. Surveying: registered surveyor in Massachusetts that has been regularly and continuously engaged in surveying for the last 10 years.
 3. Excavation and shoring: experienced in the Work specified as Sections of Division 31 for a minimum of continuous experience in the last 5 years.
 4. Geotechnical monitoring: minimum 5 years' experience in as specified in Section 31 09 00 with professional engineer registration in Massachusetts.

1.04 PROPOSED DESIGN PROFESSIONALS AND SURVEYORS

A. Complete the following.

Name	Address	Area of Responsibility	Years of Experience
		Surveyor	Regularly and continuously engaged in surveying work for the past 10 years
		Geotechnical Monitoring Contractor	Minimum 5 years
		Geotechnical Monitoring Instrumentation Engineer	Minimum 5 years of directly related experience

B. Attach detailed resumes of qualifications, previous employers and experience for each design professional and surveyor listed above.

1.07 SUPPLIERS

Name	Address	Product, Material, Equipment

1.08 PERSONNEL

- A. Identify supervisory personnel that are currently employed by the Bidder and available for assignment to the Project (project manager, superintendents, principal foremen and engineers). Identify full-time on-Site project manager in responsible charge of the Work with at least 10 years' experience as project manager on comparable projects.

Name	Title	Years of Experience
	Full time, on-Site Project Manager	Minimum 10 years

- B. Attach detailed resumes of qualifications, previous employers and experience for each supervisory staff listed above.

1.09 EMERGENCY RESPONSE CAPABILITIES

- A. Describe Bidder's 24 hour/7 days per week emergency response and communication capabilities. Attach additional documentation as necessary.

1.11 BUSINESS INTERESTS

- A. Identify the names and addresses of the members of the Board of Directors of corporation, or the names and addresses of all persons and parties interested in this Bid as partners of a partnership or as individuals.

Name	Address	Telephone No.

- B. Identify the bank or banks representing the financial responsibility of the Bidder.

Name of Bank	Address	Contact Name and Telephone No.

1.12 CITATIONS AND LITIGATION

A. Identify safety citations issued to the Bidder over the last 5 years.

Name of Client and Project	Contact Name/ Telephone No.	Type of Citation	Issued by

B. Identify projects Bidder has undertaken in the last 5 years which have resulted in partial or final settlement of the contract by arbitration or litigation.

Name of Client and Project	Contact Name/ Telephone No.	Original Contract Amount	Total Claims	Arbitrated or Litigated Amount of Settlement of Claims

1.13 LABOR DISPUTES

- A. Identify labor disputes the Bidder has been the subject of, or otherwise been involved in, during the last 5 years. For these purposes, "labor disputes" shall include picketing or any other activity which disrupted or delayed the work. Attach additional sheets as necessary.

Name and Location of the Project	
Nature of the Dispute	
Duration and dates during which the dispute took place	
How the dispute was resolved	
Name and Location of the Project	
Nature of the Dispute	
Duration and dates during which the dispute took place	
How the dispute was resolved	

END OF SECTION

SECTION 00 45 19

NON-COLLUSION AFFIDAVIT

_____, being duly sworn, depose and, under the penalty of perjury, say that the following is true:

1. I am the person responsible within my firm for the final decision as to the price(s) and amount of this Bid or, if not, that I have written authorization, enclosed herewith, from that person to make the statements set out below on his or her behalf and on the behalf of my firm.
2. The price(s) and amount of this Bid have been arrived at independently, without collusion, consultation, communication, or agreement for the purpose of restricting competition with any other contractor, competitor, Bidder, or potential Bidder.
3. Unless otherwise required by law, neither the price(s) nor the amount of this Bid have been disclosed to any other firm or person who is a Bidder, competitor, or potential Bidder on the Project, and will not be so disclosed either directly or indirectly prior to Bid opening.
4. No attempt has been made or will be made to solicit, cause, or induce any firm, partnership, corporation, or person to submit or not submit a Bid on this Project, or to submit a Bid higher than the Bid of this firm, or submit an intentionally high or noncompetitive Bid or other form of complementary Bid, or for the purpose of restricting competition.
5. The Bid of my firm is made in good faith and not pursuant to any agreement or discussion with, or inducement from, any firm or person to submit a complementary Bid.
6. My firm has not offered or entered into a subcontracting agreement regarding the purchase of materials or services from any firm or person, or offered, promised, or paid cash or anything of value to any firm or person, whether in connection with this or any other Project, in consideration for an agreement or promise by any firm or person to refrain from proposing or to submit a complementary Bid on the Project.
7. My firm has not accepted nor been promised any subcontract or agreement regarding the sale of materials or services to any firm or person, and has not been promised or paid cash or anything of value to any firm or person, whether in connection with this or any other project, in consideration for my firm's submitting a complementary Bid or agreeing to do so, on the Project.

228340.04
Issue Date: January 2017

Contract A
Canal Street Flood Mitigation Project – Phase II
Salem, Massachusetts

8. I have made a diligent inquiry of all members, officers, employees, and agents of my firm with responsibilities relating to the preparation, approval, or submission of my firm's Bid on the Project and have been advised by each of them that he or she has not participated in any communication, consultation, discussion, agreement, collusion, act, or other conduct inconsistent with any of the statements and representations made in this affidavit.

Company Name

Signature

Company Position

Date: _____

Attest: _____

Date: _____

END OF SECTION

SAMPLE NOTICE OF AWARD (C-00 51 00)

Date: _____

Project:

Owner:

Owner's Contract No.:

Contract:

Engineer's Project No.:

Bidder:

Bidder's Address:

You are notified that your Bid dated [_____] for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract for [_____] subject to the following conditions being met and subject to required reviews and approvals. *and specifically, *funding* approval by [_____].**

The *Lump Sum* *Total* Contract Price of your Contract is _____ Dollars (\$ _____).

You must comply with the following conditions precedent **within 10 days** of the date you receive this Notice of Award.

1. Deliver the Contract security (Bonds) as specified in the General Conditions and Supplementary Conditions (Articles 2 and 5);
2. Deliver the insurance certificates indicating coverages as specified in the General Conditions and Supplementary Conditions (Articles 2 and 5);
3. Deliver the following completed and executed certifications and documents:
 - a. Pursuant to MGL Chapter 30, Section 39R *Definitions; contract provisions; management and financial statements; enforcement* per Section 00 22 13:
 - A statement by management on internal accounting controls (sample attached);
 - A statement prepared by an independent certified public accountant regarding management's statement (sample attached); and
 - An audited financial statement for the most recent completed fiscal year.
 - b. From each Subcontractor:
 - Certificate of Good Standing from the Department of Revenue with respect to all returns due and taxes per Section 00 22 13
 - Certification from the Secretary of State for foreign corporations per Section 00 22 13

SAMPLE NOTICE OF AWARD (C-00 51 00)

4. Other conditions precedent:

LIST OTHERS IF ANY

Failure to comply with the above conditions within the time specified will entitle the Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

After confirming that you have complied with the above conditions *and required approvals are obtained,* Owner will deliver the conformed Contract Documents for execution.

Owner
By: _____
Authorized Signature

Title

Copy to Engineer

SAMPLE NOTICE OF AWARD (C-00 51 00)

**SAMPLE LETTER FROM CONTRACTOR REGARDING ACCOUNTING CONTROLS
Pursuant to MGL Chapter 30, Section 39R**

TO BE SUBMITTED ON CONTRACTOR'S LETTERHEAD

DATE

INSERT Owner name and address

RE: [INSERT CONTRACT #/PROJECT # AND NAME]

Dear [_____]:

This letter is being submitted pursuant to MGL Chapter 30 §39R(c). Please be advised that our firm has a system of internal accounting controls which assure that:

- (1) transactions are executed in accordance with management's general and specific authorization;
- (2) transactions are recorded as necessary, to permit preparation of financial statements in conformity with generally accepted accounting principles, and 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.

Sincerely,

[Name and title of authorized representative of Contractor]

SAMPLE NOTICE OF AWARD (C-00 51 00)

**SAMPLE LETTER FROM CPA REGARDING CONTRACTOR ACCOUNTING CONTROLS
Pursuant to MGL Chapter 30, Section 39R**

TO BE SUBMITTED ON CPA'S LETTERHEAD

DATE

INSERT Owner name and address

RE: [INSERT CONTRACT #/PROJECT # AND NAME]

Dear [_____]:

Please be advised that we have reviewed the Statement of Internal Accounting Controls prepared by [NAME OF CONTRACTOR], in connection with the above-captioned Project as required under MGL Chapter 30, § 39R. In our opinion, representations of management are consistent with our evaluations of the system of internal accounting controls and such representations are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to [NAME OF CONTRACTOR]'s financial statements.

Sincerely,

_____, CPA
[Name]

SECTION 00 52 10

AGREEMENT FORM

THIS AGREEMENT is by and between the City of Salem, Massachusetts (“Owner”) and _____ (“Contractor”). Owner and Contractor hereby agree as follows

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work and includes the following principal features and all materials, equipment, services and construction inherent to the Work.

- Installation of new storm drain PVC pipes varying from 10 inches to 66 inches in diameter and drainage manholes and catch basins
- Installation of new sanitary sewer utility pipes
- Installation of new water utility pipes and installation of hydrants and connections to existing water system
- Temporary bypass of water, sewer and drainage
- Demolition of existing concession stand and various park features
- Baseball field and basketball court demolition and reconstruction
- Forest River Park reconstruction and grading
- Pond improvement including wetlands rehabilitation and replication
- Installation of concrete box culvert
- Installation of elevated walkway
- Milling and overlaying existing pavement and construction of asphalt and concrete sidewalks

ARTICLE 2 – THE PROJECT

2.01 The Project under the Contract Documents is generally described as “**CANAL STREET FLOOD MITIGATION PROJECT – PHASE II**”.

ARTICLE 3 – ENGINEER

- 3.01 The Project has been designed by Woodard and Curran, Inc. (Engineer) which is to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

- A. All time limits for Milestones, if any, Substantial Completion, Substantial Completion Punchlist completion and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Substantial Completion, Punchlist Completion, and Final Payment*

- A. The Work shall be substantially complete by December 1, 2017 and completed and ready for final payment by December 31, 2017 in accordance with Paragraph 14.07 of the Standard General and Supplementary Conditions, if any with the exception of the work included in Section 4.02 B.
- B. All work included within the limits of the Forest River Park Ballfield and practice field shall be substantially complete by December 31, 2017 and ready for final payment by April 28, 2018 in accordance with Paragraph 14.07 and Standard General and Supplementary Conditions, if any.
- C. The Post Substantial Completion Punchlist shall be complete in accordance with Paragraph 14.07 of the Standard General and Supplementary Conditions.
- D. Interim Milestones
1. Forest River Park Ballfield portion of the Work; sod installed by November 15, 2017 and ready for public and league use on or before April 28, 2018.

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the Standard General and Supplementary Conditions, and Additional Supplementary Conditions, if any. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner as follows.
1. **Interim Milestone Damages (per each milestone); The Contractor shall pay the Owner \$1,000** for each day that expires after the time specified in Paragraph 4.02 above for **Substantial Completion of each milestone** until the Work is substantially complete and the Contractor shall pay the Owner ANY expenses incurred by the City for the milestone not completed on time.
 2. After Entire Project Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work (**Post Substantial Completion Punchlist Completion**) within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner **\$2,000** for each day that expires after the time specified in Paragraph 4.03 above.
 3. If Contractor shall neglect, refuse, or fail to **complete Final Completion** within the Contract Time specified in Paragraph 4.02 above or any proper extension thereof granted by Owner, Contractor shall pay Owner an amount equal to **1 percent** of the total Contract Price.

4.04 *Actual Damages*

- A. Contractor shall pay actual damages incurred by Owner imposed by Conservation Commission for Contractor’s failure to comply with the Order of Conditions, including civil administrative penalties, and other damages related thereto.
- B. Contractor shall pay actual damages incurred by Owner for failure to meet any of the interim milestones listed above in section 4.02.

ARTICLE 5 – CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraph 5.01.A below based on unit pricing stated in Contractor’s Bid attached hereto:

TOTAL PRICE

[IN WORDS] Dollars and [# OF CENTS] Cents

[\$[DOLLAR AMOUNT]]

- A. Unit Prices have been computed in accordance with Paragraph 11.03.A of the Standard General Conditions and Supplementary Conditions, if any.
- B. The prices for Unit Price Work set forth as of the Effective Date of the Agreement are based on estimated quantities. As provided in Paragraph 11.03 of the Standard General Conditions and Supplementary Conditions, if any, estimated quantities are not guaranteed (except for those that may be estimated by the Contractor), and determinations of actual quantities and classifications are to be made by Engineer as provided in Paragraph 9.07 of the Standard General Conditions and Supplementary Conditions, if any. Final payment for unit price items will be based on actual quantities determined and based on the unit prices in the Unit Prices Form included in Section 00 54 00.
- C. When the accepted quantity of any item of Unit Price Work performed by the Contractor (as measured in accordance with 9.07 of the General and Supplementary Conditions, if any) differs from the estimated quantity indicated in the attachment(s) to this Agreement for an item of Unit Price Work, no adjustment or allowance will be made for any increased expenses, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor resulting either directly or indirectly from such increased or decreased quantities, or from unbalanced allocation of overhead expense among the Unit Price Work items on the part of the Contractor, or subsequent loss of expected reimbursements therefor.

5.02 *Adjustments to the Contract Price*

- A. Adjustments to the Contract Price will be made for diesel fuel, gasoline, liquid asphalt, and portland cement in cast-in-place concrete based on the Base Prices and index established for adjustments in accordance with price adjustment clauses included in Section 00 73 73, SC-12.01.
- B. Adjustments to the Contract Price (deduction) will be made for each approved hour worked outside the specified allowable Work hours in Section 00 73 10 to cover additional costs incurred by the Owner such as for Engineer and Resident Site Representative (“Additional Work Fee”). Any Work conducted by the Contractor outside of the specified allowable Work hours must be approved by the Owner in advance. The Contract Price shall be reduced by \$130.00 per hour for each hour worked outside the allowable Work hours and deducted from payments due.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 14 of the Standard General Conditions and Supplementary Conditions, if any. Applications for Payment will be processed by Engineer as provided in the Standard General Conditions and Supplementary Conditions, if any, and the General Requirements.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor’s Applications for Payment on or about the (to be determined) day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the Standard General Conditions and Supplementary Conditions, if any, (and in the case of Unit Price Work based on the number of units completed).
 - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the Standard General Conditions and Supplementary Conditions, if any, and additional retainage allowed by Laws and Regulations.
 - a. Progress Payments of 95 percent for Work completed (with the balance of 5 percent being retainage); and
 - b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance of 5 percent being retainage).

2. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 99 percent of the Work completed (with the balance of 1 percent being retainage), less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and Supplementary Conditions, if any, and less the Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected (Punch List) attached to the certificate of Substantial Completion and subject to Paragraph 14.04 of the General Conditions and Supplementary Conditions, if any.

However, retainage for items planted in the ground shall remain at 5 percent of the cost of such items until Final Payment per Massachusetts General Laws Chapter 30, Section 39G.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General and Supplementary Conditions, if any, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

ARTICLE 7 – INTEREST

- 7.01 All moneys not paid when due as provided in Article 14 of the General and Supplementary Conditions, if any, shall bear interest at the rate 3 percentage points above the rediscount rate then charged by the Federal Reserve Bank of Boston per Massachusetts General Laws Chapter 30, Section 39G. Interest shall not be accrued on retainage.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS AND CERTIFICATIONS

- 8.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:
 - A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.
 - B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph SC-4.02 of the Supplementary Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that

have been identified in Paragraph SC-4.06 of the Supplementary Conditions as containing reliable "technical data."

- E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in Paragraph 8.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

8.02 The Contractor certifies, under the penalties of perjury, that:

- A. Contractor has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.
- B. Contractor has complied with all laws of the Commonwealth of Massachusetts relating to taxes, reporting of employees and contractors, and withholding and remitting of child support and, has provided for itself and each Subcontractor, a Certificate of Good Standing from the Department of Revenue with respect to all returns due and taxes and further, certifies that, to the best of its knowledge and belief, all state tax returns have been filed and all state taxes have been paid as required by Law pursuant to Massachusetts General Laws Chapter 62C, Section 49A;
 - C. If a foreign corporation, Contractor has provided for itself and each Subcontractor that is a foreign corporation, a certificate of the state secretary stating that the corporation has complied with requirements of Massachusetts General Laws Chapter 156D, Part 15, Section 15.03 of subdivision A 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, pursuant to Massachusetts General Laws Chapter 30, Section 39L;
 - D. Contractor 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 further certifies that all employees to be employed at the Work Site 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 shall furnish documentation of successful completion of said course with the first certified payroll report for each employee, all as required by Massachusetts General Laws Chapter 30, Section 39S;
 - E. Contractor is not presently debarred from entering into a public contract Commonwealth of Massachusetts under the provisions of Massachusetts General Laws Chapter 29, Section 29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
 - F. Pursuant to Massachusetts General Laws Chapter 30, Section 39R, Contractor has provided a statement by management on internal accounting controls, a statement prepared by an independent certified public accountant regarding management’s statement, and an audited financial statement for the most recent completed fiscal year;
 - G. Contractor will incorporate the applicable provisions of the Contract Documents into all subcontracts and Purchase Orders so that such provisions will be binding upon each Subcontractor or Supplier.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
 - 1. This Agreement and attachments
 - 2. Items listed in Section 00 54 00
 - 3. Forms listed in 00 60 00
 - 4. Standard General Conditions in Section 00 72 05
 - 5. Supplementary Conditions listed in Section 00 73 05
 - 6. General Requirements, Specifications and Drawings as listed in the table of contents of the Contract Documents
 - 7. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
 - a. Notice to Proceed
 - b. Work Change Directives
 - c. Change Orders
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement and made a part hereof.
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the Standard General Conditions and Supplementary Conditions, if any.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

- A. Terms used in this Agreement will have the meanings stated in the Standard General Conditions and Supplementary Conditions, if any.

10.02 *Assignment of Contract*

- A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

228340.04
Issue Date: January 2017

Contract A
Canal Street Flood Mitigation Project – Phase II
Salem, Massachusetts

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf.

This Agreement will be effective on _____ (which is the Effective Date of the Agreement).

OWNER:
CITY OF SALEM, MASSACHUSETTS

CONTRACTOR:

By: _____
Ms. Kimberley Driscoll
Mayor

By:
Printed Name
Title

By: _____
Mr. David Knowlton, P.E.
City Engineer

License No.

By: _____
Ms. Whitney Haskell
Purchasing Agent

By: _____
Ms. Sarah Stanton
Finance Director

Attest:
Title
Address for giving notices:

Attest:
Title
Address for giving notices:

Agent for service of process:

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

WOODARD & CURRAN

AGREEMENT FORM
00 52 10-11

228340.04
Issue Date: January 2017

Contract A
Canal Street Flood Mitigation Project – Phase II
Salem, Massachusetts

Approved as to Form by:

City Solicitor

Pursuant to MGL c.44, s31C, I certify that an appropriation has been made in the total amount of the Agreement.

Owner's Auditor/Accountant (Name)

Date: _____

SECTION 00 54 00

AGREEMENT FORM SUPPLEMENTS

The following items included in this Section are attached to and are incorporated into the Agreement and made a part thereof.

TO BE COMPLETED AFTER AWARD LISTING ITEMS FROM SUCCESSFUL BIDDER

- Performance Bond
- Payment Bond
- Insurance certificates

- **Certifications**
 - LIST

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PERFORMANCE BOND (Form C-006113.13)

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location)*:

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:

Amount:

Modifications to this Bond Form: None See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

(seal)

Contractor's Name and Corporate Seal

(seal)

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of

the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within

two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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PAYMENT BOND (Form C-006113.16)

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: None See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal *(seal)*

Surety's Name and Corporate Seal *(seal)*

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or

(2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond

shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

This page intentionally left blank

SAMPLE NOTICE TO PROCEED (C-00 55 00)

Date: _____

Project:

Owner:

Owner's Contract No.:

Contract:

Engineer's Project No.:

Contractor:

Contractor's Address: [send Certified Mail, Return Receipt Requested]

You are notified that the Contract Times under the above Contract will commence to run on _____. On or before that date, you are to start performing your obligations under the Contract Documents * for the following portion(s) of the Work:

Describe the limits of the Work covered

*A Notice to Proceed for the remaining Work will follow. *

In accordance with Article 4 of the Agreement, the date of Substantial Completion is _____, and the date of readiness for final payment is _____ [OR the number of days to achieve Substantial Completion is _____, and the number of days to achieve readiness for final payment is _____].

Before you may start any Work at the Site, Paragraph 2.01.B of the General Conditions, and Supplementary Conditions if any, provide that you and Owner must each deliver to the other (with copies to Engineer and other identified additional insureds and loss payees) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

SAMPLE NOTICE TO PROCEED (C-00 55 00)

Also, before you may start any Work at the Site, you must:
[add other requirements].

Owner

Given by: _____

Authorized Signature

Title

Date

Copy to Engineer

SECTION 00 60 00

PROJECT FORMS

The following forms are included in this Section and shall be used for the Project as specified in the General Conditions and Supplementary Conditions if any, and the General Requirements. Completed and execution versions of these forms used during the Project shall be incorporated into the Agreement and made a part thereof.

Application for Payment Form (C-00 62 76)
Request for Interpretation/Information Form (C-00 63 15)
Field Order Form (C-00 63 36)
Work Change Directive Form (C-00 63 49)
Change Request Form (C- 00 63 60)
Change Order Form (C-00 63 63 MA)
Notice of Substantial Completion Form (C-00 65 15)
Certificate of Substantial Completion Form (C-00 65 16)
Notice of Completion Form (C-00 65 18)

This page intentionally left blank

	Application Period:	Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

**Application For Payment
Change Order Summary**

Approved Change Orders			1. ORIGINAL CONTRACT PRICE.....	\$ _____
Number	Additions	Deductions	2. Net change by Change Orders.....	\$ _____
			3. Current Contract Price (Line 1 ± 2).....	\$ _____
			4. TOTAL COMPLETED AND STORED TO DATE	
			(Column F on Progress Estimate).....	\$ _____
			5. RETAINAGE:	
			a. X _____ Work Completed.....	\$ _____
			b. X _____ Stored Material.....	\$ _____
			c. Total Retainage (Line 5a + Line 5b).....	\$ _____
			6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c).....	\$ _____
			7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application).....	\$ _____
			8. AMOUNT DUE THIS APPLICATION.....	\$ _____
			9. BALANCE TO FINISH, PLUS RETAINAGE	
			(Column G on Progress Estimate + Line 5 above).....	\$ _____
TOTALS				
NET CHANGE BY CHANGE ORDERS				

Contractor's Certification

The undersigned Contractor certifies that to the best of its knowledge: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

By: _____ Date: _____

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____ (Engineer) _____ (Date)

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____ (Owner) _____ (Date)

Approved by: _____ Funding Agency (if applicable) _____ (Date)

Approved by: _____

**REQUEST FOR
INTERPRETATION/INFORMATION
(Form C-00 63 15)**

RFI #: _____ Attachment

To: _____

From: _____

Attn: _____

Issue Date: _____

Project: _____

Required Reply Date: _____

DISTRIBUTION:

Contractor

Owner

Engineer

REFERENCES:

- Specifications: _____ Section: _____ Page/Paragraph: _____
- Drawings: _____ Issue Date: _____ Detail/Sections: _____
- Work Area: _____ Grid/Level: _____

RFI DESCRIPTION:

From: _____

Tel No: _____ Fax: No: _____

Initial: _____

E-mail: _____

RFI REPLY:

Possible Cost Effect Yes: No:

Possible Schedule Effect Yes: No:

From: _____

Reply Date: _____ xc: _____

Initial: _____

This page intentionally left blank

Field Order (C-00 63 36)

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

Attention:

You are hereby directed to promptly execute this Field Order issued in accordance with General Conditions Paragraph 9.04.A, for minor changes in the Work without changes in Contract Price or Contract Times. If you consider that a change in Contract Price or Contract Times is required, please notify the Engineer immediately and before proceeding with this Work.

Reference: _____ (Specification Section(s)) _____ (Drawing(s) / Detail(s))

Description:

Attachments:

Engineer:

Receipt Acknowledged by Contractor:	Date:
-------------------------------------	-------

Copy to Owner

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Change Order No. _____

(Form C-00 63 63) MA

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:	Date of Contract:	
Contractor:	Engineer's Project No.:	

The Contract Documents are modified as follows upon execution of this Change Order:

Description:

Attachments (list documents supporting change):

CHANGE IN CONTRACT PRICE:

CHANGE IN CONTRACT TIMES:

Original Contract Price:

\$ _____

[Increase] [Decrease] from previously approved
Change Orders No. _____ to No. _____:

\$ _____

Contract Price prior to this Change Order:

\$ _____

[Increase] [Decrease] of this Change Order:

\$ _____

Contract Price incorporating this Change Order:

\$ _____

Original Contract Times: Working days Calendar days

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

[Increase] [Decrease] from previously approved Change Orders
No. _____ to No. _____:

Substantial completion (days): _____

Ready for final payment (days): _____

Contract Times prior to this Change Order:

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

[Increase] [Decrease] of this Change Order:

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

Contract Times with all approved Change Orders:

Substantial completion (days or date): _____

Ready for final payment (days or date): _____

RECOMMENDED:

By: _____

Engineer (Authorized Signature)

Date: _____

Approved by Funding Agency (if applicable):

Date: _____

ACCEPTED:

By: _____

Owner (Authorized Signature)

Date: _____

Approved by Funding Agency (if applicable):

Date: _____

ACCEPTED:

By: _____

Contractor (Authorized Signature)

Date: _____

Approved by Funding Agency (if applicable):

Date: _____

Based on EJCDC C-941 Change Order

Prepared by the Engineers Joint Contract Documents Committee and endorsed by the Construction Specifications Institute.

Pursuant to MGL c.44, s31C, I certify that appropriated funds are available for the total amount of this Change Order.

Owner's Auditor/Accountant (Name) Date: _____

Pursuant to MGL c.30, s39I, reasons for deviation are as stated on Page 1. The specified deviation(s) does not materially injure the Project as a whole, the Work is of the same cost and quality or an equitable adjustment has been agreed upon, and the deviation is in the best interest of the Owner.

Owner Date: _____

Change Order

Instructions

A. GENERAL INFORMATION

This document was developed to provide a uniform format for handling contract changes that affect Contract Price or Contract Times. Changes that have been initiated by a Work Change Directive must be incorporated into a subsequent Change Order if they affect Price or Times.

Changes that affect Contract Price or Contract Times should be promptly covered by a Change Order. The practice of accumulating Change Orders to reduce the administrative burden may lead to unnecessary disputes.

If Milestones have been listed in the Agreement, any effect of a Change Order thereon should be addressed.

For supplemental instructions and minor changes not involving a change in the Contract Price or Contract Times, a Field Order should be used.

B. COMPLETING THE CHANGE ORDER FORM

Engineer normally initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by Contractor, or requests from Owner, or both.

Once Engineer has completed and signed the form, all copies should be sent to Owner or Contractor for approval, depending on whether the Change Order is a true order to the Contractor or the formalization of a negotiated agreement for a previously performed change. After approval by one contracting party, all copies should be sent to the other party for approval. Engineer should make distribution of executed copies after approval by both parties.

If a change only applies to price or to times, cross out the part of the tabulation that does not apply.

This page intentionally left blank

Notice of Substantial Completion (C-00 65 15)

Project:	Owner:	Owner's Contract No.:
Contract:	Date of Contract:	
Contractor:		

This NOTICE of Substantial Completion applies to:

The following Systems, Equipment or specified portions : All Work under the Contract Documents

:

_____ Date of Substantial Completion for above

The following documents are attached to and made part of this Notice.

Submitted by Contractor

Date

This page intentionally left blank

Certificate of Substantial Completion (Form C-00 65 16)

Project:

Owner:

Owner's Contract No.:

Contract:

Engineer's Project No.:

This [tentative] [definitive] Certificate of Substantial Completion applies to:

- All Work under the Contract Documents: The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Project or portion thereof designated above is hereby declared and is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below.

A [tentative] [definitive] list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as provided in the Contract Documents except as amended as follows:

- Amended Responsibilities Not Amended

Owner's Amended Responsibilities:

Contractor's Amended Responsibilities:

Notice of Completion (Form C-00 65 18)

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		

This NOTICE of Completion applies to:

- All Work under the Contract Documents: The following specified portions:

Date of final Completion

The Work to which this Notice applies is ready for inspection by authorized representatives of Engineer and Owner. Contractor has completed all corrections, delivered all required documentation, and the Project, or portion designated above, is complete. The Date of Completion of the Project or portion thereof designated above is hereby declared by the Contractor.

The following documents are attached to and made part of this Certificate:

Final Punchlist

Final Application for Payment

Only the **making and acceptance of final payment** will constitute:

1. A waiver of all claims by Owner against Contractor, except claims arising from any unsettled liens, from Defective Construction appearing after final inspection; from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
2. A waiver of all claims by Contractor against Owner other than those previously timely made in writing and still unsettled.

Submitted by Contractor

Date

This page intentionally left blank

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

SECTION 00 72 05 STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by



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PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
A Practice Division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

**REVISIONS HIGHLIGHTED WITHIN THE TEXT OF THIS SECTION
HAVE BEEN PREPARED BY WOODARD & CURRAN ON BEHALF OF OWNER**

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

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SECTION 00 72 05
STANDARD GENERAL CONDITIONS OF THE
CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed. May also be referred to as “Proposal” which may be used interchangeably and shall have the same meaning.
 6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
 7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
 9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
 10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer’s written recommendation of final payment.
15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work*—See Paragraph 11.01 for definition.
17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor and complement the Specifications. Shop Drawings and other Contractor submittals are not Drawings as so defined. May also referred to as “Plans”, which may be used interchangeably and shall have the same meaning. Notes on Drawings are directed to Contractor unless specifically noted otherwise.
18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. *Engineer*—The individual or entity named as such in the Agreement.
20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. *General Requirements*—Sections of Division 01 of the Specifications which govern the Work in all sections of the Specifications.
22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.
27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. *PCBs*—Polychlorinated biphenyls.
31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor’s plan to accomplish the Work within the Contract Times. May also be referred to as “Construction Schedule”, which may be used interchangeably and shall have the same meaning.
33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.
37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto. The Specifications are based on the guidelines of the Construction Specifications Institute (CSI) Project Resource Manual, and are directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases in the Specifications.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.
45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

B. Additional Terms

1. *Final Completion*—The time at which all Work is completed and ready for final payment in accordance with Paragraph 14.07 of these General Conditions.
2. *Industry Practice*—The written practices, methods, materials, supplies and equipment, as changed from time to time, that are commonly used in the industry applicable to the Project to design, construct and operate facilities and plants, or any practices, methods and acts, which in the exercise of reasonable judgment in light of the facts known at the time, could have been expected to accomplish the desired results consistent with good business practices, reliability, safety and expedition.
3. *Punch List*—A list of open items representing portions of the Work which Contractor, Engineer, Owner reasonably agree is not complete on the date of Substantial Completion or Final Completion, but which items will not significantly interfere with the safe, reliable operation and integrity of the Project or its intended use.
4. *Purchase Order*—A written agreement between Contractor and a Supplier for provision of material and equipment.
5. *Warranty Period*—The correction period after the date of Substantial Completion per Paragraph 13.07 of these General Conditions.

1.02 Terminology

- A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. Intent of Certain Terms or Adjectives:
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.
- C. Day:
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight. See also Paragraph 17.02 of these General Conditions.
- D. Defective:
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).
- E. Furnish, Install, Perform, Provide:
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. ~~When Contractor delivers the executed counterparts~~Prior to execution of the Agreement ~~to Owner~~, Contractor shall ~~also~~ deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Prior to execution of the Agreement and bBefore any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor up to ~~ten~~5 printed or hard copies of the Contract Documents or Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the ~~sixtieth~~90th day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, unless mutually agreed otherwise, whichever date is earlier.

2.04 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents and the lead times for equipment and materials per the listing in subparagraph 2.05.A.4;
2. a preliminary Schedule of Submittals; and
3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work which will be confirmed in writing by Contractor at the time of submission. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work; and-
4. a complete listing of equipment and materials with lead times between placing orders and delivery, including normal allowances of time for processing and correcting Shop Drawings. All orders for long lead items shall be placed within 30 days after Effective Date of the Agreement if delivery is critical to scheduling. Failure to place orders promptly may result in full liability for liquidated damages if Contract Times are not met.

B. *Evidence of Insurance:* In accordance with Paragraph 2.01.

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all and comprise the entire agreement between Owner and Contractor concerning the Work. If any term or provision of any of the Contract Documents, or the application thereof to any party or circumstance shall, to any extent, be determined to be invalid or unenforceable, the remaining provisions of the Contract Documents, or the application of such term or provision to parties or circumstances other than those as to which it is held invalid or unenforceable, shall not be affected thereby, and each term and provision of each of the Contract Documents shall be valid and shall be enforced to the fullest extent permitted by Laws and Regulations.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

- A. Standards, Specifications, Codes, Laws, and Regulations
 1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies:

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall ~~not~~ be liable to Owner or Engineer for failure to report any such conflict, error, ambiguity, or discrepancy in the Contract Documents unless-if Contractor ~~had actual knowledge~~ new or reasonably should have known thereof.

B. Resolving Discrepancies:

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
 - a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
 - 1. A Field Order;
 - 2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or
 - 3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

- A. Contractor and any Subcontractor or Supplier shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
 - 2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

- A. ~~Unless otherwise stated in the Supplementary Conditions, the~~ data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies), files transmitted in in portable document format (PDF), and other electronic media formats of text, data, graphics or other file types supported by any digital document exchange system implemented for the Project, all of which are understood by all parties to constitute official Project correspondence and submittals. ~~Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk.~~ If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 Availability of Lands

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 Subsurface and Physical Conditions

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

- A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:
1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
 2. is of such a nature as to require a change in the Contract Documents; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

- B. ~~(Not Used) Engineer's Review: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.~~

C. Possible Price and Times Adjustments:

1. The Contract Price or the Contract Times, or both, ~~will~~may be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

- b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
 - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; ~~or~~
 - c. Contractor failed to give the written notice as required by Paragraph 4.03.A, or
 - e.d. written notice is submitted after final payment.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

- A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents;
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated:

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated ~~or not shown or indicated with reasonable accuracy~~ in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.
3. Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, shall not be liable to Contractor for any Claims, losses, or damages incurred by Contractor (including but not limited to all fees and changes of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) related to Underground Facilities not shown or indicated.

4.05 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the “technical data” contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such “technical data” is identified in the Supplementary Conditions. Except for such reliance on such “technical data,” Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work unless Contractor caused or contributed to such Hazardous Environmental Condition. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.
- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the 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 Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual’s authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within ~~20~~5 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.
- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor’s obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor’s liability under the indemnities granted to Owner in the Contract Documents.

5.04 Contractor's Insurance

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed, complies with the requirements of Article 5, and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
 - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
 5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; ~~and~~
 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.;
 7. claims arising out of violation of Laws or Regulations; and
 8. claims for damages because of negligent acts, errors and omissions arising out of performing or providing professional services.
- B. The policies of insurance required by this Paragraph 5.04 shall:
1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.~~6~~7 inclusive, be written on an occurrence basis, include as additional insureds by endorsement (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be ~~listed~~ included as additional insureds by endorsement, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided herein and in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide) and will contain waiver provisions in accordance with Paragraph 5.07;
5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
6. include completed operations coverage:
 - a. Such insurance shall remain in effect for two years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

7. In the event general liability insurance is provided on a claims-made policy, the retroactive date of such policy shall not be later than the date of the Notice to Proceed or the Effective Date of the Agreement, whichever is earlier. For construction periods extending beyond the expiration date of an initial claims-made policy, the retroactive date of all subsequent claims-made policies shall not be later than the date of the Notice to Proceed.

C. The limits of liability for the insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation and related coverage:

<u>Minimum limit of liability</u>	<u>Statutory</u>
<u>Applicable Federal (e.g., Longshoreman's)</u>	<u>Statutory</u>
<u>Employer's Liability</u>	<u>\$1,000,000</u>

2. Contractor's General Liability:

\$1,000,000 per occurrence; \$2,000,000 general aggregate; \$2,000,000 per project aggregate, including:

- Broad Form Property Damage Liability including coverage for acts of terrorism
- Completed Operations and Product Liability
- Contractual Liability
- Independent Contractors
- Explosion, Collapse & Underground Hazards
- Personal Injury Coverage, Exclusion "C" Deleted
- Fire Legal Liability - \$1,000,000
- Medical payments - \$1,000,000

Pollution Liability (covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from the Contractor's operations and completed operations maintained for no less than three years after final completion): \$1,000,000

Excess or Umbrella Liability: \$5,000,000 per occurrence; \$5,000,000 general aggregate

3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions:

Combined Single Limit of \$1,000,000 for bodily injury & property damage covering Contractor and any vehicles owned, hired and non-owned by the Contractor

4. Professional Liability (E&O for engineers, architects or surveyors): \$1,000,000 for each claim with an annual aggregate of at least \$2,000,000 if professional services are required under the Specifications

5. Owners Protective Liability: as may be specified in the Supplementary Conditions

Any self-insured retention (not allowed for Worker's Compensation) and/or deductibles must be identified and cannot exceed \$100,000 per occurrence without the prior approval of the Owner. Contractor must provide either an audited financial statement to confirm solvency or a letter of credit guaranteeing the \$100,000 in case of loss for the duration of the Project and for the Correction Period.

5.05 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations (ongoing and completed) under the Contract Documents.

5.06 *Property Insurance*

- A. ~~Unless otherwise provided in the Supplementary Conditions,~~ Owner may, in its discretion, purchase and maintain property insurance upon the Work at the Site. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. ~~Contractor shall be responsible for any (subject to such deductible amounts or self-insured retention as may be provided in the Supplementary Conditions or required by Laws and Regulations).~~ This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;
2. be written on a ~~Builder's Risk "all-risk"~~ Special Forms policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against ~~at least the following special form~~ perils or causes of loss, including but not limited to: fire, lightning, flood, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
5. allow for partial utilization of the Work by Owner;
6. include testing and startup; and
7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and

7.8. comply with the requirements of Paragraph 5.06.C of the General Conditions.

- B. ~~(Not used) Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.~~
- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work, ~~to the extent of any deductible amounts that are identified in the Supplementary Conditions.~~ The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, ~~and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.~~
- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 Waiver of Rights

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:
1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds* (Not used)

- ~~Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.~~
- ~~Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.~~

~~5.11~~5.09 *Acceptance of Bonds and Insurance; Option to Replace*

- A. If ~~either~~ Owner ~~or Contractor~~ has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the ~~other party~~ Contractor in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the ~~objecting party~~ Owner shall so notify the ~~other party~~ Contractor in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. ~~Owner and Contractor shall each provide to the other Owner,~~ such additional information in respect of insurance provided as ~~the other~~ may be reasonably requested. If ~~either party~~ Contractor does not purchase or maintain all of the bonds and insurance required ~~of such party~~ by the Contract

Documents, ~~such party Contractor~~ shall notify the ~~other party Owner~~ in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the ~~other party Owner~~ may elect to obtain equivalent bonds or insurance to protect ~~such other party's Owner's~~ interests at the expense of the ~~party Contractor who was required to provide such coverage~~, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.125.10 *Partial Utilization, Acknowledgment of Property Insurer*

- A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner’s written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.
- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

D. Provision of any instructions:

- 1. will not be effective to assign to Owner, or any of Owner'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 Paragraph 8.09; and
- 2. will not be effective to assign to Engineer, or any of 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 Paragraph 9.09.

6.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and “Or-Equals”*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item, make or catalogue number, or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or-equal” item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *“Or-Equal” Items:* If in Engineer’s sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an “or-equal” item, in which case review and approval of the proposed item may, in Engineer’s sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

- 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
- 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
- 3) it has a proven record of performance and availability of responsive service.

b. Contractor certifies that, if approved and incorporated into the Work:

- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
- 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

a. If in Engineer’s sole discretion an item of material or equipment proposed by Contractor does not qualify as an “or-equal” item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - 1) shall certify that the proposed substitute item will:
 - a) perform adequately the functions and achieve the results called for by the general design,
 - b) be similar in substance to that specified, and
 - c) be suited to the same use as that specified;
 - 2) will state:
 - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
 - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
 - 3) will identify:
 - a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services; and
 - 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Bidding Requirements or Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and ~~if~~ the Contractor has submitted a list thereof in accordance with the Bidding Requirements or Supplementary Conditions (which shall be included as an attachment to the Agreement), Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will

be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
1. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

2. Such agreement between Contractor and the Subcontractor or Supplier shall specifically include dispute resolution provisions similar to those in Article 16 (if any) and provisions required by Laws and Regulations identified in the various Supplementary Conditions.

6.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.
- D. At the Owner's option, Contractor shall defend claims in connection with any alleged infringement of such rights.

6.08 *Permits*

- A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor observes that the Specifications or Drawings are at variance with any Laws or Regulations, Contractor shall give Engineer prompt written notice thereof, and any necessary changes will be authorized by one of the methods set forth in Paragraph 3.04. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.
- B. If Owner is sales tax exempt, specific provisions shall be as set forth in the Supplementary Conditions.

6.11 *Use of Site and Other Areas*

- A. Limitation on Use of Site and Other Areas:
 - 1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
 3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work, Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings and other closeout submittals specified will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;
 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs (if any) and other safety requirements that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

- A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. Shop Drawings:

- a. Submit number of copies specified in the General Requirements.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. Samples:

- a. Submit number of Samples specified in the Specifications.
- b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

- B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures:

1. Before submitting each Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1. or for errors or omissions in a Shop Drawing or Sample.

E. Resubmittal Procedures:

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than 3 submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples, or other items requiring approval and Contractor shall reimburse Owner for Engineer's charges for such time.
3. In the event that Contractor requests a change of a previously approved item, Contractor shall reimburse Owner for Engineer's charges for its review time unless the need for such change is beyond the control of Contractor.

6.18 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and in accordance with Subcontractor warranties, manufacturers and Suppliers warranties on equipment and material, and extended or special warranties and will not be defective for the correction period specified in 13.07. Owner and Engineer and its-their officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

1. Contractor shall obtain and preserve for the benefit of the Owner:

- a. manufacturers' and Suppliers' written warranties and guarantees on equipment and material incorporated into the Work;
- b. written warranties and guarantees from each Subcontractor engaged in the performance of the Work; and

2. extended or special warranties.

- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
 6. any inspection, test, or approval by others; ~~or~~
 7. any correction of defective Work by Owner; or;

8. any acceptance by Owner or any failure to do so.

D. Contractor shall prepare and execute a written general warranty and guarantee applicable to the Work reflecting the provisions of this Paragraph 6.19, Article 13 and other applicable provisions of the Contract Documents pertaining to warranties and guarantees, Subcontractor, manufacturers and Supplier warranties and guarantees, and extended or special warranties and guarantees. Contractor shall submit this written general warranty and guarantee in accordance with Article 14 and the General Requirements.

E. Provision of any warranties or guarantees:

1. will not be effective to assign to Owner, or any of Owner'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 Paragraph 8.09; and

2. will not be effective to assign to Engineer, or any of 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 Paragraph 9.09.

F. The warranty and guarantee provisions of this Paragraph 6.19 shall be in addition to and not in limitation of any other warranties, guarantees or remedies allowed by Law or the Contract Documents.

6.20 Indemnification

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend, and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that 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 but only to the extent caused by any negligent or wrongful act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

1. Without limiting the generality of the preceding Paragraph, the Contractor hereby specifically agrees to indemnify, defend, and hold harmless the Owner and Engineer from all such claims, losses or expenses which arise out of injuries of employees of the Contractor or any of its Subcontractors or Suppliers of any tier related to performance of the Work. It is the Owner intention that all financial risk of injuries related to the Work be borne by the Contractor, and that the Owner have no financial responsibility, direct or indirect, for any such claims.

- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
1. the preparation or approval of ~~;~~ ~~or the failure to prepare or approve~~ maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications, provided however, that if the claim, cost, loss or damage referred to in this Paragraph 6.20 results from failure of the Engineer to discover a condition, Underground Facilities or object which is underground or otherwise not reasonably observable by the Engineer, and if said failure to discover either was or should have been apparent to the Contractor in that the said condition or object is omitted from the Engineer's maps, Drawings, opinions, reports, surveys, Change Orders, designs or Specifications, then the Contractor shall be liable for indemnification of the Engineer and Owner under Paragraph 6.20 for claims, costs, losses and damages resulting from said failure to discover unless Contractor shall have notified Engineer of the existence and location of such condition or object prior to the occurrence of such claims, costs, losses and damages and in sufficient time for Engineer to have made provisions therefor; or
 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage; or
 3. caused by the negligent acts, errors or omissions of any of them.

6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
 - 1. written notice thereof will be given to Contractor prior to starting any such other work; and
 - 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. ~~The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.~~
- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
 - 1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
 - 2. the specific matters to be covered by such authority and responsibility will be itemized; and
 - 3. the extent of such authority and responsibilities will be provided.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

- A. In case of termination of the employment of Engineer, Owner shall appoint an engineer ~~to whom Contractor makes no reasonable objection~~, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

- A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

- A. Owner ~~is obligated to~~ may execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. However, the Owner shall have the right to direct the Contractor to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER’S STATUS DURING CONSTRUCTION

9.01 *Owner’s Representative*

- A. Engineer will be Owner’s representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner’s representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor’s executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer’s efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer’s visits and observations are subject to all the limitations on Engineer’s authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer’s visits or observations of Contractor’s Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. However, the Engineer shall have the right to direct the Contractor to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto.

9.03 *Project Representative*

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided ~~in the Supplementary Conditions~~herein, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer’s consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.
- B. The Resident Project Representative (RPR) will be Engineer's employee or agent at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions. RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall be through or with the full knowledge and approval of Contractor. The RPR shall:

1. Schedules: Review the Progress Schedule, schedule of Shop Drawing and Samples submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
2. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other Project-related meetings, and prepare and circulate copies of minutes thereof.
3. Liaison:
 - a. Serve as Engineer's liaison with Contractor, working principally through Contractor's authorized representative, to assist in providing information regarding the intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
4. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
5. Shop Drawings and Samples:
 - a. Record date of receipt of Samples and approved Shop Drawings.
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
6. Modifications:
 - a. Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, to Engineer.
 - b. Transmit to Contractor in writing, decisions as issued by Engineer.
7. Review of Work and Rejection of Defective Work:
 - a. Conduct on-Site observations of Contractor's Work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Engineer whenever RPR believes that any part of Contractor's Work in progress will not produce a completed Project that conforms generally to the Contract Documents or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged,

or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of Work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

8. Inspections, Tests, and System Startups:

- a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
- b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.

9. Records:

- a. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of Contractor, Subcontractors, and major Suppliers.
- b. Maintain records for use in preparing Project documentation.

10. Reports:

- a. Furnish periodic reports to Engineer as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
- b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
- c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, damage to property by fire or other causes, or the discovery of any Hazardous Environmental Condition or conditions that may impede the compliant operation of existing facilities on Site.

11. *Payment Requests:* Review Applications for Payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

12. *Certificates, Operation and Maintenance Manuals:* During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Specifications to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

13. Completion:

- a. Participate in a Substantial Completion inspection, assist in the determination of Substantial Completion and the preparation of the Punch List (lists of items to be completed or corrected).
- b. Participate in a final inspection in the company of Engineer, Owner, and Contractor and prepare a final Punch List (list of items to be completed and deficiencies to be remedied).
- c. Observe whether all items on the final Punch List have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the Notice of Acceptability of the Work.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment, including “or-equal” items.
2. Exceed limitations of Engineer’s authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, Suppliers, or Contractor’s superintendent.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor’s Work unless such advice or directions are specifically required by the Contract Documents.
5. Advise on, issue directions regarding, or assume control over safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-Site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part or determine operational protocol that may affect the compliant operation of existing facilities.

9.04 *Authorized Variations in Work*

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

- A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. However, the Engineer shall have the right to direct the Contractor to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

F. Engineer will have no responsibility or authority:

1. To order changes in construction which will result in additional costs or which will require extensions of Contract Times;
2. To suspend all or any portion of Contractor's operations;
3. To terminate all or any portion of the Work;
4. To make final acceptance of all or any portion of the Work; and
5. To operate or maintain any portion of the Work.

9.10 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
 - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
 - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
 - 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 Notification to Surety

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 Claims

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than ~~30-14~~ days) after the start of the event giving rise thereto. Failure to comply with this notice requirement shall constitute a waiver of the Claim. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within ~~60-30~~ days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).
- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
 - 1. deny the Claim in whole or in part;
 - 2. approve the Claim; or
 - 3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

G. Contractor shall not have the right to stop performance of the Work pending resolution of a Claim.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 Cost of the Work

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:
 - 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 - 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 - 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the

Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - 1) Rentals of construction equipment and machinery and the parts thereof whether rented from Contractor or others in accordance with rates published in current edition of the Rental Rate Blue Book® for construction equipment published by EquipmentWatch® (www.equipmentwatch.com). When Contractor-owned equipment is ordered by Owner or Engineer to be held at standby, equipment rental rates shall be 50% of normal rate. Rental or standby shall not include time that equipment is inoperative because of malfunction or breakdown and shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with

the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. Cash Allowances: (Not used)

~~0. Contractor agrees that:~~

~~— the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and~~

~~— Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.~~

F.C. Owner's Contingency Allowances:

1. Contractor agrees that any Owner's a contingency allowance, if any, is for the sole use of Owner to cover ~~un~~estimated anticipated costs for certain items.

G.D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by Owner's contingency allowances, and the Contract Price shall be correspondingly adjusted. Contractor shall not receive payment for any unused portion of the contingency allowance.

11.03 Unit Price Work

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

~~C. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:~~

~~0. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and~~

~~1. there is no corresponding adjustment with respect to any other item of Work; and~~

~~— Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.~~

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).
- C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15-10 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15-10 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each

be paid a fee of five percent of the amount paid to the next lower tier Subcontractor, provided, however, that on any subcontracted work the total maximum fee to be paid by Owner under this subparagraph shall be no greater than 27 percent of the costs incurred by the Subcontractor who actually performs the Work;

- d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
- e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
- f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, acts of war or terrorism, or acts of God (force majeure).
- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of war or terrorism, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract

Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

- D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 Tests and Inspections

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
 - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
 - 3. as otherwise specifically provided in the Contract Documents.

- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Except as provided in 13.03.B above and where responsibility for a specific inspection or test is expressly allocated to Owner in the Specifications or by Laws and Regulations, Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense, ~~unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.~~

13.04 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.
- D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. repair such defective land or areas; or
 - 2. correct such defective Work; or
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution

costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor and may be deducted from amounts otherwise due the Contractor.

- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work, including materials, equipment and supplies or as defined in manufacturers' and Suppliers' warranties (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed and the terms of this Paragraph 13.07 will continue to apply.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, or immediately in the case of an emergency, correct, or remedy any such deficiency.

- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Schedule of Values

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 Progress Payments

- A. Applications for Payments:
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and

equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. Review of Applications:

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
 - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due:

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. Reduction in Payment:

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
 - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

- b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens and provides an indemnity satisfactory to Owner for all claims, costs, losses and damages arising out of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended including liability for liquidated damages and correction of defective work by Owner or others; or
 - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
 3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use and final testing has been completed in accordance with the General Requirements, Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor in the Punchlist as incomplete) using the Notice of Substantial Completion form included in the Contract Documents, submit the Contractor's written general warranty and guarantee per Paragraph 6.19.D., and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion using the Certificate of Substantial Completion included in the Contract Documents. There shall be attached to the certificate a Punch List (tentative list of items to be completed or corrected before final payment). Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised Punch List (tentative list of items to be completed or corrected)) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
 2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

B. Owner may request in writing that Contractor permit Owner to separately operate any part of the Work although it is not substantially complete subject to the following conditions.

1. A copy of such request will be sent to Engineer and, within a reasonable time thereafter, Owner, Contractor and Engineer shall make an inspection of that part of the Work not substantially complete to determine the status of completion and will prepare a Punch List before final payment.
2. If Contractor does not indicate in writing to Owner and Engineer that such part of the Work is not ready for separate operation by Owner, Engineer will finalize the Punch List and will deliver such list to Owner and Contractor, together with a written recommendation as to the division of responsibilities between Owner and Contractor with respect to security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that part of the Work pending final payment.
3. The Engineer's recommendation and Punch List will become binding upon Owner and Contractor at the time the Owner takes over and separately operates such part of the Work unless otherwise agreed in writing and so informed Engineer.
4. During such separate operation by Owner and prior to Substantial Completion of such part of the Work, Owner shall allow Contractor reasonable access to complete or correct Punch List and to complete other related Work.

14.06 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 Final Payment

A. Application for Payment:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, warranties, updated Contractor's written general warranty and guarantee per Paragraph 6.19.D if modified, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, and Engineer has indicated that the Work is acceptable (subject to the provisions of Paragraph 14.09), Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
 - b. consent of the surety, if any, to final payment;
 - c. a list of all Claims against Owner that Contractor believes are unsettled;
 - e.d. Certificate of Completion; and
 - d.e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to

Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due:

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted as detailed on the Certificate of Completion. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:
1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
 2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
1. Contractor's ~~persistent~~ failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
 2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 3. Contractor's repeated disregard of the authority of Engineer; or
 4. Contractor's violation in any substantial way of any provisions of the Contract Documents; or-
 5. Contractor commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if Contractor takes any equivalent or similar action by filing a petition or otherwise under any Laws and Regulations in effect at such time relating to the bankruptcy or insolvency; or
 6. a petition is filed against Contractor under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against Contractor under any Laws and Regulations in effect at the time relating to bankruptcy or insolvency; or
 7. Contractor makes a general assignment for the benefit of creditors; or
 8. a trustee, receiver, custodian or agent of Contractor is appointed under applicable law or under contract, whose appointment or authority to take charge of property of Contractor is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of Contractor's creditors; or
 9. Contractor admits in writing its inability to pay its debts generally as they become due.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:
1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);
 2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
 3. complete the Work as Owner may deem expedient.

- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
 - 3. all-reasonable claims, costs, losses, and damages (including but not limited to all-reasonable fees and charges of engineers, architects, attorneys, and other professionals and all-reasonable court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
 - 4. reasonable expenses directly attributable to termination.

- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Subject to the requirements in Paragraph 10.05, Owner and Contractor agree that they will submit any and all unsettled Claims, counterclaims, disputes and other matters in question between them arising out of or relating to the Contract Documents ("disputes"), to mediation by senior management representatives of each party for a period of 5 days. If resolution is not achieved, then the dispute shall be submitted to formal mediation prior to either of them initiating against the other, a demand for arbitration pursuant to Paragraph 16.02, unless delay in initiating arbitration would irrevocably prejudice one of the Parties. Any time limits within which to file a demand for arbitration shall be suspended with respect to a dispute submitted to mediation within those same applicable time limits and shall remain suspended until 10 days after the termination of the mediation. The mediator of any dispute submitted to mediation shall not serve as arbitrator of such dispute unless otherwise agreed.

A.B. Subject to Paragraph 16.01.A, eEither Owner or Contractor may request formal mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

~~B.C.~~ Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

~~C.D.~~ If the Claim is not resolved by senior management mediation or formal mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke ~~any—the~~ dispute resolution process pursuant to Paragraph 16.02~~provided for in the Supplementary Conditions~~; or
2. agrees with the other party to submit the Claim to another dispute resolution process; ~~or~~
- ~~2.—gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.~~

16.02 Arbitration

A. All Claims or counterclaims, disputes, or other matters in question between Owner and Contractor arising out of or relating to the Contract Documents or the breach thereof (except for Claims which have been waived by the making or acceptance of final payment as provided by Paragraph 14.09) including but not limited to those not resolved under the provisions of Paragraphs 10.05 or 16.01, will be subject to arbitration in accordance with the rules of Construction Industry Rules of the American Arbitration Association, subject to the conditions and limitations of this Paragraph 16.02. This agreement to arbitrate, and any other agreement or consent to arbitrate entered into, will be specifically enforceable under the prevailing Laws of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to this Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the 30 day period specified in Paragraph 16.01.D, and in all other cases, within a reasonable time after the Claim or counterclaim, dispute, or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such Claim or other dispute or matter in question would be barred by the applicable statute of limitations.

C. No arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.
- D. Consolidation shall be by order of the arbitrator(s) in any pending case, or if the arbitrator(s) fail to make an order, a party may apply to a court of competent jurisdiction for such order. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity shall be specifically enforceable in accordance with the Laws of any court having jurisdiction thereof.
- E. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include: (i) a concise breakdown of the award; (ii) a written explanation of the award specifically citing the Contract Document provisions deemed applicable and relied on in making the award.
- F. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the controlling Laws relating to vacating or modifying an arbitral award.
- G. If the parties decline to arbitrate, such Claims, disputes and other matters shall be decided by a court having jurisdiction.

16.03 General

- A. The Contractor will require similar arbitration provisions in agreements with its Subcontractors and Suppliers.
- B. Contractor shall not have the right to stop performance of the Work pending resolution of a Claim or dispute.
- C. Notwithstanding any provision contained in this Article or elsewhere in the Contract Documents, the Owner reserves the following rights in connection with Claims and disputes between the Owner and the Contractor:
1. The right to institute legal action against the Contractor in any court of competent jurisdiction in lieu of demanding arbitration pursuant to this Article, in which case the Claims or disputes which are the subject of such action shall be decided by such court, and not by arbitration.
 2. The right to obtain from any court of competent jurisdiction a stay of any arbitration instituted by the Contractor, provided that the application for such stay is made before the appointment of the neutral arbitrator in such arbitration, in which case the Claims or disputes which are the subject of such arbitration shall be decided by such court, and not by arbitration.
 3. The right to require the Contractor to join as a party in any arbitration between the Owner and the Engineer relating to the Project, in which case the Contractor agrees to be bound by the decision of the arbitrator or arbitrators in such arbitration.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

- A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph 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.

17.04 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

17.07 Professional Fees and Court Costs Included

- A. In any action or proceeding to enforce or interpret any contractual provision or to resolve any conflict or dispute relating to or arising from this Contract, the prevailing party shall be entitled to recover, as part of its claim, award or judgment, reasonable attorneys; fees and associated costs and expenses, including expenses of engineering, claims and other consultants.

END OF SECTION

SECTION 00 73 05

SUPPLEMENTARY CONDITIONS

The following sections modify or supplement the Standard General Conditions of the Construction Contract (“General Conditions”) included in Section 00 72 05 and are in addition to the modifications highlighted within the text thereof. All provisions which are not so modified or supplemented remain in full force and effect. The Supplementary Conditions may include certain provisions required by Laws and Regulations. Contractor is responsible to determine and obtain applicable Laws and Regulations and to review and interpret the full text of such Laws and Regulations.

The terms used in these Supplementary Conditions have the meanings stated in the Standard General Conditions and as may be included within the Sections listed below.

- 00 73 10 Project Specific Requirements
- 00 73 19 Health and Safety Requirements
- 00 73 43 Wage Rate Requirements
- 00 73 46 Wage Determination Schedule
- 00 73 73 Statutory Requirements

END OF SECTION

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SECTION 00 73 10

PROJECT SPECIFIC REQUIREMENTS

GENERAL

The address system used herein is the same as the address system used in the General Conditions, with the prefix "SC" added thereto. Additional terms used in this Section have the meanings stated below, which are applicable to both the singular and plural thereof.

SC-1.01.B Additional Terms: Add the following new definition.

6. *Installer* -- The entity engaged by Contractor or a Subcontractor for installation, erection, application and similar required operations of a particular portion of the Work at the Site, including who has specialty experience in the Work they are engaged to perform.

SC-2.05 Before Starting Construction

Pursuant to subparagraph 2.05.A.3 regarding the Schedule of Values, the Unit Prices Form included as Section 00 43 22 shall constitute the preliminary Schedule of Values for this Project.

Add the following immediately after Paragraph 2.05.B.

- C. Additionally, within 10 days after the Effective Date of the Agreement, Contractor shall submit a Construction Operations Plan incorporating the schedules submitted pursuant to Paragraph 2.05.A and covering the following.
 1. Construction methods and sequence of operations
 2. Proposed Site access
 3. Proposed erosion control measures and proposed measures to minimize impacts to existing vegetation and impacts to water quality in compliance with the General Requirements.

SC-2.07 Initial Acceptance of Schedules

Add the following immediately after subparagraph 2.07.A.3.

4. Contractor's Construction Operations Plan submitted pursuant to Paragraph 2.05.C. will be acceptable to Engineer if it accurately and reasonably addresses all aspects of the Work.

SC 4.01 Availability of Lands

Pursuant to Paragraph 4.01.A, easements and rights-of-way exist for the Project and are reflected on the Drawings. Documentation is on file with Owner and available upon request.

SC-4.02 Subsurface and Physical Conditions

- A. Pursuant to Paragraph 4.02.A,
1. the following reports of explorations and tests of subsurface conditions at or contiguous to the Site are known to Owner:
 - a. Report dated January 2017 prepared by Geocomp entitled “Final Design Geotechnical Recommendations Report” consisting of 82 pages
 2. The following drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) are known to Owner:
 - a. NONE
 3. The reports identified above are not part of the Contract Documents, but the “technical data” contained therein upon which Contractor may rely, as expressly identified and established above, are incorporated in the Contract Documents by reference and may be reflected in the Drawings. Contractor is not entitled to rely upon any other information and data known to or identified by Owner or Engineer.
 4. Copies of reports identified above are included as an attachment to Section 01 17 00.

SC 4.05 Reference Points

Pursuant to Paragraph 4.05.A, surveys exist for the Project. and are reflected on the Drawings.

SC-4.06 Hazardous Environmental Conditions at Site

- A. Pursuant to Paragraph 4.06.A,
1. The following technical data regarding Environmental Conditions at the Site are known to Owner:
 - a. NONE.

SC-5.04 Contractor's Insurance

Pursuant to Paragraph 5.04.A, there are no other loss payees in addition to the individuals and entities specified in subparagraph 5.04.B.1.

Pursuant to subparagraph 5.04.C.5, also provide Owner's Protective Liability in the amount of \$3,000,000 (per occurrence for bodily injury & property damage combined single limit).

SC-6.02 Labor; Working Hours

Pursuant to Paragraph 6.02.B, regular working hours for this Project are 7 a.m. to 4 p.m., Monday through Friday.

Add the following new subparagraph immediately after Paragraph 6.02.B.

1. Any Work conducted by the Contractor outside of the specified allowable Work hours must be approved by the Owner. Adjustments to the Contract Price (deductions) will be made for each approved hour worked outside the specified allowable Work hours as set forth in the Agreement.

SC-6.08 Permits

Pursuant to subparagraph 6.08.A.1, Contractor shall comply with the following licenses and permits Owner has obtained for the Project.

- Order of Conditions, executed July 22, 2015 – DEP File #64-596; referenced Notice of Intent with attachments and included in Section 01 70 00. This Order is applicable to specific areas of the Work Site and contains Special Conditions.
- MassDEP Chapter 91 Waterway License Modification, dated September 30, 2015, included in Section 01 70 00.

SC-6.09 Laws and Regulations

Pursuant to Paragraph 6.09, the Contractor shall comply with additional requirements included in Section 00 73 73 and Section 01 17 00.

SC-7.01 Related Work at Site

Pursuant to Paragraph 7.01, Owner has separately contracted for or intends to separately contract for electrical work by National Grid. See SC-7.02 for coordination details.

Other work will be performed at or near the Site although not by Owner nor under Owner's direction for electric utilities. It is anticipated that portions of the Work under this Contract will require connection to and coordination with the work by National Grid and the City of Salem Department of Public Works (DPW). Contractor shall coordinate with the National Grid and City of Salem DPW as specified in Paragraph 7.01.B.

SC-7.02 Coordination

Pursuant to Paragraph 7.02.A, for other work on the Project at the Site Owner has separately contracted for or intends to separately contract for, as identified in SC-7.01 above, authority and responsibility for coordination of the other work will be identified at the Preconstruction Conference.

SC-14.02. Progress Payments

Insert the following language before “;or” at the end of subparagraph 14.02.D.1.c:

and deductions for Additional Work Fees defined the Agreement

SC-14.07 Final Payment

Pursuant to Paragraph 14.07.A.2.a., documentation shall include Certificate(s) of Occupancy required for building(s).

END OF SECTION

SECTION 00 73 19

HEALTH AND SAFETY REQUIREMENTS

Contractor shall comply with the following minimum requirements and is solely responsible to determine, obtain, review and interpret the full text of applicable Laws and Regulations.

- A. Code of Federal Regulations, Chapter XVII-Occupational Safety and Health Administration (OSHA), Department of Labor, Title 29, Part 1926, Safety and Health Regulations for Construction
 - 1. Contractor shall strictly comply with the Hazard Communication Standard 1910.1200 regulated by OSHA, including providing and maintaining Safety Data Sheets, labeling of hazardous substances, and providing required protective equipment and training and instruction to personnel on the Site including Owner and Engineer's personnel.
 - 2. Perform confined space work in accordance with OSHA General Industry 1910.146: Permit Required Confined Space Entry.
- B. ANSI/ASSE A10 series of safety construction standards including the "Manual of Accident Prevention In Construction" published by The Associated General Contractors of America
- C. AASHTO Guide on Occupational Safety on Highway Construction Projects, Subpart N, 1926.550, relating to protection of personnel and equipment under electric lines and construction equipment clearances at overhead electric lines especially during operations using large vehicles
- D. Pursuant to *MGL Chapter 30, Section 39S*, all employees to be employed at the Work Site 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. Any employee found on a Work Site subject to this section without documentation of successful completion of 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 shall be subject to immediate removal.

- E. This Project is also subject to the following.
- MGL Chapter 82, *The Laying Out, Alteration, Relocation and Discontinuance Of Public Ways, And Specific Repairs Thereon, Section 40:*
 - Section 40 Definitions
 - Section 40A Excavations; notice
 - Section 40B Designation of location of underground facilities
 - Section 40C Excavator’s responsibility to maintain designation markings; damage caused by excavator
 - Section 40D Local laws requiring excavation permits; public ways
 - MGL Chapter 82A, *Excavation and Trench Safety*
 - Section 1 Unattended open trenches; safety hazards; rules and regulations; fines
 - Section 2 Trench excavating permits; permits issued by board or officer; certificate of insurance; fees
 - Section 3 Form of trench excavation permits; required statements
 - Section 4 Definitions
 - Section 5 Additional requirements
 - MGL Chapter 149
 - Section 6C Health and safety of general public and asbestos workers; rules and regulations*
 - Section 18A Sanitary and safety conditions; tools*
 - Section 18B Confined spaces; ventilation*
 - Section 18C Power transmission equipment*
 - Section 18D Ropes, hooks and cranes; use and operation*
 - Section 18E Safety precautions in dangerous undertakings*
 - Section 18F Explosives*
 - Section 18G Industrial truck and internal combustion equipment*
 - Section 129A Shoring Trenches for local governments*
 - Massachusetts Department of Labor and Industries, Division of Occupational Safety (Chapter 454 CMR 10.00 et seq.)
 - Massachusetts Department of Public Safety “*Excavation and Trench Safety*” (Chapter 520 CMR 14.00 et seq.)

END OF SECTION

SECTION 00 73 43

WAGE RATE REQUIREMENTS

The content of this Section does not represent or reflect all applicable Laws and Regulations and may only include excerpts and portions of certain Laws and Regulations. Other provisions required by statute shall be deemed to be so included and incorporated herein. Contractor is solely responsible to determine, obtain, review and interpret the full text of applicable Laws and Regulations.

The Project is subject to minimum wage rates as issued by the Executive Office of Labor and Workforce Development, Department of Labor Standards and the requirements of MGL Chapter 149, Sections 26, 27 and 27A to 27H. Wage Determination Schedules are included in Section 00 73 46. Pursuant to MGL Chapter 149, Section 34B, wages paid to reserve police officers shall be the same prevailing rate of wage paid to regular police officers at the location of the Project.

1.01 State Requirements

Submit required records and statements of compliance in accordance with MGL Chapter 149, Section 27B using the latest Weekly Payroll and Compliance forms available on the following website. Copies included in this section are for information only.

<http://www.mass.gov/lwd/labor-standards/prevailing-wage-program>

WEEKLY PAYROLL RECORDS REPORT & STATEMENT OF COMPLIANCE

In accordance with Massachusetts General Law c. 149, §27B, a true and accurate record must be kept of all persons employed on the public works project for which the enclosed rates have been provided. A Payroll Form is available from the Department of Labor Standards (DLS) at www.mass.gov/dols/pw and includes all the information required to be kept by law. Every contractor or subcontractor is required to keep these records and preserve them for a period of three years from the date of completion of the contract.

On a weekly basis, every contractor and subcontractor is required to submit a certified copy of their weekly payroll records to the awarding authority; this includes the payroll forms and the Statement of Compliance form. The certified payroll records must be submitted either by regular mail or by e-mail to the awarding authority. Once collected, the awarding authority is required to preserve those records for three years from the date of completion of the project.

Each such contractor and subcontractor shall furnish weekly **and** within 15 days after completion of its portion of the work, to the awarding authority directly by first-class mail or e-mail, a statement, executed by the contractor, subcontractor or by any authorized officer thereof who supervised the payment of wages, this form, accompanied by their payroll:

STATEMENT OF COMPLIANCE	
_____, 20____	
I, _____,	_____
(Name of signatory party)	(Title)
do hereby state:	
That I pay or supervise the payment of the persons employed by	
_____	_____
(Contractor, subcontractor or public body)	(Building or project)
and that all mechanics and apprentices, teamsters, chauffeurs and laborers employed on said project have been paid in accordance with wages determined under the provisions of sections twenty-six and twenty-seven of chapter one hundred and forty nine of the General Laws.	
Signature _____	
Title _____	

05/14

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SECTION 00 73 46

WAGE DETERMINATION SCHEDULE

The Project is subject to the following wage rates (included in this section) in accordance with the requirements included in Section 00 73 43.

- Minimum wage rates as issued by the Executive Office of Labor and Workforce Development, Department of Labor Standards pursuant to MGL Chapter 149, Sections 26, 27 and 27A to 27H

END OF SECTION

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**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**

RONALD L. WALKER, II
Secretary

WILLIAM D MCKINNEY
Director

CHARLES D. BAKER
Governor

KARYN E. POLITO
Lt. Governor

Awarding Authority: City of Salem, Massachusetts

Contract Number: _____ **City/Town:** SALEM

Description of Work: Canal Street Flooding Mitigation Project Phase II-A, Install new drainage pipes and structures, water and sewer utility pipes, paving, and improvements to park and pond.

Job Location: Canal St. Salem, MA.

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- 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 from the Department of Labor Standards (“DLS”) 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 any sub-contractor.
- All apprentices working on the project are required to be registered with the Massachusetts Department of Labor Standards, Division of Apprentice Standards (DLS/DAS). Apprentice must keep his/her apprentice identification card on his/her person 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 DLS/DAS regardless of whether or not they are registered with any other federal, state, local, or private agency must be paid the journeyworker's rate for the trade.**
- 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. Awarding authorities are required to request these updates 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, 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. Contractors are required to obtain the wage schedules from awarding authorities, and to pay no less than these rates to covered workers. The annual update requirement is not applicable to 27F “rental of equipment” contracts.
- Every contractor or subcontractor which performs construction work on the project is required to 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. A sample of a payroll reporting form may be obtained at <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.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may report the violation to the Fair Labor Division of the office of the Attorney General at (617) 727-3465.
- 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

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
Construction						
(2 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	12/01/2016	\$32.15	\$10.91	\$10.89	\$0.00	\$53.95
(3 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	12/01/2016	\$32.22	\$10.91	\$10.89	\$0.00	\$54.02
(4 & 5 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	12/01/2016	\$32.34	\$10.91	\$10.89	\$0.00	\$54.14
ADS/SUBMERSIBLE PILOT <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2015	\$88.29	\$9.80	\$19.23	\$0.00	\$117.32
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2016	\$33.15	\$7.45	\$12.65	\$0.00	\$53.25
For apprentice rates see "Apprentice- LABORER"						
ASBESTOS REMOVER - PIPE / MECH. EQUIPT. <i>HEAT & FROST INSULATORS LOCAL 6 (BOSTON)</i>	12/01/2016	\$33.90	\$11.50	\$7.10	\$0.00	\$52.50
	06/01/2017	\$34.90	\$11.50	\$7.10	\$0.00	\$53.50
	12/01/2017	\$35.90	\$11.50	\$7.10	\$0.00	\$54.50
	06/01/2018	\$36.90	\$11.50	\$7.10	\$0.00	\$55.50
	12/01/2018	\$37.90	\$11.50	\$7.10	\$0.00	\$56.50
	06/01/2019	\$38.90	\$11.50	\$7.10	\$0.00	\$57.50
	12/01/2019	\$39.90	\$11.50	\$7.10	\$0.00	\$58.50
	06/01/2020	\$40.90	\$11.50	\$7.10	\$0.00	\$59.50
	12/01/2020	\$41.90	\$11.50	\$7.10	\$0.00	\$60.50
ASPHALT RAKER <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$45.38	\$10.00	\$15.25	\$0.00	\$70.63
	06/01/2017	\$46.38	\$10.00	\$15.25	\$0.00	\$71.63
	12/01/2017	\$47.38	\$10.00	\$15.25	\$0.00	\$72.63
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$45.38	\$10.00	\$15.25	\$0.00	\$70.63
	06/01/2017	\$46.38	\$10.00	\$15.25	\$0.00	\$71.63
	12/01/2017	\$47.38	\$10.00	\$15.25	\$0.00	\$72.63
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BARCO-TYPE JUMPING TAMPER <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER <i>LABORERS - ZONE 2</i>	12/01/2016	\$33.15	\$7.45	\$12.65	\$0.00	\$53.25
For apprentice rates see "Apprentice- LABORER"						
BOILER MAKER <i>BOILERMAKERS LOCAL 29</i>	01/01/2017	\$42.92	\$6.97	\$16.21	\$0.00	\$66.10

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - BOILERMAKER - Local 29

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	\$27.90	\$6.97	\$10.54	\$0.00	\$45.41
2	65	\$27.90	\$6.97	\$10.54	\$0.00	\$45.41
3	70	\$30.04	\$6.97	\$11.35	\$0.00	\$48.36
4	75	\$32.19	\$6.97	\$12.16	\$0.00	\$51.32
5	80	\$34.34	\$6.97	\$12.97	\$0.00	\$54.28
6	85	\$36.48	\$6.97	\$13.78	\$0.00	\$57.23
7	90	\$38.63	\$6.97	\$14.59	\$0.00	\$60.19
8	95	\$40.77	\$6.97	\$15.40	\$0.00	\$63.14

Notes:

Apprentice to Journeyworker Ratio:1:5

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING)	08/01/2016	\$50.76	\$10.18	\$19.22	\$0.00	\$80.16
BRICKLAYERS LOCAL 3 (LYNN)	02/01/2017	\$50.76	\$10.18	\$19.79	\$0.00	\$80.73

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

Effective Date - 08/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.38	\$10.18	\$19.22	\$0.00	\$54.78
2	60	\$30.46	\$10.18	\$19.22	\$0.00	\$59.86
3	70	\$35.53	\$10.18	\$19.22	\$0.00	\$64.93
4	80	\$40.61	\$10.18	\$19.22	\$0.00	\$70.01
5	90	\$45.68	\$10.18	\$19.22	\$0.00	\$75.08

Effective Date - 02/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.38	\$10.18	\$19.79	\$0.00	\$55.35
2	60	\$30.46	\$10.18	\$19.79	\$0.00	\$60.43
3	70	\$35.53	\$10.18	\$19.79	\$0.00	\$65.50
4	80	\$40.61	\$10.18	\$19.79	\$0.00	\$70.58
5	90	\$45.68	\$10.18	\$19.79	\$0.00	\$75.65

Notes:

Apprentice to Journeyworker Ratio:1:5

BULLDOZER/GRADER/SCRAPER OPERATING ENGINEERS LOCAL 4	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CAISSON & UNDERPINNING BOTTOM MAN <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2016	\$37.95	\$7.45	\$14.00	\$0.00	\$59.40
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2016	\$36.80	\$7.45	\$14.00	\$0.00	\$58.25
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING TOP MAN <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2016	\$36.80	\$7.45	\$14.00	\$0.00	\$58.25
For apprentice rates see "Apprentice- LABORER"						
CARBIDE CORE DRILL OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
CARPENTER <i>CARPENTERS -ZONE 2 (Eastern Massachusetts)</i>	09/01/2016	\$37.80	\$9.90	\$17.00	\$0.00	\$64.70
	03/01/2017	\$38.77	\$9.90	\$17.00	\$0.00	\$65.67
	09/01/2017	\$39.78	\$9.90	\$17.00	\$0.00	\$66.68
	03/01/2018	\$40.78	\$9.90	\$17.00	\$0.00	\$67.68
	09/01/2018	\$41.82	\$9.90	\$17.00	\$0.00	\$68.72
	03/01/2019	\$42.85	\$9.90	\$17.00	\$0.00	\$69.75

Apprentice - CARPENTER - Zone 2 Eastern MA

Effective Date - 09/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$18.90	\$9.90	\$1.63	\$0.00	\$30.43
2	60	\$22.68	\$9.90	\$1.63	\$0.00	\$34.21
3	70	\$26.46	\$9.90	\$12.11	\$0.00	\$48.47
4	75	\$28.35	\$9.90	\$12.11	\$0.00	\$50.36
5	80	\$30.24	\$9.90	\$13.74	\$0.00	\$53.88
6	80	\$30.24	\$9.90	\$13.74	\$0.00	\$53.88
7	90	\$34.02	\$9.90	\$15.37	\$0.00	\$59.29
8	90	\$34.02	\$9.90	\$15.37	\$0.00	\$59.29

Effective Date - 03/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$19.39	\$9.90	\$1.63	\$0.00	\$30.92
2	60	\$23.26	\$9.90	\$1.63	\$0.00	\$34.79
3	70	\$27.14	\$9.90	\$12.11	\$0.00	\$49.15
4	75	\$29.08	\$9.90	\$12.11	\$0.00	\$51.09
5	80	\$31.02	\$9.90	\$13.74	\$0.00	\$54.66
6	80	\$31.02	\$9.90	\$13.74	\$0.00	\$54.66
7	90	\$34.89	\$9.90	\$15.37	\$0.00	\$60.16
8	90	\$34.89	\$9.90	\$15.37	\$0.00	\$60.16

Notes:

Apprentice to Journeyworker Ratio:1:5

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CEMENT MASONRY/PLASTERING <i>BRICKLAYERS LOCAL 3 (LYNN)</i>	01/01/2017	\$45.67	\$12.20	\$19.41	\$1.30	\$78.58
	07/01/2017	\$46.30	\$12.20	\$19.41	\$1.30	\$79.21
	01/01/2018	\$46.54	\$12.20	\$19.41	\$1.30	\$79.45
	07/01/2018	\$46.79	\$12.20	\$19.41	\$1.30	\$79.70
	01/01/2019	\$47.03	\$12.20	\$19.41	\$1.30	\$79.94
	07/01/2019	\$47.27	\$12.20	\$19.41	\$1.30	\$80.18
	01/01/2020	\$47.52	\$12.20	\$19.41	\$1.30	\$80.43

Apprentice - CEMENT MASONRY/PLASTERING - Eastern Mass (Lynn)

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.84	\$12.20	\$12.41	\$0.00	\$47.45
2	60	\$27.40	\$12.20	\$14.41	\$1.30	\$55.31
3	65	\$29.69	\$12.20	\$15.41	\$1.30	\$58.60
4	70	\$31.97	\$12.20	\$16.41	\$1.30	\$61.88
5	75	\$34.25	\$12.20	\$17.41	\$1.30	\$65.16
6	80	\$36.54	\$12.20	\$18.41	\$1.30	\$68.45
7	90	\$41.10	\$12.20	\$19.41	\$1.30	\$74.01

Effective Date - 07/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.15	\$12.20	\$12.41	\$0.00	\$47.76
2	60	\$27.78	\$12.20	\$14.41	\$1.30	\$55.69
3	65	\$30.10	\$12.20	\$15.41	\$1.30	\$59.01
4	70	\$32.41	\$12.20	\$16.41	\$1.30	\$62.32
5	75	\$34.73	\$12.20	\$17.41	\$1.30	\$65.64
6	80	\$37.04	\$12.20	\$18.41	\$1.30	\$68.95
7	90	\$41.67	\$12.20	\$19.41	\$1.30	\$74.58

Notes:

Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.

Apprentice to Journeyworker Ratio:1:3

CHAIN SAW OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$46.38	\$10.00	\$15.25	\$0.00	\$71.63
	06/01/2017	\$47.38	\$10.00	\$15.25	\$0.00	\$72.63
	12/01/2017	\$48.38	\$10.00	\$15.25	\$0.00	\$73.63
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
COMPRESSOR OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$31.17	\$10.00	\$15.25	\$0.00	\$56.42
	06/01/2017	\$31.86	\$10.00	\$15.25	\$0.00	\$57.11
	12/01/2017	\$32.55	\$10.00	\$15.25	\$0.00	\$57.80
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DELEADER (BRIDGE) <i>PAINTERS LOCAL 35 - ZONE 2</i>	01/01/2017	\$51.41	\$7.85	\$16.10	\$0.00	\$75.36

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.71	\$7.85	\$0.00	\$0.00	\$33.56
2	55	\$28.28	\$7.85	\$3.66	\$0.00	\$39.79
3	60	\$30.85	\$7.85	\$3.99	\$0.00	\$42.69
4	65	\$33.42	\$7.85	\$4.32	\$0.00	\$45.59
5	70	\$35.99	\$7.85	\$14.11	\$0.00	\$57.95
6	75	\$38.56	\$7.85	\$14.44	\$0.00	\$60.85
7	80	\$41.13	\$7.85	\$14.77	\$0.00	\$63.75
8	90	\$46.27	\$7.85	\$15.44	\$0.00	\$69.56

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

DEMO: ADZEMAN LABORERS - ZONE 2	12/01/2015	\$35.50	\$7.45	\$13.55	\$0.00	\$56.50
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For apprentice rates see "Apprentice- LABORER"

DEMO: BACKHOE/LOADER/HAMMER OPERATOR LABORERS - ZONE 2	12/01/2015	\$36.50	\$7.45	\$13.55	\$0.00	\$57.50
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For apprentice rates see "Apprentice- LABORER"

DEMO: BURNERS LABORERS - ZONE 2	12/01/2015	\$36.25	\$7.45	\$13.55	\$0.00	\$57.25
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For apprentice rates see "Apprentice- LABORER"

DEMO: CONCRETE CUTTER/SAWYER LABORERS - ZONE 2	12/01/2015	\$36.50	\$7.45	\$13.55	\$0.00	\$57.50
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For apprentice rates see "Apprentice- LABORER"

DEMO: JACKHAMMER OPERATOR LABORERS - ZONE 2	12/01/2015	\$36.25	\$7.45	\$13.55	\$0.00	\$57.25
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For apprentice rates see "Apprentice- LABORER"

DEMO: WRECKING LABORER LABORERS - ZONE 2	12/01/2015	\$35.50	\$7.45	\$13.55	\$0.00	\$56.50
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For apprentice rates see "Apprentice- LABORER"

DIRECTIONAL DRILL MACHINE OPERATOR OPERATING ENGINEERS LOCAL 4	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

DIVER PILE DRIVER LOCAL 56 (ZONE 1)	08/01/2015	\$58.86	\$9.80	\$19.23	\$0.00	\$87.89
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For apprentice rates see "Apprentice- PILE DRIVER"

DIVER TENDER PILE DRIVER LOCAL 56 (ZONE 1)	08/01/2015	\$42.04	\$9.80	\$19.23	\$0.00	\$71.07
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For apprentice rates see "Apprentice- PILE DRIVER"

DIVER TENDER (EFFLUENT) PILE DRIVER LOCAL 56 (ZONE 1)	08/01/2015	\$63.06	\$9.80	\$19.23	\$0.00	\$92.09
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For apprentice rates see "Apprentice- PILE DRIVER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DIVER/SLURRY (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2015	\$88.23	\$9.80	\$19.23	\$0.00	\$117.26
For apprentice rates see "Apprentice- PILE DRIVER"						
DRAWBRIDGE OPERATOR (Construction) <i>ELECTRICIANS LOCAL 103</i>	09/01/2016	\$47.13	\$13.00	\$17.41	\$0.00	\$77.54
	03/01/2017	\$48.33	\$13.00	\$17.45	\$0.00	\$78.78
	09/01/2017	\$49.28	\$13.00	\$17.48	\$0.00	\$79.76
	03/01/2018	\$50.48	\$13.00	\$17.51	\$0.00	\$80.99
	09/01/2018	\$51.67	\$13.00	\$17.55	\$0.00	\$82.22
	03/01/2019	\$52.87	\$13.00	\$17.59	\$0.00	\$83.46
For apprentice rates see "Apprentice- ELECTRICIAN"						
ELECTRICIAN <i>ELECTRICIANS LOCAL 103</i>	09/01/2016	\$47.13	\$13.00	\$17.41	\$0.00	\$77.54
	03/01/2017	\$48.33	\$13.00	\$17.45	\$0.00	\$78.78
	09/01/2017	\$49.28	\$13.00	\$17.48	\$0.00	\$79.76
	03/01/2018	\$50.48	\$13.00	\$17.51	\$0.00	\$80.99
	09/01/2018	\$51.67	\$13.00	\$17.55	\$0.00	\$82.22
	03/01/2019	\$52.87	\$13.00	\$17.59	\$0.00	\$83.46

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - ELECTRICIAN - Local 103

Effective Date - 09/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$18.85	\$13.00	\$0.57	\$0.00	\$32.42
2	40	\$18.85	\$13.00	\$0.57	\$0.00	\$32.42
3	45	\$21.21	\$13.00	\$13.36	\$0.00	\$47.57
4	45	\$21.21	\$13.00	\$13.36	\$0.00	\$47.57
5	50	\$23.57	\$13.00	\$13.73	\$0.00	\$50.30
6	55	\$25.92	\$13.00	\$14.09	\$0.00	\$53.01
7	60	\$28.28	\$13.00	\$14.46	\$0.00	\$55.74
8	65	\$30.63	\$13.00	\$14.83	\$0.00	\$58.46
9	70	\$32.99	\$13.00	\$15.20	\$0.00	\$61.19
10	75	\$35.35	\$13.00	\$15.57	\$0.00	\$63.92

Effective Date - 03/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$19.33	\$13.00	\$0.58	\$0.00	\$32.91
2	40	\$19.33	\$13.00	\$0.58	\$0.00	\$32.91
3	45	\$21.75	\$13.00	\$13.37	\$0.00	\$48.12
4	45	\$21.75	\$13.00	\$13.37	\$0.00	\$48.12
5	50	\$24.17	\$13.00	\$13.75	\$0.00	\$50.92
6	55	\$26.58	\$13.00	\$14.11	\$0.00	\$53.69
7	60	\$29.00	\$13.00	\$14.48	\$0.00	\$56.48
8	65	\$31.41	\$13.00	\$14.85	\$0.00	\$59.26
9	70	\$33.83	\$13.00	\$15.22	\$0.00	\$62.05
10	75	\$36.25	\$13.00	\$15.60	\$0.00	\$64.85

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	01/01/2017	\$55.86	\$15.28	\$15.71	\$0.00	\$86.85
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Apprentice - ELEVATOR CONSTRUCTOR - Local 4

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.93	\$15.28	\$0.00	\$0.00	\$43.21
2	55	\$30.72	\$15.28	\$15.71	\$0.00	\$61.71
3	65	\$36.31	\$15.28	\$15.71	\$0.00	\$67.30
4	70	\$39.10	\$15.28	\$15.71	\$0.00	\$70.09
5	80	\$44.69	\$15.28	\$15.71	\$0.00	\$75.68

Notes:
Steps 1-2 are 6 mos.; Steps 3-5 are 1 year

Apprentice to Journeyworker Ratio:1:1

ELEVATOR CONSTRUCTOR HELPER <i>ELEVATOR CONSTRUCTORS LOCAL 4</i>	01/01/2017	\$39.10	\$15.28	\$15.71	\$0.00	\$70.09
For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"						
FENCE & GUARD RAIL ERECTOR <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	11/01/2016	\$41.37	\$10.00	\$15.15	\$0.00	\$66.52
	05/01/2017	\$42.25	\$10.00	\$15.15	\$0.00	\$67.40
	11/01/2017	\$42.98	\$10.00	\$15.15	\$0.00	\$68.13
	05/01/2018	\$43.69	\$10.00	\$15.15	\$0.00	\$68.84
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	11/01/2016	\$42.82	\$10.00	\$15.15	\$0.00	\$67.97
	05/01/2017	\$43.71	\$10.00	\$15.15	\$0.00	\$68.86
	11/01/2017	\$44.44	\$10.00	\$15.15	\$0.00	\$69.59
	05/01/2018	\$45.16	\$10.00	\$15.15	\$0.00	\$70.31
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	11/01/2016	\$21.98	\$10.00	\$15.15	\$0.00	\$47.13
	05/01/2017	\$22.51	\$10.00	\$15.15	\$0.00	\$47.66
	11/01/2017	\$22.93	\$10.00	\$15.15	\$0.00	\$48.08
	05/01/2018	\$23.36	\$10.00	\$15.15	\$0.00	\$48.51
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIRE ALARM INSTALLER <i>ELECTRICIANS LOCAL 103</i>	09/01/2016	\$47.13	\$13.00	\$17.41	\$0.00	\$77.54
	03/01/2017	\$48.33	\$13.00	\$17.45	\$0.00	\$78.78
	09/01/2017	\$49.28	\$13.00	\$17.48	\$0.00	\$79.76
	03/01/2018	\$50.48	\$13.00	\$17.51	\$0.00	\$80.99
	09/01/2018	\$51.67	\$13.00	\$17.55	\$0.00	\$82.22
	03/01/2019	\$52.87	\$13.00	\$17.59	\$0.00	\$83.46
For apprentice rates see "Apprentice- ELECTRICIAN"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FIRE ALARM REPAIR / MAINTENANCE / COMMISSIONING <i>ELECTRICIANS</i>	09/01/2016	\$35.35	\$13.00	\$15.57	\$0.00	\$63.92
<i>LOCAL 103</i>	03/01/2017	\$36.25	\$13.00	\$15.60	\$0.00	\$64.85
	09/01/2017	\$36.96	\$13.00	\$15.62	\$0.00	\$65.58
	03/01/2018	\$37.86	\$13.00	\$15.65	\$0.00	\$66.51
	09/01/2018	\$38.75	\$13.00	\$15.67	\$0.00	\$67.42
	03/01/2019	\$39.65	\$13.00	\$15.70	\$0.00	\$68.35
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"						
FIREMAN (ASST. ENGINEER) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$37.65	\$10.00	\$15.25	\$0.00	\$62.90
	06/01/2017	\$38.49	\$10.00	\$15.25	\$0.00	\$63.74
	12/01/2017	\$39.32	\$10.00	\$15.25	\$0.00	\$64.57
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FLAGGER & SIGNALER <i>LABORERS - ZONE 2</i>	12/01/2016	\$20.50	\$7.45	\$12.65	\$0.00	\$40.60
For apprentice rates see "Apprentice- LABORER"						
FLOORCOVERER <i>FLOORCOVERERS LOCAL 2168 ZONE I</i>	03/01/2016	\$42.13	\$9.80	\$17.62	\$0.00	\$69.55

Apprentice - FLOORCOVERER - Local 2168 Zone I

Effective Date - 03/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.07	\$9.80	\$1.79	\$0.00	\$32.66
2	55	\$23.17	\$9.80	\$1.79	\$0.00	\$34.76
3	60	\$25.28	\$9.80	\$12.25	\$0.00	\$47.33
4	65	\$27.38	\$9.80	\$12.25	\$0.00	\$49.43
5	70	\$29.49	\$9.80	\$14.04	\$0.00	\$53.33
6	75	\$31.60	\$9.80	\$14.04	\$0.00	\$55.44
7	80	\$33.70	\$9.80	\$15.83	\$0.00	\$59.33
8	85	\$35.81	\$9.80	\$15.83	\$0.00	\$61.44

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

FORK LIFT/CHERRY PICKER <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$45.38	\$10.00	\$15.25	\$0.00	\$70.63
	06/01/2017	\$46.38	\$10.00	\$15.25	\$0.00	\$71.63
	12/01/2017	\$47.38	\$10.00	\$15.25	\$0.00	\$72.63
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GENERATOR/LIGHTING PLANT/HEATERS <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$31.17	\$10.00	\$15.25	\$0.00	\$56.42
	06/01/2017	\$31.86	\$10.00	\$15.25	\$0.00	\$57.11
	12/01/2017	\$32.55	\$10.00	\$15.25	\$0.00	\$57.80
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) <i>GLAZIERS LOCAL 35 (ZONE 2)</i>	01/01/2017	\$40.91	\$7.85	\$16.10	\$0.00	\$64.86

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - GLAZIER - Local 35 Zone 2

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.46	\$7.85	\$0.00	\$0.00	\$28.31
2	55	\$22.50	\$7.85	\$3.66	\$0.00	\$34.01
3	60	\$24.55	\$7.85	\$3.99	\$0.00	\$36.39
4	65	\$26.59	\$7.85	\$4.32	\$0.00	\$38.76
5	70	\$28.64	\$7.85	\$14.11	\$0.00	\$50.60
6	75	\$30.68	\$7.85	\$14.44	\$0.00	\$52.97
7	80	\$32.73	\$7.85	\$14.77	\$0.00	\$55.35
8	90	\$36.82	\$7.85	\$15.44	\$0.00	\$60.11

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

HOISTING ENGINEER/CRANES/GRADALLS	12/01/2016	\$45.38	\$10.00	\$15.25	\$0.00	\$70.63
OPERATING ENGINEERS LOCAL 4	06/01/2017	\$46.38	\$10.00	\$15.25	\$0.00	\$71.63
	12/01/2017	\$47.38	\$10.00	\$15.25	\$0.00	\$72.63

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - OPERATING ENGINEERS - Local 4

Effective Date - 12/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$24.96	\$10.00	\$0.00	\$0.00	\$34.96
2	60	\$27.23	\$10.00	\$15.25	\$0.00	\$52.48
3	65	\$29.50	\$10.00	\$15.25	\$0.00	\$54.75
4	70	\$31.77	\$10.00	\$15.25	\$0.00	\$57.02
5	75	\$34.04	\$10.00	\$15.25	\$0.00	\$59.29
6	80	\$36.30	\$10.00	\$15.25	\$0.00	\$61.55
7	85	\$38.57	\$10.00	\$15.25	\$0.00	\$63.82
8	90	\$40.84	\$10.00	\$15.25	\$0.00	\$66.09

Effective Date - 06/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$25.51	\$10.00	\$0.00	\$0.00	\$35.51
2	60	\$27.83	\$10.00	\$15.25	\$0.00	\$53.08
3	65	\$30.15	\$10.00	\$15.25	\$0.00	\$55.40
4	70	\$32.47	\$10.00	\$15.25	\$0.00	\$57.72
5	75	\$34.79	\$10.00	\$15.25	\$0.00	\$60.04
6	80	\$37.10	\$10.00	\$15.25	\$0.00	\$62.35
7	85	\$39.42	\$10.00	\$15.25	\$0.00	\$64.67
8	90	\$41.74	\$10.00	\$15.25	\$0.00	\$66.99

Notes:

Apprentice to Journeyworker Ratio:1:6

HVAC (DUCTWORK) SHEETMETAL WORKERS LOCAL 17 - A	11/01/2016	\$43.40	\$10.70	\$23.07	\$2.32	\$79.49
	02/01/2017	\$44.50	\$10.70	\$23.07	\$2.32	\$80.59
	08/01/2017	\$45.60	\$10.70	\$23.07	\$2.32	\$81.69
	02/01/2018	\$46.75	\$10.70	\$23.07	\$2.32	\$82.84

For apprentice rates see "Apprentice- SHEET METAL WORKER"

HVAC (ELECTRICAL CONTROLS) ELECTRICIANS LOCAL 103	09/01/2016	\$47.13	\$13.00	\$17.41	\$0.00	\$77.54
	03/01/2017	\$48.33	\$13.00	\$17.45	\$0.00	\$78.78
	09/01/2017	\$49.28	\$13.00	\$17.48	\$0.00	\$79.76
	03/01/2018	\$50.48	\$13.00	\$17.51	\$0.00	\$80.99
	09/01/2018	\$51.67	\$13.00	\$17.55	\$0.00	\$82.22
	03/01/2019	\$52.87	\$13.00	\$17.59	\$0.00	\$83.46

For apprentice rates see "Apprentice- ELECTRICIAN"

HVAC (TESTING AND BALANCING - AIR) SHEETMETAL WORKERS LOCAL 17 - A	11/01/2016	\$43.40	\$10.70	\$23.07	\$2.32	\$79.49
	02/01/2017	\$44.50	\$10.70	\$23.07	\$2.32	\$80.59
	08/01/2017	\$45.60	\$10.70	\$23.07	\$2.32	\$81.69
	02/01/2018	\$46.75	\$10.70	\$23.07	\$2.32	\$82.84

For apprentice rates see "Apprentice- SHEET METAL WORKER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
HVAC (TESTING AND BALANCING -WATER) <i>PIPEFITTERS LOCAL 537 (Local 138)</i>	09/01/2016	\$47.86	\$9.70	\$16.14	\$0.00	\$73.70
	03/01/2017	\$48.86	\$9.70	\$16.14	\$0.00	\$74.70
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HVAC MECHANIC <i>PIPEFITTERS LOCAL 537 (Local 138)</i>	09/01/2016	\$47.86	\$9.70	\$16.14	\$0.00	\$73.70
	03/01/2017	\$48.86	\$9.70	\$16.14	\$0.00	\$74.70
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HYDRAULIC DRILLS <i>LABORERS - ZONE 2</i>	12/01/2016	\$33.15	\$7.45	\$12.65	\$0.00	\$53.25
For apprentice rates see "Apprentice- LABORER"						
INSULATOR (PIPES & TANKS) <i>HEAT & FROST INSULATORS LOCAL 6 (BOSTON)</i>	09/01/2016	\$45.09	\$11.75	\$14.20	\$0.00	\$71.04
	09/01/2017	\$47.09	\$11.75	\$14.20	\$0.00	\$73.04
	09/01/2018	\$49.34	\$11.75	\$14.20	\$0.00	\$75.29
	09/01/2019	\$51.84	\$11.75	\$14.20	\$0.00	\$77.79

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

Effective Date - 09/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.55	\$11.75	\$10.45	\$0.00	\$44.75
2	60	\$27.05	\$11.75	\$11.20	\$0.00	\$50.00
3	70	\$31.56	\$11.75	\$11.95	\$0.00	\$55.26
4	80	\$36.07	\$11.75	\$12.70	\$0.00	\$60.52

Effective Date - 09/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.55	\$11.75	\$10.45	\$0.00	\$45.75
2	60	\$28.25	\$11.75	\$11.20	\$0.00	\$51.20
3	70	\$32.96	\$11.75	\$11.95	\$0.00	\$56.66
4	80	\$37.67	\$11.75	\$12.70	\$0.00	\$62.12

Notes:

Steps are 1 year

Apprentice to Journeyworker Ratio:1:4

IRONWORKER/WELDER <i>IRONWORKERS LOCAL 7 (BOSTON AREA)</i>	09/16/2016	\$44.05	\$7.80	\$20.85	\$0.00	\$72.70
	03/16/2017	\$44.65	\$7.80	\$20.85	\$0.00	\$73.30

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - IRONWORKER - Local 7 Boston

Effective Date - 09/16/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$26.43	\$7.80	\$20.85	\$0.00	\$55.08
2	70	\$30.84	\$7.80	\$20.85	\$0.00	\$59.49
3	75	\$33.04	\$7.80	\$20.85	\$0.00	\$61.69
4	80	\$35.24	\$7.80	\$20.85	\$0.00	\$63.89
5	85	\$37.44	\$7.80	\$20.85	\$0.00	\$66.09
6	90	\$39.65	\$7.80	\$20.85	\$0.00	\$68.30

Effective Date - 03/16/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$26.79	\$7.80	\$20.85	\$0.00	\$55.44
2	70	\$31.26	\$7.80	\$20.85	\$0.00	\$59.91
3	75	\$33.49	\$7.80	\$20.85	\$0.00	\$62.14
4	80	\$35.72	\$7.80	\$20.85	\$0.00	\$64.37
5	85	\$37.95	\$7.80	\$20.85	\$0.00	\$66.60
6	90	\$40.19	\$7.80	\$20.85	\$0.00	\$68.84

Notes:

** Structural 1:6; Ornamental 1:4

Apprentice to Journeyworker Ratio:**

JACKHAMMER & PAVING BREAKER OPERATOR LABORERS - ZONE 2	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
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For apprentice rates see "Apprentice- LABORER"

LABORER LABORERS - ZONE 2	12/01/2016	\$32.40	\$7.45	\$12.65	\$0.00	\$52.50
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Apprentice - LABORER - Zone 2

Effective Date - 12/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$19.44	\$7.45	\$12.65	\$0.00	\$39.54
2	70	\$22.68	\$7.45	\$12.65	\$0.00	\$42.78
3	80	\$25.92	\$7.45	\$12.65	\$0.00	\$46.02
4	90	\$29.16	\$7.45	\$12.65	\$0.00	\$49.26

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER: CARPENTER TENDER LABORERS - ZONE 2	12/01/2016	\$32.40	\$7.45	\$12.65	\$0.00	\$52.50
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For apprentice rates see "Apprentice- LABORER"

LABORER: CEMENT FINISHER TENDER LABORERS - ZONE 2	12/01/2016	\$32.40	\$7.45	\$12.65	\$0.00	\$52.50
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Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER"						
LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER <i>LABORERS - ZONE 2</i>	12/01/2015	\$31.35	\$7.45	\$12.60	\$0.00	\$51.40
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
LABORER: MULTI-TRADE TENDER <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.40	\$7.45	\$12.65	\$0.00	\$52.50
For apprentice rates see "Apprentice- LABORER"						
LABORER: TREE REMOVER <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.40	\$7.45	\$12.65	\$0.00	\$52.50
This classification applies to all tree work associated with the removal of standing trees, and trimming and removal of branches and limbs when the work is not done for a utility company for the purpose of operation, maintenance or repair of utility company equipment. For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
MARBLE & TILE FINISHERS <i>BRICKLAYERS LOCAL 3 - MARBLE & TILE</i>	08/01/2016	\$38.78	\$10.18	\$17.78	\$0.00	\$66.74
	02/01/2017	\$38.78	\$10.18	\$18.24	\$0.00	\$67.20

Apprentice - MARBLE & TILE FINISHER - Local 3 Marble & Tile

Effective Date - 08/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$19.39	\$10.18	\$17.78	\$0.00	\$47.35
2	60	\$23.27	\$10.18	\$17.78	\$0.00	\$51.23
3	70	\$27.15	\$10.18	\$17.78	\$0.00	\$55.11
4	80	\$31.02	\$10.18	\$17.78	\$0.00	\$58.98
5	90	\$34.90	\$10.18	\$17.78	\$0.00	\$62.86

Effective Date - 02/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$19.39	\$10.18	\$18.24	\$0.00	\$47.81
2	60	\$23.27	\$10.18	\$18.24	\$0.00	\$51.69
3	70	\$27.15	\$10.18	\$18.24	\$0.00	\$55.57
4	80	\$31.02	\$10.18	\$18.24	\$0.00	\$59.44
5	90	\$34.90	\$10.18	\$18.24	\$0.00	\$63.32

Notes:

Apprentice to Journeyworker Ratio:1:3

MARBLE MASONS, TILELAYERS & TERRAZZO MECH <i>BRICKLAYERS LOCAL 3 - MARBLE & TILE</i>	08/01/2016	\$50.80	\$10.18	\$19.22	\$0.00	\$80.20
	02/01/2017	\$50.80	\$10.18	\$19.79	\$0.00	\$80.77

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - MARBLE-TILE-TERRAZZO MECHANIC - Local 3 Marble & Tile

Effective Date - 08/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.40	\$10.18	\$19.22	\$0.00	\$54.80
2	60	\$30.48	\$10.18	\$19.22	\$0.00	\$59.88
3	70	\$35.56	\$10.18	\$19.22	\$0.00	\$64.96
4	80	\$40.64	\$10.18	\$19.22	\$0.00	\$70.04
5	90	\$45.72	\$10.18	\$19.22	\$0.00	\$75.12

Effective Date - 02/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.40	\$10.18	\$19.79	\$0.00	\$55.37
2	60	\$30.48	\$10.18	\$19.79	\$0.00	\$60.45
3	70	\$35.56	\$10.18	\$19.79	\$0.00	\$65.53
4	80	\$40.64	\$10.18	\$19.79	\$0.00	\$70.61
5	90	\$45.72	\$10.18	\$19.79	\$0.00	\$75.69

Notes:

Apprentice to Journeyworker Ratio:1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MECHANICS MAINTENANCE <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MILLWRIGHT (Zone 1) <i>MILLWRIGHTS LOCAL 1121 - Zone 1</i>	04/01/2015	\$37.64	\$9.80	\$16.21	\$0.00	\$63.65
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Apprentice - MILLWRIGHT - Local 1121 Zone 1

Effective Date - 04/01/2015

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$20.70	\$9.80	\$4.48	\$0.00	\$34.98
2	65	\$24.47	\$9.80	\$13.36	\$0.00	\$47.63
3	75	\$28.23	\$9.80	\$14.18	\$0.00	\$52.21
4	85	\$31.99	\$9.80	\$14.99	\$0.00	\$56.78

Notes:

Steps are 2,000 hours

Apprentice to Journeyworker Ratio:1:5

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
MORTAR MIXER <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
OILER (OTHER THAN TRUCK CRANES,GRADALLS) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$22.96	\$10.00	\$15.25	\$0.00	\$48.21
	06/01/2017	\$23.47	\$10.00	\$15.25	\$0.00	\$48.72
	12/01/2017	\$23.99	\$10.00	\$15.25	\$0.00	\$49.24
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
OILER (TRUCK CRANES, GRADALLS) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$26.94	\$10.00	\$15.25	\$0.00	\$52.19
	06/01/2017	\$27.54	\$10.00	\$15.25	\$0.00	\$52.79
	12/01/2017	\$28.15	\$10.00	\$15.25	\$0.00	\$53.40
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
OTHER POWER DRIVEN EQUIPMENT - CLASS II <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PAINTER (BRIDGES/TANKS) <i>PAINTERS LOCAL 35 - ZONE 2</i>	01/01/2017	\$51.41	\$7.85	\$16.10	\$0.00	\$75.36

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.71	\$7.85	\$0.00	\$0.00	\$33.56
2	55	\$28.28	\$7.85	\$3.66	\$0.00	\$39.79
3	60	\$30.85	\$7.85	\$3.99	\$0.00	\$42.69
4	65	\$33.42	\$7.85	\$4.32	\$0.00	\$45.59
5	70	\$35.99	\$7.85	\$14.11	\$0.00	\$57.95
6	75	\$38.56	\$7.85	\$14.44	\$0.00	\$60.85
7	80	\$41.13	\$7.85	\$14.77	\$0.00	\$63.75
8	90	\$46.27	\$7.85	\$15.44	\$0.00	\$69.56

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, NEW) *	01/01/2017	\$42.31	\$7.85	\$16.10	\$0.00	\$66.26
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* If 30% or more of surfaces to be painted are new construction,

NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 2*

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - New

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.16	\$7.85	\$0.00	\$0.00	\$29.01
2	55	\$23.27	\$7.85	\$3.66	\$0.00	\$34.78
3	60	\$25.39	\$7.85	\$3.99	\$0.00	\$37.23
4	65	\$27.50	\$7.85	\$4.32	\$0.00	\$39.67
5	70	\$29.62	\$7.85	\$14.11	\$0.00	\$51.58
6	75	\$31.73	\$7.85	\$14.44	\$0.00	\$54.02
7	80	\$33.85	\$7.85	\$14.77	\$0.00	\$56.47
8	90	\$38.08	\$7.85	\$15.44	\$0.00	\$61.37

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT) PAINTERS LOCAL 35 - ZONE 2	01/01/2017	\$40.37	\$7.85	\$16.10	\$0.00	\$64.32
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Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.19	\$7.85	\$0.00	\$0.00	\$28.04
2	55	\$22.20	\$7.85	\$3.66	\$0.00	\$33.71
3	60	\$24.22	\$7.85	\$3.99	\$0.00	\$36.06
4	65	\$26.24	\$7.85	\$4.32	\$0.00	\$38.41
5	70	\$28.26	\$7.85	\$14.11	\$0.00	\$50.22
6	75	\$30.28	\$7.85	\$14.44	\$0.00	\$52.57
7	80	\$32.30	\$7.85	\$14.77	\$0.00	\$54.92
8	90	\$36.33	\$7.85	\$15.44	\$0.00	\$59.62

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (TRAFFIC MARKINGS) LABORERS - ZONE 2	12/01/2016	\$32.40	\$7.45	\$12.65	\$0.00	\$52.50
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For Apprentice rates see "Apprentice- LABORER"

PAINTER / TAPER (BRUSH, NEW) *	01/01/2017	\$40.91	\$7.85	\$16.10	\$0.00	\$64.86
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* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. PAINTERS LOCAL 35 - ZONE 2

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER - Local 35 Zone 2 - BRUSH NEW

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.46	\$7.85	\$0.00	\$0.00	\$28.31
2	55	\$22.50	\$7.85	\$3.66	\$0.00	\$34.01
3	60	\$24.55	\$7.85	\$3.99	\$0.00	\$36.39
4	65	\$26.59	\$7.85	\$4.32	\$0.00	\$38.76
5	70	\$28.64	\$7.85	\$14.11	\$0.00	\$50.60
6	75	\$30.68	\$7.85	\$14.44	\$0.00	\$52.97
7	80	\$32.73	\$7.85	\$14.77	\$0.00	\$55.35
8	90	\$36.82	\$7.85	\$15.44	\$0.00	\$60.11

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, REPAINT) PAINTERS LOCAL 35 - ZONE 2	01/01/2017	\$38.97	\$7.85	\$16.10	\$0.00	\$62.92
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Apprentice - PAINTER Local 35 Zone 2 - BRUSH REPAINT

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$19.49	\$7.85	\$0.00	\$0.00	\$27.34
2	55	\$21.43	\$7.85	\$3.66	\$0.00	\$32.94
3	60	\$23.38	\$7.85	\$3.99	\$0.00	\$35.22
4	65	\$25.33	\$7.85	\$4.32	\$0.00	\$37.50
5	70	\$27.28	\$7.85	\$14.11	\$0.00	\$49.24
6	75	\$29.23	\$7.85	\$14.44	\$0.00	\$51.52
7	80	\$31.18	\$7.85	\$14.77	\$0.00	\$53.80
8	90	\$35.07	\$7.85	\$15.44	\$0.00	\$58.36

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PANEL & PICKUP TRUCKS DRIVER TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	12/01/2012	\$30.28	\$9.07	\$8.00	\$0.00	\$47.35
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PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) PILE DRIVER LOCAL 56 (ZONE 1) For apprentice rates see "Apprentice- PILE DRIVER"	08/01/2015	\$42.04	\$9.80	\$19.23	\$0.00	\$71.07
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PILE DRIVER PILE DRIVER LOCAL 56 (ZONE 1)	08/01/2015	\$42.04	\$9.80	\$19.23	\$0.00	\$71.07
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Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PILE DRIVER - Local 56 Zone 1

Effective Date - 08/01/2015

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.02	\$9.80	\$19.23	\$0.00	\$50.05
2	60	\$25.22	\$9.80	\$19.23	\$0.00	\$54.25
3	70	\$29.43	\$9.80	\$19.23	\$0.00	\$58.46
4	75	\$31.53	\$9.80	\$19.23	\$0.00	\$60.56
5	80	\$33.63	\$9.80	\$19.23	\$0.00	\$62.66
6	80	\$33.63	\$9.80	\$19.23	\$0.00	\$62.66
7	90	\$37.84	\$9.80	\$19.23	\$0.00	\$66.87
8	90	\$37.84	\$9.80	\$19.23	\$0.00	\$66.87

Notes:

Apprentice to Journeyworker Ratio:1:3

PIPEFITTER & STEAMFITTER <i>PIPEFITTERS LOCAL 537 (Local 138)</i>	09/01/2016	\$47.86	\$9.70	\$16.14	\$0.00	\$73.70
	03/01/2017	\$48.86	\$9.70	\$16.14	\$0.00	\$74.70

Apprentice - PIPEFITTER Local 537 (Local 138)

Effective Date - 09/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$19.14	\$9.70	\$5.50	\$0.00	\$34.34
2	45	\$21.54	\$9.70	\$16.14	\$0.00	\$47.38
3	60	\$28.72	\$9.70	\$16.14	\$0.00	\$54.56
4	70	\$33.50	\$9.70	\$16.14	\$0.00	\$59.34
5	80	\$38.29	\$9.70	\$16.14	\$0.00	\$64.13

Effective Date - 03/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$19.54	\$9.70	\$5.50	\$0.00	\$34.74
2	45	\$21.99	\$9.70	\$16.14	\$0.00	\$47.83
3	60	\$29.32	\$9.70	\$16.14	\$0.00	\$55.16
4	70	\$34.20	\$9.70	\$16.14	\$0.00	\$60.04
5	80	\$39.09	\$9.70	\$16.14	\$0.00	\$64.93

Notes:

** 1:3; 3:15; 1:10 thereafter / Steps are 1 yr.
Refrig/AC Mechanic **1:1;1:2;2:4;3:6;4:8;5:10;6:12;7:14;8:17;9:20;10:23(Max)

Apprentice to Journeyworker Ratio:**

PIPELAYER <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
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For apprentice rates see "Apprentice- LABORER"

PLUMBER <i>PLUMBERS & GASFITTERS LOCAL 12 (Local 138)</i>	09/01/2016	\$47.61	\$11.32	\$15.46	\$0.00	\$74.39
	03/01/2017	\$48.61	\$11.32	\$15.46	\$0.00	\$75.39

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

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

Effective Date - 09/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$16.66	\$11.32	\$5.74	\$0.00	\$33.72
2	40	\$19.04	\$11.32	\$6.49	\$0.00	\$36.85
3	55	\$26.19	\$11.32	\$8.73	\$0.00	\$46.24
4	65	\$30.95	\$11.32	\$10.23	\$0.00	\$52.50
5	75	\$35.71	\$11.32	\$11.72	\$0.00	\$58.75

Effective Date - 03/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$17.01	\$11.32	\$5.74	\$0.00	\$34.07
2	40	\$19.44	\$11.32	\$6.49	\$0.00	\$37.25
3	55	\$26.74	\$11.32	\$8.73	\$0.00	\$46.79
4	65	\$31.60	\$11.32	\$10.23	\$0.00	\$53.15
5	75	\$36.46	\$11.32	\$11.72	\$0.00	\$59.50

Notes:

Steps are 1 yr
Step 4 with lic\$55.65 Step5 with lic\$61.89

Apprentice to Journeyworker Ratio:1:5

PNEUMATIC CONTROLS (TEMP.) <i>PIPEFITTERS LOCAL 537 (Local 138)</i>	09/01/2016	\$47.86	\$9.70	\$16.14	\$0.00	\$73.70
	03/01/2017	\$48.86	\$9.70	\$16.14	\$0.00	\$74.70
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
PNEUMATIC DRILL/TOOL OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
POWDERMAN & BLASTER <i>LABORERS - ZONE 2</i>	12/01/2016	\$33.40	\$7.45	\$12.65	\$0.00	\$53.50
For apprentice rates see "Apprentice- LABORER"						
POWER SHOVEL/DERRICK/TRENCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$45.38	\$10.00	\$15.25	\$0.00	\$70.63
	06/01/2017	\$46.38	\$10.00	\$15.25	\$0.00	\$71.63
	12/01/2017	\$47.38	\$10.00	\$15.25	\$0.00	\$72.63
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (CONCRETE) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$45.38	\$10.00	\$15.25	\$0.00	\$70.63
	06/01/2017	\$46.38	\$10.00	\$15.25	\$0.00	\$71.63
	12/01/2017	\$47.38	\$10.00	\$15.25	\$0.00	\$72.63
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (DEWATERING, OTHER) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$31.17	\$10.00	\$15.25	\$0.00	\$56.42
	06/01/2017	\$31.86	\$10.00	\$15.25	\$0.00	\$57.11
	12/01/2017	\$32.55	\$10.00	\$15.25	\$0.00	\$57.80
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
READY-MIX CONCRETE DRIVER <i>TEAMSTERS LOCAL 42</i>	05/01/2016	\$24.15	\$8.49	\$10.68	\$0.00	\$43.32
	04/30/2017	\$24.15	\$8.49	\$11.07	\$0.00	\$43.71
	05/01/2017	\$24.21	\$8.49	\$11.54	\$0.00	\$44.24
	04/30/2018	\$24.21	\$8.49	\$11.96	\$0.00	\$44.66
	05/01/2018	\$24.24	\$8.49	\$12.46	\$0.00	\$45.19
	04/30/2019	\$24.24	\$8.49	\$12.92	\$0.00	\$45.65
RECLAIMERS <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
RESIDENTIAL WOOD FRAME (All Other Work) <i>CARPENTERS -ZONE 2 (Residential Wood)</i>	06/01/2016	\$25.32	\$9.80	\$16.82	\$0.00	\$51.94
RESIDENTIAL WOOD FRAME CARPENTER **	10/01/2016	\$25.69	\$7.07	\$7.18	\$0.00	\$39.94
** The Residential Wood Frame Carpenter classification applies only to the construction of new, wood frame residences that do not exceed four stories including the basement. <i>CARPENTERS -ZONE 2 (Residential Wood)</i>	04/01/2017	\$26.31	\$7.07	\$7.18	\$0.00	\$40.56
	10/01/2017	\$26.93	\$7.07	\$7.18	\$0.00	\$41.18
	04/01/2018	\$27.35	\$7.07	\$7.18	\$0.00	\$41.60
	10/01/2018	\$27.77	\$7.07	\$7.18	\$0.00	\$42.02
	04/01/2019	\$28.20	\$7.07	\$7.18	\$0.00	\$42.45
	10/01/2019	\$28.63	\$7.07	\$7.18	\$0.00	\$42.88

As of 9/1/09 Carpentry work on wood-frame residential WEATHERIZATION projects shall be paid the RESIDENTIAL WOOD FRAME CARPENTER rate.

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - CARPENTER (Residential Wood Frame) - Zone 2

Effective Date - 10/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$15.41	\$7.07	\$0.00	\$0.00	\$22.48
2	60	\$15.41	\$7.07	\$0.00	\$0.00	\$22.48
3	65	\$16.70	\$7.07	\$7.18	\$0.00	\$30.95
4	70	\$17.98	\$7.07	\$7.18	\$0.00	\$32.23
5	75	\$19.27	\$7.07	\$7.18	\$0.00	\$33.52
6	80	\$20.55	\$7.07	\$7.18	\$0.00	\$34.80
7	85	\$21.84	\$7.07	\$7.18	\$0.00	\$36.09
8	90	\$23.12	\$7.07	\$7.18	\$0.00	\$37.37

Effective Date - 04/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$15.79	\$7.07	\$0.00	\$0.00	\$22.86
2	60	\$15.79	\$7.07	\$0.00	\$0.00	\$22.86
3	65	\$17.10	\$7.07	\$7.18	\$0.00	\$31.35
4	70	\$18.42	\$7.07	\$7.18	\$0.00	\$32.67
5	75	\$19.73	\$7.07	\$7.18	\$0.00	\$33.98
6	80	\$21.05	\$7.07	\$7.18	\$0.00	\$35.30
7	85	\$22.36	\$7.07	\$7.18	\$0.00	\$36.61
8	90	\$23.68	\$7.07	\$7.18	\$0.00	\$37.93

Notes:

Apprentice to Journeyworker Ratio:1:5

RIDE-ON MOTORIZED BUGGY OPERATOR LABORERS - ZONE 2	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
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For apprentice rates see "Apprentice- LABORER"

ROLLER/SPREADER/MULCHING MACHINE OPERATING ENGINEERS LOCAL 4	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

ROOFER (Inc.Roofers Waterproofing &Roofers Damproofg) ROOFERS LOCAL 33	08/01/2016	\$41.11	\$11.00	\$13.00	\$0.00	\$65.11
	02/01/2017	\$42.26	\$11.00	\$13.00	\$0.00	\$66.26
	08/01/2017	\$43.36	\$11.00	\$13.00	\$0.00	\$67.36
	02/01/2018	\$44.51	\$11.00	\$13.00	\$0.00	\$68.51
	08/01/2018	\$45.61	\$11.00	\$13.00	\$0.00	\$69.61
	02/01/2019	\$46.76	\$11.00	\$13.00	\$0.00	\$70.76

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - ROOFER - Local 33

Effective Date - 08/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.56	\$11.00	\$3.44	\$0.00	\$35.00
2	60	\$24.67	\$11.00	\$13.00	\$0.00	\$48.67
3	65	\$26.72	\$11.00	\$13.00	\$0.00	\$50.72
4	75	\$30.83	\$11.00	\$13.00	\$0.00	\$54.83
5	85	\$34.94	\$11.00	\$13.00	\$0.00	\$58.94

Effective Date - 02/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.13	\$11.00	\$3.44	\$0.00	\$35.57
2	60	\$25.36	\$11.00	\$13.00	\$0.00	\$49.36
3	65	\$27.47	\$11.00	\$13.00	\$0.00	\$51.47
4	75	\$31.70	\$11.00	\$13.00	\$0.00	\$55.70
5	85	\$35.92	\$11.00	\$13.00	\$0.00	\$59.92

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	08/01/2016	\$41.36	\$11.00	\$13.00	\$0.00	\$65.36
ROOFERS LOCAL 33	02/01/2017	\$42.51	\$11.00	\$13.00	\$0.00	\$66.51
	08/01/2017	\$43.61	\$11.00	\$13.00	\$0.00	\$67.61
	02/01/2018	\$44.76	\$11.00	\$13.00	\$0.00	\$68.76
	08/01/2018	\$45.86	\$11.00	\$13.00	\$0.00	\$69.86
	02/01/2019	\$47.01	\$11.00	\$13.00	\$0.00	\$71.01

For apprentice rates see "Apprentice- ROOFER"

SHEETMETAL WORKER	11/01/2016	\$43.40	\$10.70	\$23.07	\$2.32	\$79.49
SHEETMETAL WORKERS LOCAL 17 - A	02/01/2017	\$44.50	\$10.70	\$23.07	\$2.32	\$80.59
	08/01/2017	\$45.60	\$10.70	\$23.07	\$2.32	\$81.69
	02/01/2018	\$46.75	\$10.70	\$23.07	\$2.32	\$82.84

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - SHEET METAL WORKER - Local 17-A

Effective Date - 11/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$17.36	\$10.70	\$5.24	\$0.00	\$33.30
2	40	\$17.36	\$10.70	\$5.24	\$0.00	\$33.30
3	45	\$19.53	\$10.70	\$10.31	\$1.22	\$41.76
4	45	\$19.53	\$10.70	\$10.31	\$1.22	\$41.76
5	50	\$21.70	\$10.70	\$11.21	\$1.31	\$44.92
6	50	\$21.70	\$10.70	\$11.46	\$1.32	\$45.18
7	60	\$26.04	\$10.70	\$13.02	\$1.49	\$51.25
8	65	\$28.21	\$10.70	\$13.93	\$1.59	\$54.43
9	75	\$32.55	\$10.70	\$15.74	\$1.77	\$60.76
10	85	\$36.89	\$10.70	\$17.05	\$1.94	\$66.58

Effective Date - 02/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$17.80	\$10.70	\$5.24	\$0.00	\$33.74
2	40	\$17.80	\$10.70	\$5.24	\$0.00	\$33.74
3	45	\$20.03	\$10.70	\$10.31	\$1.24	\$42.28
4	45	\$20.03	\$10.70	\$10.31	\$1.24	\$42.28
5	50	\$22.25	\$10.70	\$11.21	\$1.32	\$45.48
6	50	\$22.25	\$10.70	\$11.46	\$1.33	\$45.74
7	60	\$26.70	\$10.70	\$13.02	\$1.51	\$51.93
8	65	\$28.93	\$10.70	\$13.93	\$1.61	\$55.17
9	75	\$33.38	\$10.70	\$15.74	\$1.79	\$61.61
10	85	\$37.83	\$10.70	\$17.05	\$1.97	\$67.55

Notes:
Steps are 6 mos.

Apprentice to Journeyworker Ratio:1:4

SIGN ERECTOR PAINTERS LOCAL 35 - ZONE 2	06/01/2013	\$25.81	\$7.07	\$7.05	\$0.00	\$39.93
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Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - SIGN ERECTOR - Local 35 Zone 2

Effective Date - 06/01/2013

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$12.91	\$7.07	\$0.00	\$0.00	\$19.98
2	55	\$14.20	\$7.07	\$2.45	\$0.00	\$23.72
3	60	\$15.49	\$7.07	\$2.45	\$0.00	\$25.01
4	65	\$16.78	\$7.07	\$2.45	\$0.00	\$26.30
5	70	\$18.07	\$7.07	\$7.05	\$0.00	\$32.19
6	75	\$19.36	\$7.07	\$7.05	\$0.00	\$33.48
7	80	\$20.65	\$7.07	\$7.05	\$0.00	\$34.77
8	85	\$21.94	\$7.07	\$7.05	\$0.00	\$36.06
9	90	\$23.23	\$7.07	\$7.05	\$0.00	\$37.35

Notes:
Steps are 4 mos.

Apprentice to Journeyworker Ratio:1:1

SPECIALIZED EARTH MOVING EQUIP < 35 TONS <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	12/01/2016	\$32.44	\$10.91	\$10.89	\$0.00	\$54.24
SPECIALIZED EARTH MOVING EQUIP > 35 TONS <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	12/01/2016	\$32.73	\$10.91	\$10.89	\$0.00	\$54.53
SPRINKLER FITTER <i>SPRINKLER FITTERS LOCAL 550 - (Section B) Zone 2</i>	01/01/2017	\$49.57	\$8.77	\$17.20	\$0.00	\$75.54
	03/01/2017	\$50.47	\$8.77	\$17.20	\$0.00	\$76.44

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

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

Effective Date - 01/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$17.35	\$8.77	\$8.70	\$0.00	\$34.82
2	40	\$19.83	\$8.77	\$8.70	\$0.00	\$37.30
3	45	\$22.31	\$8.77	\$8.70	\$0.00	\$39.78
4	50	\$24.79	\$8.77	\$8.70	\$0.00	\$42.26
5	55	\$27.26	\$8.77	\$8.70	\$0.00	\$44.73
6	60	\$29.74	\$8.77	\$10.20	\$0.00	\$48.71
7	65	\$32.22	\$8.77	\$10.20	\$0.00	\$51.19
8	70	\$34.70	\$8.77	\$10.20	\$0.00	\$53.67
9	75	\$37.18	\$8.77	\$10.20	\$0.00	\$56.15
10	80	\$39.66	\$8.77	\$10.20	\$0.00	\$58.63

Effective Date - 03/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$17.66	\$8.77	\$8.70	\$0.00	\$35.13
2	40	\$20.19	\$8.77	\$8.70	\$0.00	\$37.66
3	45	\$22.71	\$8.77	\$8.70	\$0.00	\$40.18
4	50	\$25.24	\$8.77	\$8.70	\$0.00	\$42.71
5	55	\$27.76	\$8.77	\$8.70	\$0.00	\$45.23
6	60	\$30.28	\$8.77	\$10.20	\$0.00	\$49.25
7	65	\$32.81	\$8.77	\$10.20	\$0.00	\$51.78
8	70	\$35.33	\$8.77	\$10.20	\$0.00	\$54.30
9	75	\$37.85	\$8.77	\$10.20	\$0.00	\$56.82
10	80	\$40.38	\$8.77	\$10.20	\$0.00	\$59.35

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

STEAM BOILER OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TELECOMMUNICATION TECHNICIAN <i>ELECTRICIANS LOCAL 103</i>	09/01/2016	\$35.35	\$13.00	\$15.57	\$0.00	\$63.92
	03/01/2017	\$36.25	\$13.00	\$15.60	\$0.00	\$64.85
	09/01/2017	\$36.96	\$13.00	\$15.62	\$0.00	\$65.58
	03/01/2018	\$37.86	\$13.00	\$15.65	\$0.00	\$66.51
	09/01/2018	\$38.75	\$13.00	\$15.67	\$0.00	\$67.42
	03/01/2019	\$39.65	\$13.00	\$15.70	\$0.00	\$68.35

Apprentice - TELECOMMUNICATION TECHNICIAN - Local 103

Effective Date - 09/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$14.14	\$13.00	\$0.42	\$0.00	\$27.56
2	40	\$14.14	\$13.00	\$0.42	\$0.00	\$27.56
3	45	\$15.91	\$13.00	\$11.53	\$0.00	\$40.44
4	45	\$15.91	\$13.00	\$11.53	\$0.00	\$40.44
5	50	\$17.68	\$13.00	\$11.80	\$0.00	\$42.48
6	55	\$19.44	\$13.00	\$12.07	\$0.00	\$44.51
7	60	\$21.21	\$13.00	\$12.36	\$0.00	\$46.57
8	65	\$22.98	\$13.00	\$12.63	\$0.00	\$48.61
9	70	\$24.75	\$13.00	\$13.91	\$0.00	\$51.66
10	75	\$26.51	\$13.00	\$14.19	\$0.00	\$53.70

Effective Date - 03/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$14.50	\$13.00	\$0.44	\$0.00	\$27.94
2	40	\$14.50	\$13.00	\$0.44	\$0.00	\$27.94
3	45	\$16.31	\$13.00	\$12.54	\$0.00	\$41.85
4	45	\$16.31	\$13.00	\$12.54	\$0.00	\$41.85
5	50	\$18.13	\$13.00	\$12.81	\$0.00	\$43.94
6	55	\$19.94	\$13.00	\$13.09	\$0.00	\$46.03
7	60	\$21.75	\$13.00	\$13.37	\$0.00	\$48.12
8	65	\$23.56	\$13.00	\$13.65	\$0.00	\$50.21
9	70	\$25.38	\$13.00	\$13.93	\$0.00	\$52.31
10	75	\$27.19	\$13.00	\$14.21	\$0.00	\$54.40

Notes:

Apprentice to Journeyworker Ratio:1:1

TERRAZZO FINISHERS	08/01/2016	\$49.70	\$10.18	\$19.22	\$0.00	\$79.10
BRICKLAYERS LOCAL 3 - MARBLE & TILE	02/01/2017	\$49.70	\$10.18	\$19.79	\$0.00	\$79.67

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - TERRAZZO FINISHER - Local 3 Marble & Tile

Effective Date - 08/01/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.85	\$10.18	\$19.22	\$0.00	\$54.25
2	60	\$29.82	\$10.18	\$19.22	\$0.00	\$59.22
3	70	\$34.79	\$10.18	\$19.22	\$0.00	\$64.19
4	80	\$39.76	\$10.18	\$19.22	\$0.00	\$69.16
5	90	\$44.73	\$10.18	\$19.22	\$0.00	\$74.13

Effective Date - 02/01/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.85	\$10.18	\$19.79	\$0.00	\$54.82
2	60	\$29.82	\$10.18	\$19.79	\$0.00	\$59.79
3	70	\$34.79	\$10.18	\$19.79	\$0.00	\$64.76
4	80	\$39.76	\$10.18	\$19.79	\$0.00	\$69.73
5	90	\$44.73	\$10.18	\$19.79	\$0.00	\$74.70

Notes:

Apprentice to Journeyworker Ratio:1:3

TEST BORING DRILLER <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2016	\$38.20	\$7.45	\$14.00	\$0.00	\$59.65
For apprentice rates see "Apprentice- LABORER"						
TEST BORING DRILLER HELPER <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2016	\$36.92	\$7.45	\$14.00	\$0.00	\$58.37
For apprentice rates see "Apprentice- LABORER"						
TEST BORING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2016	\$36.80	\$7.45	\$14.00	\$0.00	\$58.25
For apprentice rates see "Apprentice- LABORER"						
TRACTORS/PORTABLE STEAM GENERATORS <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$44.94	\$10.00	\$15.25	\$0.00	\$70.19
	06/01/2017	\$45.93	\$10.00	\$15.25	\$0.00	\$71.18
	12/01/2017	\$46.92	\$10.00	\$15.25	\$0.00	\$72.17
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TRAILERS FOR EARTH MOVING EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	12/01/2016	\$33.02	\$10.91	\$10.89	\$0.00	\$54.82
TUNNEL WORK - COMPRESSED AIR <i>LABORERS (COMPRESSED AIR)</i>	12/01/2016	\$49.08	\$7.45	\$14.40	\$0.00	\$70.93
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) <i>LABORERS (COMPRESSED AIR)</i>	12/01/2016	\$51.08	\$7.45	\$14.40	\$0.00	\$72.93
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR <i>LABORERS (FREE AIR TUNNEL)</i>	12/01/2016	\$41.15	\$7.45	\$14.40	\$0.00	\$63.00
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR (HAZ. WASTE) <i>LABORERS (FREE AIR TUNNEL)</i>	12/01/2016	\$43.15	\$7.45	\$14.40	\$0.00	\$65.00
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>	12/01/2016	\$32.44	\$10.91	\$10.89	\$0.00	\$54.24
WAGON DRILL OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2016	\$32.65	\$7.45	\$12.65	\$0.00	\$52.75
For apprentice rates see "Apprentice- LABORER"						
WASTE WATER PUMP OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2016	\$45.38	\$10.00	\$15.25	\$0.00	\$70.63
	06/01/2017	\$46.38	\$10.00	\$15.25	\$0.00	\$71.63
	12/01/2017	\$47.38	\$10.00	\$15.25	\$0.00	\$72.63
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
WATER METER INSTALLER <i>PLUMBERS & GASFITTERS LOCAL 12 (Local 138)</i>	09/01/2016	\$47.61	\$11.32	\$15.46	\$0.00	\$74.39
	03/01/2017	\$48.61	\$11.32	\$15.46	\$0.00	\$75.39
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						
Outside Electrical - East						
CABLE TECHNICIAN (Power Zone) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$26.61	\$7.50	\$1.80	\$0.00	\$35.91
	09/03/2017	\$27.14	\$7.75	\$1.81	\$0.00	\$36.70
For apprentice rates see "Apprentice- LINEMAN"						
CABLEMAN (Underground Ducts & Cables) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$37.70	\$7.50	\$8.87	\$0.00	\$54.07
	09/03/2017	\$38.45	\$7.75	\$9.53	\$0.00	\$55.73
For apprentice rates see "Apprentice- LINEMAN"						
DRIVER / GROUNDMAN CDL <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$31.05	\$7.50	\$8.89	\$0.00	\$47.44
	09/03/2017	\$31.66	\$7.75	\$9.44	\$0.00	\$48.85
For apprentice rates see "Apprentice- LINEMAN"						
DRIVER / GROUNDMAN -Inexperienced (<2000 Hrs) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$24.39	\$7.50	\$1.73	\$0.00	\$33.62
	09/03/2017	\$24.88	\$7.75	\$1.75	\$0.00	\$34.38
For apprentice rates see "Apprentice- LINEMAN"						
EQUIPMENT OPERATOR (Class A CDL) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$37.70	\$7.50	\$12.95	\$0.00	\$58.15
	09/03/2017	\$38.45	\$7.75	\$13.61	\$0.00	\$59.81
For apprentice rates see "Apprentice- LINEMAN"						
EQUIPMENT OPERATOR (Class B CDL) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$33.26	\$7.50	\$9.63	\$0.00	\$50.39
	09/03/2017	\$33.92	\$7.75	\$10.21	\$0.00	\$51.88
For apprentice rates see "Apprentice- LINEMAN"						
GROUNDMAN <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$24.39	\$7.50	\$1.73	\$0.00	\$33.62
	09/03/2017	\$24.88	\$7.75	\$1.75	\$0.00	\$34.38
For apprentice rates see "Apprentice- LINEMAN"						
GROUNDMAN -Inexperienced (<2000 Hrs.) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$19.96	\$7.50	\$1.60	\$0.00	\$29.06
	09/03/2017	\$20.35	\$7.75	\$1.61	\$0.00	\$29.71
For apprentice rates see "Apprentice- LINEMAN"						
JOURNEYMAN LINEMAN <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	08/28/2016	\$44.35	\$7.50	\$15.83	\$0.00	\$67.68
	09/03/2017	\$45.23	\$7.75	\$16.61	\$0.00	\$69.59

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - LINEMAN (Outside Electrical) - East Local 104

Effective Date - 08/28/2016

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$26.61	\$7.50	\$3.30	\$0.00	\$37.41
2	65	\$28.83	\$7.50	\$3.36	\$0.00	\$39.69
3	70	\$31.05	\$7.50	\$3.43	\$0.00	\$41.98
4	75	\$33.26	\$7.50	\$5.00	\$0.00	\$45.76
5	80	\$35.48	\$7.50	\$5.06	\$0.00	\$48.04
6	85	\$37.70	\$7.50	\$5.13	\$0.00	\$50.33
7	90	\$39.92	\$7.50	\$7.20	\$0.00	\$54.62

Effective Date - 09/03/2017

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$27.14	\$7.75	\$3.31	\$0.00	\$38.20
2	65	\$29.40	\$7.75	\$3.38	\$0.00	\$40.53
3	70	\$31.66	\$7.75	\$3.45	\$0.00	\$42.86
4	75	\$33.92	\$7.75	\$5.02	\$0.00	\$46.69
5	80	\$36.18	\$7.75	\$5.09	\$0.00	\$49.02
6	85	\$38.45	\$7.75	\$5.15	\$0.00	\$51.35
7	90	\$40.71	\$7.75	\$7.22	\$0.00	\$55.68

Notes:

Apprentice to Journeyworker Ratio:1:2

TELEDATA CABLE SPLICER
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104 01/01/2016 \$28.98 \$4.25 \$3.12 \$0.00 \$36.35

TELEDATA LINEMAN/EQUIPMENT OPERATOR
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104 01/01/2016 \$27.31 \$4.25 \$3.07 \$0.00 \$34.63

TELEDATA WIREMAN/INSTALLER/TECHNICIAN
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104 01/01/2016 \$27.31 \$4.25 \$3.07 \$0.00 \$34.63

TREE TRIMMER
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104 01/31/2016 \$18.51 \$3.55 \$0.00 \$0.00 \$22.06

This classification applies only to tree work done: (a) for a utility company, R.E.A. cooperative, or railroad or coal mining company, and (b) for the purpose of operating, maintaining, or repairing the utility company's equipment, and (c) by a person who is using hand or mechanical cutting methods and is not on the ground. This classification does not apply to wholesale tree removal.

TREE TRIMMER GROUNDMAN
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104 01/31/2016 \$16.32 \$3.55 \$0.00 \$0.00 \$19.87

This classification applies only to tree work done: (a) for a utility company, R.E.A. cooperative, or railroad or coal mining company, and (b) for the purpose of operating, maintaining, or repairing the utility company's equipment, and (c) by a person who is using hand or mechanical cutting methods and is on the ground. This classification does not apply to wholesale tree removal.

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 00 73 73

STATUTORY REQUIREMENTS

The address system used herein is the same as the address system used in the General Conditions, with the prefix "SC" added thereto. Additional terms used in this Section have the meanings stated below, which are applicable to both the singular and plural thereof.

This Section may include certain provisions required by Laws and Regulations, but does not represent or reflect all applicable provisions and policies or Laws and Regulations, and may only include excerpts and portions thereof. Other required provisions and policies, and Laws and Regulations, shall be deemed to be so included and incorporated herein. Contractor is solely responsible to determine, obtain, review and interpret the full text of applicable provisions and policies, Regulations, and Laws.

The Project is specifically subject to the provisions of the Massachusetts General Laws (“MGL”).

SC-1.01.A.15 Contractor: Add the following language at the end of the definition.

Also referred to as “general Contractor” in applicable statutory provisions which may be used interchangeably and shall have the same meaning.

SC-1.01.A.29 Owner: Add the following language at the end of the definition.

Also referred to as “Awarding Authority” or “contracting authority” in applicable statutory provisions which may be used interchangeably and shall have the same meaning.

SC-1.01.A.44 Substantial Completion: Add the following language at the end of the definition.

For the purposes of MGL Chapter 30, Section 39G, *Completion of public works; semi-final and final estimates; payments; extra work; disputed items*, Substantial Completion shall also mean either that the Work has been completed except for Work having a valued at less than 1 percent of the then adjusted total Contract Price, 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 as required by the Contract.

SC-1.01.B Additional Terms

Add the following new definition.

7. *material or Material* -- As used in MGL Chapter 30, Section 39M, *Contracts for construction and materials; manner of awarding*, regarding items equal to those specified, the word “material” shall mean and include

any article, assembly, system, included in the Work, or any component part thereof.

SC-4.03 Differing Subsurface or Physical Conditions

Delete Paragraph 4.03.B in its entirety and insert the following in its place.

- B. Pursuant to MGL Chapter 30, Section 39N, *Construction contracts; equitable adjustment in contract price for differing subsurface or latent physical conditions*, 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 and 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.

SC-5.01 Performance, Payment, and Other Bond

Add the following new subparagraphs immediately after Paragraph 5.01.A.

1. Pursuant to MGL Chapter 30, Section 39A, *Construction contracts for public ways, airports or public works; truck rentals; security for payment*, and MGL Chapter 149, Section 29, *Bonds for payment for labor, materials, rentals or transportation charges (et al)*, the required payment bond shall also cover payment by the Contractor and Subcontractors for the rental or hire of dump trucks and “the rental or hire of vehicles, steam shovels, rollers propelled by steam or other power, concrete mixers, tools and other appliances and equipment employed in such construction,” and for payment of transportation charges directly related to such rental or hire. Such security for payment of transportation charges shall be incorporated by appropriate reference thereto as an additional obligation or condition in the required bonds.

2. In addition, such bonds shall cover payment by Contractor and Subcontractors of any sums due trustees or other persons authorized to collect such payments from the Contractor or Subcontractors, for health and welfare plans, supplementary unemployment benefit plans and other fringe benefits which are payable in cash and provided for in collective bargaining agreements between organized labor and the Contractor or Subcontractors;

SC-5.02 Licensed Sureties and Insurers

Add the following new subparagraphs immediately after Paragraph 5.02.A.

1. Pursuant to MGL Chapter 149, Section 29D, *Surety company; bonds*, every performance bond and every payment bond issued for any construction work in the Commonwealth shall be the bond of a surety company organized pursuant to Section 105 of MGL Chapter 175 or of a surety company authorized to do business in the Commonwealth under the provisions of Section 106 of said Chapter 175 and be approved by the U.S. Department of Treasury and are acceptable as sureties and reinsurers on federal bonds under Title 31 of the United States Code, sections 9304 to 9308.
2. If there is more than one surety company, the surety companies shall be jointly and severally liable.

SC-5.04 Contractor's Insurance:

Add the following language at the end of subparagraph 5.04.A.1.

, pursuant to MGL Chapter 149, Section 34A, *Contracts for public works; workers' compensation insurance; breach of contract; enforcement and violation of statute;*

Add the following language at the end of subparagraph 5.04.C.1,

, in compliance with MGL Chapter 152

SC-6.02 Labor; Working Hours:

Add the following new subparagraphs immediately after subparagraph 6.02.A.1.

2. Pursuant to MGL Chapter 30, Section 39S, *Contracts for construction; requirements*, Contractor shall furnish labor that can work in harmony with all other elements of labor employed or to be employed in the Work.
3. Pursuant to MGL Chapter 149, Section 26, *Public works; preference to veterans and citizens; wages*, preference shall be given to citizens of the Commonwealth of Massachusetts, citizens of the town or city where the

Project is located, veterans and service-disabled veterans, and citizens of the United States.

4. The Contractor shall not participate in or cooperate with an international boycott, as defined in Section 999 (b)(3) and (4) of the Internal Revenue Code as amended, or engage in conduct declared to be unlawful by MGL Chapter 151E, *Prohibition Of Certain Discrimination By Businesses, Section 2*.

Add the following new subparagraph immediately after Paragraph 6.02.B.

1. MGL Chapter 149, Section 30, *Eight hour day and six day week; emergencies; work on highways*, and Section 34, *Public contracts; stipulation as to hours and days of work; void contracts*, apply to this Project which limits work hours of those employed on public construction to 8 hours in any one day or 48 hours in any one week or 6 days in any one week, except in cases of emergency.

SC-6.05 Substitutes and “Or-Equals”

Add the following language at the end of Paragraph 6.05.A.

The provisions of MGL Chapter 30, Section 39M, subsection (b) also applies to this Paragraph.

SC-6.10 Taxes

Add the following new subparagraph immediately after Paragraph 6.10.A.

1. MGL Chapter 64H, Section 6, *Exemptions*, subsection (f), exempts from Massachusetts sales tax, building materials and supplies to be used in the Project, and Contractor shall not include any amount therefor. The words “building materials and supplies” shall include all materials and supplies consumed, employed or expended in the construction, reconstruction, alteration, remodeling or repair of any building, structure, public highway, bridge, or other such public work, as well as such materials and supplies physically incorporated therein. Said words shall also include rental charges for construction vehicles, equipment and machinery rented specifically for use on the Project Site, or while being used exclusively for the transportation of materials for the Project.

SC-6.12 Record Documents

Add the following new paragraph and subparagraphs immediately after Paragraph 6.12.A.

- B. Subject to the provisions of MGL Chapter 266, Section 67C, *Capital facility construction projects, etc.; false entries in records; penalties*, and pursuant to

MGL Chapter 30, Section 39R, *Definitions; contract provisions; management and financial statements; enforcement*:

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 until the expiration of six years after final payment, the office of inspector general, and the commissioner of capital asset management and maintenance shall have the right to examine any books, documents, papers or records of the Contractor or of his Subcontractors that directly pertain to, and involve transactions relating to, the Contractor or his Subcontractors; and
2. 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 and included in Section 00 54 00, including in his description the date of the change and reasons therefor, and shall accompany said description with a letter from the Contractor's independent certified public accountant approving or otherwise commenting on the changes.
3. The Contractor shall annually file with the commissioner of capital asset management and maintenance during the term of the Contract, a financial statement prepared by an independent certified public accountant on the basis of an audit by such 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.
4. Contractor's failure to satisfy any of the requirements of this section of the MGL may be grounds for debarment pursuant to MGL Chapter 149, Section 44C, *Suspension or debarment of contractors*.

SC-9.08 Decisions on Requirements of Contract Documents and Acceptability of Work

In Paragraph 9.08.B, replace "with reasonable promptness" with "within 30 days pursuant to MGL Chapter 30, Section 39P, *Contracts for construction and materials; awarding authority's decisions on interpretation of specifications, etc.; time limit; notice*".

SC-10.01 Authorized Changes in the Work

Add the following subparagraph immediately after Paragraph 10.01.A.

1. Changes to the Work are subject to the requirements of MGL Chapter 30, Section 39I, *Deviations from plans and specifications*.

SC-10.05 *Claims*

Add the following paragraph immediately after Paragraph 10.05.G.

- H. Presentation of false, fictitious, or fraudulent Claims is subject to the provisions of MGL Chapter 266, Section 67B, *Presentation of false claims*.

SC-11.01 *Cost of the Work*

Pursuant to subparagraph 11.01.A.1.a., prevailing wage requirements are included in Sections 00 73 43 and 00 73 46.

Add the following new subparagraph immediately after Paragraph 11.01.A.5.d.

- 1) The Project is exempt from sales tax as set forth in SC-6.01.

SC-12.01 *Change of Contract Price*

Add the following new paragraph and subparagraphs immediately after subparagraph 12.01.B.3.

4. ***Monthly Price Adjustments for Certain Materials:*** As required by Massachusetts Chapter 150 of the Acts of 2013, the following price adjustment clauses for fuel (both diesel and gasoline), liquid asphalt and Portland cement contained in cast-in-place concrete shall be applicable to the Project. The following Base Prices are established for the Project, based on period prices **for December 2016** as published by the Massachusetts Department of Transportation - Highway Division.

Liquid Asphalt - \$345.00 per TON
Diesel - \$2.087 per GALLON
Gasoline - \$1.933 per GALLON
Portland Cement - \$123.82 per TON

- b. **Monthly Price Adjustment for Hot Mix Asphalt (HMA) Mixtures:** This adjustment will provide for either additional compensation to the Contractor or repayment to the Owner, depending on an increase or decrease in the Period Price of Liquid Asphalt.
- 1) **Base Price:** The Base Price of liquid asphalt listed above is the fixed price determined at the time of Bid by the Owner by using the same method as for the determination of the Period Price detailed below.
- 2) **Price Adjustment:** The Price Adjustment will be based on the variance in price for the liquid asphalt component only

from the Base Price to the Period Price. It shall not include transportation or other charges. This Price Adjustment will occur on a monthly basis.

- 3) Period Price: The Period Price for this Contract shall be the current “New Asphalt Price Method” Liquid Asphalt Period Price, in English Units, as published by the Massachusetts Department of Transportation – Highway Division at

<http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/Construction/PriceAdjustments.aspx>

- 4) Applicability: The Price Adjustment applies only to the actual virgin liquid asphalt content in the mixture placed on the Project in accordance with the Contract Documents.
- 5) Payment/Credit of Price Adjustment: The Contract Price of the hot mix asphalt mixture will be paid under the respective items in the Contract. The price adjustment, as herein provided, upwards or downwards, will be made after the Work has been performed, using the monthly Period Price for the month during which the Work was performed. The Price Adjustment will be a separate payment item and processed by Change Order. It will be determined by multiplying the number of tons of hot mix asphalt mixtures placed within pay limits during each monthly period as shown on submitted certified weigh slips times the liquid asphalt content percentage times the variance in price between Base Price and Period Price of liquid asphalt. This Price Adjustment will be paid or credited if the variance from the Base Price is 5 percent or more for a monthly period. No further Price Adjustments will be processed after the Contract is finally complete, unless an extension of Contract Time is approved by the Owner.

- b. Monthly Price Adjustment for Diesel Fuel and Gasoline: This adjustment will provide for either additional compensation to the Contractor or repayment to the Owner, depending on an increase or decrease in the Period Price of Diesel Fuel or Gasoline.

- 1) Base Price: The Base Price of Diesel Fuel and Gasoline listed above is the fixed price determined at the time of Bid by the Owner by using the same method as for the determination of the Period Price detailed below.
- 2) Price Adjustment: The Price Adjustment will be based on fuel usage factors for various items of Work included. These

factors will be multiplied by the quantities of Work completed in each item during each monthly period and further multiplied by the variance in price from the Base Price to the Period Price.

- 3) Period Price: The Period Price for this Contract shall be the current Diesel Period Price and Gasoline Period Price, in English Units, as published by the Massachusetts Department of Transportation – Highway Division at

<http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/Construction/PriceAdjustments.aspx>

- 4) Applicability: The fuel Price Adjustment will apply only to the following items of Work listed at the fuel factors shown.

- 5) Payment/Credit of Price Adjustment: The Price Adjustment will be a separate payment item and processed by Change Order. The Contract Price of items listed below will be paid under the respective items 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.

- a) The Price Adjustment will be a separate payment item. For all items, the Price Adjustment will be determined by multiplying the number of units of each item of Work times the fuel factor for each item of Work times the variance in price between Base Price and Period Price of diesel or gasoline.
- b) This Price Adjustment will be paid or credited if the variance from the Base Price is 5 percent or more for a monthly period. No further Price Adjustments will be processed after the Contract is finally complete, unless an extension of Contract Time is approved by the Owner.

ITEM No.	ITEMS OF WORK COVERED (PER UNIT PRICES FORM)	FUEL FACTORS	
		DIESEL	GASOLINE
2a	6-inch PVC Sewer Pipe	0.32 Gallons per LF	0.17 Gallons per LF
2b	8-inch PVC Sewer Pipe	0.32 Gallons per LF	0.17 Gallons per LF
2c	15-inch PVC Sewer Pipe	0.43 Gallons per LF	0.22 Gallons per LF
3	4-inch PVC Sewer Service	0.32 Gallons per LF	0.17 Gallons per LF
4	4-foot Diameter Sewer Manhole	9.8 Gallons per EA	5.1 Gallons per EA
6a	6-inch PVC Drain Pipe	0.32 Gallons per LF	0.17 Gallons per LF
6b	12-inch PVC Drain Pipe	0.32 Gallons per LF	0.17 Gallons per LF
6c	18-inch PVC Drain Pipe	0.43 Gallons per LF	0.22 Gallons per LF
6d	42-inch Class III RCP Drain Pipe	1.13 Gallons per LF	0.59 Gallons per LF
6e	48-inch Class III RCP Drain Pipe	1.13 Gallons per LF	0.59 Gallons per LF
7	30-inch Cement Lined Ductile Iron Drain Pipe	0.94 Gallons per LF	0.49 Gallons per LF
8	Forest River Park Pre-Cast Concrete Box Culvert Area	2.0 Gallons per \$1000	2.0 Gallons per \$1000
9	4-foot Diameter Catch Basin	9.8 Gallons per EA	5.1 Gallons per EA
10a	4-foot Diameter Drainage Manhole	9.8 Gallons per EA	5.1 Gallons per EA
10b	5-foot Diameter Drainage Manhole	9.8 Gallons per EA	5.1 Gallons per EA
10c	6-foot Diameter Drainage Manhole	14 Gallons per EA	7.2 Gallons per EA
10d	8-foot Diameter Drainage Manhole	31 Gallons per EA	16 Gallons per EA
13	Plunge Pool	3.9 Gallons per \$1000	3.9 Gallons per \$1000
14	Grassed Channel & Forest River Park Grading	3.9 Gallons per \$1000	3.9 Gallons per \$1000
16	8-inch Cement Lined Ductile Iron Manhole Vent	1.2 Gallons per LS	0.64 Gallons per LS
17a	6-inch Cement Lined Ductile Iron Water Pipe	0.43 Gallons per LF	0.22 Gallons per LF
17b	8-inch Cement Lined Ductile Iron Water Pipe	0.43 Gallons per LF	0.22 Gallons per LF
17c	12-inch Cement Lined Ductile Iron Water Pipe	0.43 Gallons per LF	0.22 Gallons per LF
18a	6-inch Gate Valve & Box	0.28 Gallons per EA	0.17 Gallons per EA
18b	8-inch Gate Valve & Box	0.28 Gallons per EA	0.17 Gallons per EA
18c	12-inch Gate Valve & Box	0.28 Gallons per EA	0.17 Gallons per EA
19	Hydrants	0.28 Gallons per EA	0.17 Gallons per EA
21a	3/4-inch Corporation Stop	0.28 Gallons per EA	0.17 Gallons per EA
21b	1-inch Corporation Stop	0.28 Gallons per EA	0.17 Gallons per EA
21c	3/4-inch Curb Stop and Box	0.28 Gallons per EA	0.17 Gallons per EA
21d	1-inch Curb Stop and Box	0.28 Gallons per EA	0.17 Gallons per EA
22a	Cement Lined Ductile Iron Fittings - Force Main	0.002 Gallons per LB	0.001 Gallons per LB
22b	Cement Lined Ductile Iron Fittings - Water Distribution	0.002 Gallons per LB	0.001 Gallons per LB

ITEM No.	ITEMS OF WORK COVERED (PER UNIT PRICES FORM)	FUEL FACTORS	
		DIESEL	GASOLINE
23	Forest River Park Meter Vault and Piping	12 Gallons per LS	6.0 Gallons per LS
29	Bituminous Curb	0.10 Gallons per LF	Not Applicable
30	Remove Existing Sidewalk	0.04 Gallons per SY	0.02 Gallons per SY
31	Concrete Sidewalk	0.11 Gallons per SY	0.08 Gallons per SY
32	Bituminous Asphalt Sidewalk	0.64 Gallons per SY	Not Applicable
33	Accessible Curb Ramps	0.24 Gallons per EA	0.18 Gallons per EA
35	Concrete Driveway Aprons	0.63 Gallons per EA	0.48 Gallons per EA
36	Temporary Trench Pavement	2.9 Gallons per TON	Not Applicable
37	Permanent Trench Pavement	0.64 Gallons per SY	Not Applicable
38a	Forest Ave /Clifton Ave Area Mill and Overlay	0.24 Gallons per SY	Not Applicable
38b	Forest Park Drive Area Mill and Overlay	0.24 Gallons per SY	Not Applicable
40a	Full Depth Pavement and Road Subbase – Forest River Park Ballfield Access Roadway	0.64 Gallons per SY	Not Applicable
40b	Full Depth Pavement and Road Subbase – Clifton Ave Roadway Widening	0.64 Gallons per SY	Not Applicable
41	Pavement Overlay – Forest River Park Roadway	0.32 Gallons per SY	Not Applicable
50	Pond Area Site Improvement	3.9 Gallons per \$1000	3.9 Gallons per \$1000
51	Forest River Basketball Court Improvement Area	2.0 Gallons per \$1000	2.0 Gallons per \$1000
53	Unsuitable Material Excavation and Replacement Below Normal Grade	0.29 Gallons per CY	0.15 Gallons per CY
54	Rock/Boulder Excavation	0.29 Gallons per CY	0.18 Gallons per CY
55	Forest River Park Electrical	2.0 Gallons per \$1000	2.0 Gallons per \$1000

- c. **Monthly Price Adjustment for Portland Cement Concrete Mixes:** This adjustment will provide for either additional compensation to the Contractor or repayment to the Owner, depending on an increase or decrease in the Period Price of Portland cement.
- 1) **Base Price:** The Base Price of Portland cement listed above is the fixed price determined at the time of Bid by the Owner by using the same method as for the determination of the Period Price detailed below.

- 2) Price Adjustment: 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. This Price Adjustment will occur on a monthly basis.
- 3) Period Price: The Period Price for this Contract shall be the current Portland cement Period Price, in English Units, as published by the Massachusetts Department of Transportation – Highway Division at <http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/Construction/PriceAdjustments.aspx>
- 4) Applicability: The price adjustment applies only to the actual Portland cement content in the mix placed on the Project in accordance with the Contract Documents.
- 5) Payment/Credit of Price Adjustment: The Contract Price of the Portland cement content in the mix will be paid under the respective items in the Contract. The price adjustment, as herein provided, upwards or downwards, will be made after the Work has been performed, using the monthly Period Price for the month during which the Work was performed. The Price Adjustment will be a separate payment item and processed by Change Order. It will be determined by multiplying the number of tons of Portland cement concrete placed during each monthly period as shown on submitted certified weigh slips times the Portland cement content percentage times the variance in price between the Base Price and Period Price of Portland cement. This Price Adjustment will be paid or credited if the variance from the Base Price is 5 percent or more for a monthly period. No further Price Adjustments will be processed after the Contract is finally complete, unless an extension of Contract Time is approved by the Owner.

SC-14.02. Progress Payments

Add the following new subparagraph immediately after subparagraph 14.02.A.1.

- a. Pursuant to MGL Chapter 30, Section 39S, *Contracts for construction; requirements*, provide certification for each employee employed at the Work Site of successful completion of 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.

Add the following new subparagraph immediately after subparagraph 14.02.C.1.

2. The provisions of MGL Chapter 30, Section 39G, *Completion of public works; semi-final and final estimates; payments; extra work; disputed items*, covering “periodic estimate” and “periodic payment” apply to this Project and shall be considered Progress Payments per Paragraph 14.02. Engineer will perform some of indicated actions on behalf of the Awarding Authority as its representative, consistent with the role and responsibilities defined in the General Conditions and Supplementary Conditions, and the forms listed in Section 00 60 00 and included in the Contract Documents will be utilized.

Add the following new paragraph and subparagraphs immediately after subparagraph 14.02.D.3.

- E. The following provisions regarding payment to Subcontractors are required by MGL Chapter 30, Section 39F, *Construction contracts; assignment and subrogation; subcontractor defined; enforcement of claim for direct payment; deposit, reduction of disputed amounts*. These provisions shall be included in any subcontract in connection with Work under the Contract Documents.
 1. Engineer will perform some of indicated actions on behalf of the Awarding Authority as its representative, consistent with the role and responsibilities defined in the General Conditions and Supplementary Conditions, if any.
 - 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 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 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) above 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 or which is to be included in a payment to the general Contractor for payment to the Subcontractor as provided in subparagraphs (a) and (b) above, the Awarding Authority shall act upon the demand as provided in this section of the MGL.

- d. If, within 70 days after the Subcontractor has substantially completed the subcontract 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 Subcontractor has substantially completed the subcontract work. Within 10 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 15 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 labor 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) above 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) above shall be made out of amounts payable to the general 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 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) above, 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.

SC 14.04 Substantial Completion: Add the following new paragraph immediately after Paragraph 14.04.E.

- F. The provisions of MGL Chapter 30, Section 39G, *Completion of public works; semi-final and final estimates; payments; extra work; disputed items*, covering substantial completion apply to this Project. Engineer will perform some of indicated actions on behalf of the Awarding Authority as its representative, consistent with the role and responsibilities defined in the General Conditions and Supplementary Conditions if any, and the forms listed in Section 00 60 00 and included in the Contract Documents will be utilized.

SC 14.07 Final Payment: Add the following new Paragraph immediately after subparagraph 14.07.C.1.

- D. The provisions of MGL Chapter 30, Section 39G, *Completion of public works; semi-final and final estimates; payments; extra work; disputed items* covering the final estimate and completion of the Work apply to this Project. Engineer will perform some of indicated actions on behalf of the Awarding Authority as its representative, consistent with the role and responsibilities defined in the General Conditions and Supplementary Conditions if any, and the forms listed in Section 00 60 00 and included in the Contract Documents will be utilized.

SC-15.01 Owner May Suspend Work: Add the following new subparagraphs immediately after Paragraph 15.01.A.

1. Pursuant to MGL Chapter 30, Section 39O, *Contracts for construction and materials; suspension, delay or interruption due to order of awarding authority; adjustment in contract price; written claim*, 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 15 days or more or due to a failure of the Awarding Authority to act within the time specified in the Contract, the Awarding Authority shall make an adjustment in the Contract Price for any increase in the cost of performance of the Contract but shall not include any profit to the general Contractor on such increase; and provided 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.
2. The general Contractor must submit the amount of a Claim under provision 1 above 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 the 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 in writing of the act or failure to act involved in the Claim.

3. In the event a suspension, delay, interruption or failure to act of the Awarding Authority increases the cost of performance to any Subcontractor, that Subcontractor shall have the same rights against the general Contractor for payment for an increase in the cost of his performance as provisions 1 and 2 above give the general Contractor against the Awarding Authority, but nothing in provisions 1 and 2 above shall in any way change, modify or alter any other rights which the general Contractor or the Subcontractor may have against each other.

SC-17.05 Controlling Law: Add the following new subparagraphs immediately after Paragraph 17.05.A.

1. This Contract is subject to all Laws and Regulations of the United States of America (including the U.S. Code of Federal Regulations), the Commonwealth of Massachusetts and other public authorities, and all amendments thereto. Where any requirements contained herein do not conform to or are inconsistent with such Laws and Regulations to which the Contract is subject or by which it is governed, such Laws and Regulations shall have precedence over any matters set forth herein.
2. The Project is specifically subject to MGL Chapters 30 and 149 for contracts awarded pursuant to MGL Chapter 30, Section 39M.
3. Statutes, Regulations, and portions and summaries thereof which are set forth or referred to in the Contract Documents shall be construed to include all amendments thereto in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids). The Owner and Engineer make no representation as to and assume no responsibility for the correctness or completeness of such statutory matters referred to or set forth herein.
4. Any provision in violation of the foregoing shall be deemed null, void and of no effect. Where conflicts with Laws and Regulations exist, the more stringent requirement shall apply.

END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Project Description
- B. Description of the Work
- C. Work Sequence and Coordination
- D. Special Requirements

1.02 PROJECT DESCRIPTION

- A. The Project is described as “Canal Street Flood Mitigation Project Phase II – CONTRACT A”.

1.03 DESCRIPTION OF THE WORK

- A. The Work includes labor, material and equipment, services required for construction, testing, and commissioning of the Project in accordance with the Contract Documents and as more specifically described in the Specifications and Drawings and includes, but is not limited to, the following principal features and materials, equipment, services and construction inherent to the Work. All lengths, sizes, dimensions and quantities given are approximate.
 - Installation of new storm drain pipes varying from 10 inches to 66 inches in diameter and drainage manholes and catch basins
 - Installation of new sanitary sewer utility pipes
 - Installation of new water utility pipes and installation of hydrants and connections to existing water system
 - Temporary bypass of water, sewer and drainage
 - Demolition of existing concession stand and various park features
 - Baseball field and basketball court demolition and reconstruction
 - Forest River Park reconstruction and grading
 - Pond improvement including wetlands rehabilitation and replication

- Installation of concrete box culvert
 - Installation of elevated walkway
 - Milling and overlaying existing pavement and construction of asphalt and concrete sidewalks
 - All work noted on the Project Drawings and Specifications
- B. Work Site locations: generally as shown on the Drawings.
- C. Work by Others
1. Owners third party inspection and testing contractors
- D. Existing conditions and Site data: per the Drawings and Section 01 70 00.

1.04 INTERIM MILESTONES

- A. Forest River Park Ballfield portion of the Work; sod installed by November 15, 2017 and ready for public and league use on April 28, 2018.

1.05 WORK SEQUENCE AND COORDINATION

- A. Coordination
1. Ensure that facilities and water system flows are maintained and remain in service at all times unless otherwise noted.
 2. Maintain access to facilities for the Owner throughout the Project.
- B. Sequence
1. Pioneer Village (Village) at the Forest River Park. Phase Work to provide access to the Village.
 - a. Phase 1 - Allow parking in existing location to remain open and pedestrian access to the Village through the beach walkway and rear Village entrance gate. Culvert and boardwalk to be completed during this phase and completed by May 31, 2017.
 - b. Phase 2 – Allow parking in existing location to remain open and pedestrian access to the Village through the proposed boardwalk and gate after May 31, 2017.
 - c. Wetland planting to take place in one of the planting seasons outlined in section 01 15 30.

2. Ballfield at the Forest River Park

- a. Provide parking and access for normal and league use from Project start date through September 1, 2017. Start Work in this area after September 1, 2017.

1.06 SPECIAL PROJECT REQUIREMENTS

- A. Comply with special project management, coordination and requirements specified in more detail in Sections 01 15 30, 01 50 00 and 01 70 00 including coordination requirements of the Conservation Commission
- B. Portions of the Work are within the FEMA 100-year floodplain and are subject to the jurisdiction of the Conservation Commission. Comply with the special requirements of the Order of Conditions included in Section 01 15 30.
- C. Coordinate permitting with City of Salem.
- D. Prepare for and participate in three, 3-hour public meetings in the City of Salem, Massachusetts to present details of Project progress and to answer questions.

1.07 OWNER FURNISHED SERVICES

- A. The Owner may provide additional third party testing and monitoring in addition to the Contractor's testing requirements included in the following Specifications for verification and validity of the Work. The Contractor is still required to provide independent materials testing per the specified sections.
1. Concrete and materials testing - Section 03 30 00
2. Soils testing - Sections 31 00 00, 32 72 00, and 32 90 00

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 15 30

PAYMENT AND ADMINISTRATIVE PROCEDURES AND QUALITY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements relating to payment, the process of contract administration, and the methods of communicating, controlling, and assuring quality, and applies to all Specifications and Drawings.

B. Section Includes

1.02 PAYMENT PROCEDURES

Schedule of Values

Payment Procedures

Change Procedures

Measurement and Payment Procedures

Correlation of Submittals

1.03 ADMINISTRATIVE REQUIREMENTS

Project Management and Coordination; Meetings

Documentation of Progress

Submittal Procedures

Closeout Procedures

1.04 QUALITY REQUIREMENTS

Reference Standards and Regulatory Requirements

Qualifications

Planting Seasons

1.02 PAYMENT PROCEDURES

- A. Schedule of Values: in accordance with Article 2 of the Standard General and Supplementary Conditions, if any.
 - 1. Provide sufficient detail to allow for determination of the value of the Work at any degree of completion. For each line item, identify number and title of specification section in accordance with the Table of Contents.
 - 2. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.

- B. Payment Procedures: in accordance with Article 14 of Standard General and Supplementary Conditions, if any.
 - 1. Submit Application for Payment using the form included in the Project Forms section. Utilize latest approved Schedule of Values for listing items in Application for Payment. Provide supporting documentation for items included in the Application for Payment.
 - a. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
 - 2. Payment Period: at intervals stipulated in the Agreement.
 - 3. Submit an updated Progress Schedule with each Application for Payment.
 - 4. Submit Traffic Police requests showing the Project name; the officers' names; location of assignment; date of assignment; hours of assignment.

- C. Change Procedures: in accordance with Articles 10 and 12 of Standard General and Supplementary Conditions, if any, utilizing forms included in Section 00 60 00 Project Forms. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
 - 1. *Field Order*: as authorized by Paragraph 9.04 of the Standard General and Supplementary Conditions, if any.
 - 2. *Change Request*: issued by Engineer, Owner or Contractor to request or authorize minor variations and deviations, amendments or supplements to the Contract Documents. Initiate requests for substitute items per Paragraph 6.05 of the Standard General and Supplementary Conditions, if any, using a Change Request.
 - a. Engineer or Owner to include a detailed description of a proposed change with supplementary or revised Drawings and Specifications, including a change in Contract Times related to the change (with a stipulation for any overtime Work required) and the period of time

- during which the requested price (if any) will be considered valid. Prepare and submit an estimate within 15 days.
- b. Describe the proposed change and its full effect on the Work. Describe the reason for the change and the effect on the Contract Price and Contract Time with full documentation (and a statement describing the effect on Work by separate or other contractors). Submit a Time Impact Analysis as specified in subparagraph 1.03.B.3.b.
3. *Work Change Directive*: as defined in Paragraph 1.01.A.51 of the Standard General and Supplementary Conditions, if any.
 4. *Change Order*: in accordance with Articles 10 and 12 of the Standard General and Supplementary Conditions, if any. Submit a Time Impact Analysis as specified in subparagraph 1.03.B.3.b.
 - a. *Stipulated Price Change Order*: based on Contractor's maximum price quotation or Contractor's request for a Change Order as approved by Engineer or Owner.
 - b. *Unit Price Change Order*: for pre-determined unit prices and quantities and executed on a fixed unit price basis. Execute Work under a Work Change Directive for unit costs or quantities of Work not pre-determined. Changes in Contract Price and Contract Time to be computed as specified for Time and Material Change Order.
 - c. *Time and Material Change Order*: based on itemized account and supporting data after completion of change within time limits indicated in the Standard General and Supplementary Conditions, if any. Engineer or Owner and Contractor to determine the change allowable in Contract Price and Contract Time as provided in the Standard General and Supplementary Conditions, if any. Maintain detailed records of Work completed on this basis, provide provide full information for evaluation of proposed changes, and substantiate costs for changes in the Work.
 5. *“Or Equals” and Substitutes*: Request “Or-Equal” and substitute items items as a Change Request per subparagraph 1.02.C.2 above, with complete data substantiating compliance with Contract Documents.
 - a. “Or-Equal” and substitute items will be processed in accordance with Paragraph 6.05 of the Standard General and Supplementary Conditions, if any, and subparagraph 1.03.C.6 below.

D. Measurement and Payment Procedures

1. Payment includes full compensation for required labor, material and equipment, tools, plant, transportation, services and incidentals; erection, application or installation and construction of an item of the Work; and overhead and profit, unless otherwise indicated.
2. See Section 01 20 25 Measurement and Payment.

E. Correlation of Submittals

1. Promptly revise Schedule of Values and Applications for Payment to record each authorized Change Order as a separate line item and adjust the Contract Price.
2. Promptly revise Progress Schedule to reflect any change in Contract Times and revise sub-schedules to adjust time for other items of the Work affected by the change.
3. Promptly enter changes in Project Record Documents.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Project Management and Coordination; Meetings

1. Contact information for Owner and other entities related to the Project and special coordination requirements and contacts during prosecution of the Work are included as an attachment to this section.
2. Inform Owner and Engineer of the address for sending official correspondence and the address and telephone number of Contractor's representative who will be project manager and Site superintendent for the Contract.
3. Procure, a web-based electronic document management control system will be utilized on the Project and managed by Engineer.
4. During periods of construction and testing keep Owner and Engineer informed in writing with name, address, and telephone number of Contractor's representative who will be responsible and available outside of normal working hours for emergency repairs and the maintenance of safety devices.
 - a. Identify the 24 hour, 7 days per week emergency response telephone or cell phone number that is staffed by a person (not a passive answering machine) or provide that a phone call will be returned within one hour.

5. Provide for Contractor's superintendent's attendance at three, 3-hour public meetings in the City of Salem, Massachusetts to present details of Project progress and to answer questions. Presentation shall include a Power Point presentation and appropriate illustrative documents. Submit presentation to Engineer 2 weeks prior to the public hearing and make revisions requested prior to the public meeting. Coordinate with Owner for scheduling attendance.
6. Provide 1 Project bulletin board in accordance with the following and install on Site per manufacturer's requirements at a location determined by the Owner.
 - a. Size and type: 2 foot by 3 foot, aluminum, lockable, weatherproof and watertight.
 - b. Manufacturer/model: Best-Rite™ Enclosed Rubber Tak Bulletin Board; Quartet Enclosed Cork Bulletin Board; Balt Enclosed Rubber Tak Bulletin Board; or approved equal.
 - c. Utilize as directed by the Owner, maintain in good condition, and remove at the completion of the Project.
7. Identify correspondence, submittals, drawings, data and materials, packing slips or other items associated with this Contract as follows:

**CANAL STREET FLOOD MITIGATION PROJECT – PHASE II,
CONTRACT A**

8. Coordinate scheduling, submittals, and Work of the various Specifications to effectuate an efficient and orderly sequence for installing interdependent construction elements, with provisions for accommodating items installed later.
9. Preconstruction Conference and Site Mobilization Meeting
 - a. Owner to schedule an initial preconstruction conference in accordance with Paragraph 2.06 of the Standard General and Supplementary Conditions, if any.
 - b. Attendance required by Owner, Contractor, Engineer, Contractor's Superintendent, Project Manager, and Subcontractors as a minimum.
 - 1) A separate Pre-Construction Conference will be held with the Conservation Commission to review and ensure the requirements of the Order of Conditions.

- c. Sample Agenda
 - Distribute Contract Documents
 - Discuss design concepts
 - Discuss preliminary Progress Schedule, Schedule of Submittals, Schedule of Values and preliminary cash flow projections
 - Designate personnel representing each party; communication procedures
 - Procedures and processing of submittals, substitutions, applications for payments, Change Orders and Contract closeout procedures
 - Scheduling
 - Use of premises by Owner and Contractor
 - Owner's requirements and partial occupancy
 - Construction facilities and controls provided by Owner
 - Temporary utilities provided by Owner and Contractor
 - Review Order of Conditions
 - Survey and Site Layout
 - Security and housekeeping procedures
 - Schedules
 - Procedures for testing
 - Procedures for maintaining record documents
 - Requirements for start-up
 - Inspection and acceptance of equipment put into service during construction period
 - Access, laydown and coordination with others
 - d. Engineer will record minutes and distribute a draft version promptly after meeting to Owner and Contractor for review, then revise as required and distribute thereafter to meeting participants and those affected by decisions made. Distribution will be via web-based electronic document management control system in PDF.
10. Prior to the commencement of any activity on Site, a Preconstruction On-Site Conference will be held between the Project supervisor, Contractor and Subcontractors responsible for the Work, and the Conservation Agent and/or a member of the Conservation Commission to ensure that the requirements of the Order of Conditions are understood. The staked erosion control line shall be adjusted, if necessary, during the pre-construction meeting. Contact the Conservation Agent at (978) 619-5685 at least 48 hours prior to construction to arrange for this Preconstruction On-Site Conference.

11. Progress Meetings
 - a. Owner to schedule progress meetings beginning no later than 60 days after the Initial Conference and continue thereafter on a biweekly basis throughout progress of the Work.
 - b. Attendance required by Contractor, Contractor's Superintendent, major Subcontractors and Suppliers, Owner and Engineer as appropriate to agenda topics for each meeting.
 - c. Sample Agenda
 - Review minutes of previous meetings – unresolved issues
 - Overall project status
 - Work Completed
 - Anticipated Work
 - Schedule
 - Pay Applications
 - Change Orders
 - Submittals
 - Observations, problems, and decisions
 - General Discussion/Comments
 - Action Items
 - Date and time for next meeting
 - d. Engineer will record minutes and distribute a draft version promptly after meeting to Owner and Contractor for review, then revise as required and distribute thereafter to meeting participants and those affected by decisions made. Distribution will be via web-based electronic document management control system in PDF.
12. Pre-installation Conference and Coordination Meetings
 - a. When required, convene a pre-installation conference at Site before commencing certain Work that requires coordination or has special requirements or approval.
 - b. Convene coordination meetings as may be generally required.
 - c. Attendance required by parties directly affecting, or affected by, Work of the specific Specification section.
 - 1) For pre-installation conference, notify Owner and Engineer 5 days in advance.
 - 2) For coordination meetings, party requesting coordination meeting to notify other party(s).

- d. Review conditions, preparation and procedures, and coordination with related Work.
- B. Documentation of Progress
1. Submit preliminary and final Progress Schedules as specified in Paragraphs 2.05 and 2.07 of the Standard General and Supplementary Conditions, if any, or as established in Notice to Proceed. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
 - a. Prepare Progress Schedules using Critical Path Method (CPM).
 - 1) Provide that activities are resource-loaded in man-hours, units and durations.
 - 2) Provide that activities are cost loaded including all materials purchased and equipment used. Spread indirect charges including general and administrative expenses, overhead and profit over the activities.
 - 3) Show activity numbers, early and late starts, early and late finishes, as well as total float for each activity.
 - 4) Differentiate critical path activities by displaying them in red.
 - b. Show complete sequence of construction by activity, milestones, special requirements, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration. Identify significant Work tasks including, but not limited to:
 - Mobilization
 - Procurement, inspection, and delivery of major or critical materials and equipment
 - Shop drawings and submittals
 - Access to Site
 - Major elements of Work and Interim Milestones
 - Major testing and inspection
 - Punchlist and cleanup
 - Demobilization

- c. Indicate dates for fabrication, factory testing, delivery, shipping and field testing, and material and equipment delivery dates. Coordinate with Schedule of Submittals.
 - d. Indicate estimated percentage of completion for each item of Work at each submission.
2. Submit a 2-Week Look Ahead Schedule on a bi-weekly basis or other time frame requested by Owner. Include 1 week of actual information and a 2-week “look ahead”, consistent with the sequence of activities contained in the Progress Schedule at a level of detail equal to or greater than that in the Progress Schedule. Identify activities requiring road closings, power outages, special coordination, shutdown as a minimum.
3. Submit revised Progress Schedule on monthly basis and with each Application for Payment, identifying changes since previous version. Coordinate content with Schedule of Values, if any.
 - a. Extensions of time to Interim Milestone dates or Substantial or Final Completion Dates may be granted to the extent that the equitable time adjustments to the activity or activities affected by the Contract Modification or delay exceeds the Total Float of the affected activity or subsequent paths and extends any Interim Milestone date or the Contract Completion Date. The Float is owned by the Project and claims for Float will be rejected. Total Float is defined as the amount of time between the early start date and the late start date, or the early finish date and the late finish date, for each activity in the Progress Schedule.
 - b. When Change Orders are initiated or delays are experienced, submit a written Time Impact Analysis that includes a “fragnet” (network analysis) demonstrating how Contractor proposes to incorporate the Change Order, delay or Contractor request into the Detailed Network Diagram. The analysis shall demonstrate the time impact based on the date the change is given to Contractor, the status of construction at that point in time; and the event time computation of affected activities. The event times used in the analysis shall be those included in the latest approved Progress Schedule.
4. Documentation Of Pre-Construction Conditions, Construction Progress, and Final Conditions
 - a. *Construction Photographs*: to record Site conditions. Ensure existing conditions of roadway surfaces, curbing, berms, sidewalks, driveways, property bounds, landscaped areas, abutters property and any other items that might be affected by the Work are clearly recorded.

- 1) Submit prior to starting construction. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
 - 2) Submit photographs with Payment Application monthly during progress of Work and for final payment to record final condition.
 - 3) Construction photographs: electronic in PDF or JPG format, minimum 300 dpi quality and a minimum resolution of 6.0 megapixels. Identify photographs with date, time, orientation and Project identification.
- b. *Digital Video Recording:* Video record, in color, all areas of the Project Site. Ensure existing conditions of roadway surfaces, curbing, berms, sidewalks, driveways, property bounds, landscaped areas, abutters' property and any other items that might be affected by the Work are clearly recorded.
- 1) Submit prior to the starting construction and submit at completion of construction.
 - 2) Arrange for video recordings to be conducted by a professional videographer in digital videodisc (DVD) format. Include clear and concise audio descriptions of the existing Project Site conditions.
 - 3) Submit 1 copy of the first completed video recording to the Engineer for review of visual and audio quality. Re-record any recording furnished which, in the opinion of the Engineer, are poor quality or incomplete at no additional cost to Owner. Submit 2 copies of approved videos.
5. Reports: submitted electronically via web-based electronic document management control system in PDF. Hardcopy not required.
- a. Submit weekly Safety Reports signed by the Safety Representative in accordance with Articles 6.13 and 6.14 of the Standard General and Supplementary Conditions, if any.
 - b. Submit updates to the Construction Operations Plan approved pursuant to SC 2.07 of Section 00 73 10 when it is modified.

C. Submittal Procedures

1. Schedule submittals to expedite the Project and coordinate with schedules required by Paragraph 1.03.B above. Deliver each submittal in the quantity

and form indicated to Engineer (with copy to Owner where required) at the addresses specified below. Coordinate submission of related items.

Engineer:

Woodard & Curran
40 Shattuck Road | Suite 110
Andover, MA 01810
Office: 978-557-8150
Fax: 866-702-6371

Attn: Michael Hansen, P.E.
Phone: (978) 482-7893
Email: mhansen@woodardcurran.com

Owner:

City of Salem, Dept. of Public Service
120 Washington Street – 4th Floor
Salem, MA 01970
Attn: David Knowlton, City Engineer
(978-745-9595)

2. Present submittals in a clear and thorough manner, in English and using English units. Provide space for Contractor, Engineer, and Owner's review stamps. Use sheet size of not less than 8 1/2 by 11 inches and not more than 24 by 36 inches.
3. Revise and resubmit documents as required. Identify all changes made since previous submittal. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions. Submittals not requested on the submittal schedule may not be recognized or processed.
4. Submit preliminary and final Schedule of Submittals as specified in Article 2 of the Standard General and Supplementary Conditions, if any, or as established in Notice to Proceed. Include all submittals specified in the Standard General and Supplementary Conditions, if any, General Requirements, and other Specification sections.
 - a. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
 - b. Include description of each submittal, date by which each submittal will be delivered to Engineer and Owner date by which each submittal must be approved to maintain project schedule, and relevant section reference.

- c. Allow 15-20 days from receipt of submittal/resubmittal for Engineer review of submittals and possible resubmittal.
5. *Shop Drawings and Samples*: Submit in accordance with Paragraph 6.17 of the Standard General and Supplementary Conditions, if any, and as follows, and coordinate with the Schedule of Submittals required in subparagraph 4 above.
 - a. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
 - b. Complete the submittal transmittal form included as an attachment to this Section as is indicated, numbering each submittal consecutively. Assign resubmittals the same transmittal number as the original with a suffix of a sequential letter to indicate the resubmittal (e.g. the first resubmittal of submittal 25 would be number 25A.) Include only those documents previously issued under original transmittal number in resubmittals. Do not combine new submittals with resubmittals.
 - c. Attach a transmittal form to each group of Shop Drawings, manufacturer's literature, equipment data and Samples submitted. Use a sufficient number of transmittal forms so that: items on a single transmittal form pertain to the same equipment item, specification section or element of Work; items on a single transmittal form are either original submittals or the same number resubmittal; and each Sample is listed on a separate transmittal form.
 - d. Engineer to complete review in accordance with Paragraph 6.17.D. of the Standard General and Supplementary Conditions, if any.
 - e. Submittals which do not have a fully completed transmittal form will be returned along with unreviewed attachments. Returned submittals, even though incomplete, will be counted as a submittal.
 - f. Reimburse Owner for Engineer's time beyond 3 resubmittals per Paragraph 6.17.E. of the Standard General and Supplementary Conditions.
 - g. Submission of any Shop Drawing or Sample bearing Contractor's and Engineer's approval shall constitute a representation to Owner that the requirements of Paragraph 6.17 of the Standard General and Supplementary Conditions, if any, have been fulfilled.
6. *Variations*: Identify variations from Contract Documents and material and equipment or system limitations which may be detrimental to successful performance of the completed Work and identify reasons therefor in accordance with subparagraph 6.17.C.3 of the Standard General and Supplementary Conditions, if any.

- a. Clearly identify requests for “Or-Equal” and substitute items and submit per Paragraph 6.05 of Standard General and Supplementary Conditions, if any, and subparagraph 1.02.C.5 above. Substitute items will not be considered when indicated or implied on Shop Drawing or material and equipment data submittals without separate written request, or when acceptance will require revision to the Contract Documents.
 - b. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
7. *Manufacturers' Installation Instructions and Certificates:* Submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing.
- a. Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
 - b. Indicate special procedures, perimeter conditions requiring special attention and special environmental criteria required for application or installation.
 - c. Submit manufacturers' certificates for recent or previous test results on material or equipment, but they must be acceptable to Engineer and Owner. Indicate material or equipment conforms to or exceeds specified requirements and provide supporting reference date, affidavits, and certifications as appropriate.
 - d. Submit test results, data, and reports and certifications to Engineer based on tests performed. Submit test reports and certifications for independent testing services specified.
8. *Record Documents and Closeout Submittals:* submit in accordance with Paragraph 6.12 of the Standard General and Supplementary Conditions, if any, and Paragraph 1.03.D below.
- a. *As-Builts for Material and Equipment*
 - Number of hardcopies: 3.
 - Submit electronically via web-based electronic document management control system in PDF.

Indicate "As-Supplied" in revision block and sign. Show all changes and revisions to Final Completion per Section 01 70 00 Execution and Closeout Requirements.

- b. *Conformed to Construction Record Drawings:* Submit for Engineer's use in preparing final Record Drawings, except for Athletic field related Work.
- Number of hardcopies: 3.
 - Submit electronically via web-based electronic document management control system in PDF and AutoCad™ 2013 format or earlier (DWG file format).
- 1) Indicate "Conformed by Contractor to Construction Records" in revision block and sign. Show all changes and revisions to Final Completion per Section 01 70 00 and the Specifications, including but not limited to:
 - a) Measured horizontal and vertical locations of the above and below grade water main, valves, fittings, services, and appurtenances, referenced to permanent surface improvements, above grade permanent structures, and/or permanent visible and accessible features of the installation.
 - b) Distance from the main to curb box at each service.
 - c) Three point measured swing ties from permanent surface improvements, above grade permanent structures and/or visible and accessible features of the installation to identify all bends, services, reducers and end caps.
 - d) Depth of mains at maximum of 50-foot intervals.
 - e) Elevations of pipe inverts, pipe material and manholes/catch basins (inverts, rim, ground).
 - f) Valve locations, drainage structures, drainage pipe, sewer pipe, sewer structures, sewer laterals.
 - 2) Perform a complete as-constructed survey of athletic field Work, including, but not limited to subgrade of the athletic field (10-foot grid), all grading, athletic field final surface (10-foot grid), pavements, drainage system, irrigation, utilities, fencing, and landscape and hardscape materials and amenities installed as part of the Project.
 - a) Provide as-constructed survey prepared by a land surveyor licensed in the state where Project is located.

- b) Submit electronically via web-based electronic document management control system in PDF and AutoCad™ 2013 format or earlier (DWG file format) based on original Drawings provided by Engineer to serve as base.
- c) Submit in accordance with procedures above.
- c. *Warranties and Guarantees:* Submit duplicate notarized copies of warranty documents which are executed and transferable from Subcontractors, Suppliers, and manufacturers. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of Warranty Period.
 - 1) Submit electronically via web-based electronic document management control system in PDF. Hardcopy not required.
 - 2) Also submit 3 copies in ring binders with durable plastic covers and table of contents.
- d. *Operation and Maintenance Data*
 - 1) Submit draft of completed volumes 30 days prior to equipment startup. Revise content of all sets as required prior to final submission.
 - Number of hardcopies: 3 - in ring binders.
 - Submit electronically via web-based electronic document management control system in PDF.
 - 2) Submit final volumes within 10 days after final inspection.
 - Submit electronically via web-based electronic document management control system in PDF.
 - Submit 3 copies of data in ring binders with durable plastic covers with 8 1/2 by 11 inch text pages. Cover: title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of Project, and subject matter of binder when multiple binders are required.
- a) Subdivide contents with page dividers, logically organized as described below with laminated plastic tabs and clearly print the contents for binder if provided. Prepare a Table of Contents for each

volume, with material, equipment, or system description identified, in three parts as follows.

Part 1: Directory, listing names, addresses, and telephone numbers of Contractor, Subcontractors, and major equipment Suppliers, and service representative.

Part 2: Operation and maintenance instructions arranged by system and subdivided by Specification section.

For each system, identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Identify the following:

- Significant design criteria
- List of equipment with As-Builts certified “As-Supplied”
- Parts list for each component
- Operating instructions
- Inspection, maintenance and adjustment instructions for equipment and systems
- Lubrication and maintenance schedules
- Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents
- Troubleshooting guides
- Schematic diagrams

Part 3: Material Safety Data Sheets

Part 4: Other Project documents and certificates, including the following:

- Certificates
- Photocopies of warranties

D. Closeout Procedures

1. Substantial Completion shall have been achieved when the following has been completed and the requirements of Paragraph 14.04 of the Standard General and Supplementary Conditions, if any, have been met. Submit

documentation electronically via web-based electronic document management control system in PDF.

- a. Work is complete, systems are successfully operating, and final testing has been successfully completed.
 - b. A full inventory of the spare parts and special tools purchased by the Owner are replenished and in the custody of the Owner.
 - c. The Site has been restored to the satisfaction of the Owner.
 - d. An inspection of the Work has been completed by the Engineer and the Owner.
 - e. An updated Punch List is provided.
 - f. The Contractor's written warranty and guarantee has been submitted as required by Paragraph 16.19.D. of the Standard General and Supplementary Conditions, if any.
 - g. A Certificate of Substantial Completion has been provided in accordance with Paragraph 14.04.C. of the Standard General and Supplementary Conditions, if any.
2. The Contractor shall have sole care, custody, and control of the Work until achievement of Substantial Completion. During the period between Substantial Completion and the date for Final Completion, Contractor shall be given access to correct items on the Punch List and achieve Final Completion.
 3. The date of achieving Substantial Completion is the date set forth in the Certificate of Substantial Completion that is accepted and signed by the Owner.
 4. Final Completion shall have been achieved when the Work is complete, the requirements of Paragraphs 14.06 and 14.07 of the Standard General and Supplementary Conditions, if any, have been met, and when the following is complete.
 - a. Substantial Completion has been achieved and liquidated damages for failure to meet Substantial Completion Date have been paid.
 - b. All Work including Punch List Items has been completed.
 - c. Final cleaning has been conducted and Contractor equipment and supplies including waste materials have been removed from the Site and legally disposed of.
 - d. A full set of record documents have been submitted as specified in subparagraph 1.03.C.8 above and Contractor's written warranty and guarantee has been resubmitted if adjusted.

- e. Inspections required by Laws and Regulations are complete. Certificates and permits to occupy and operate have been issued if required.
- f. Spare parts, maintenance and extra materials have been delivered in quantities specified to Project Site and stored as directed.
- g. A request for final inspection in accordance with Paragraph 14.06 of the Standard General and Supplementary Conditions, if any, has been submitted to the Engineer and the inspection has been completed and the results accepted by the Owner.
- h. A Certificate of Completion has been provided in accordance with Paragraph 14.07.B of the Standard General and Supplementary Conditions, if any.
- i. A Final Application for Payment has been submitted to the Engineer identifying total adjusted Contract Price, previous payments, and balance due along with required documentation in accordance with Paragraph 14.07.A. of the Standard General and Supplementary Conditions, if any.

1.04 QUALITY REQUIREMENTS

A. Reference Standards and Regulatory Requirements

1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or Laws or Regulations of any governmental authority are used in accordance with Paragraph 3.02 of the Standard General and Supplementary Conditions, if any.
2. Acronyms and abbreviations used are defined in the applicable versions of the Encyclopedia of Associations published by Gale (part of Cengage Learning) generally available in large libraries and on the internet.
3. Specific requirements applicable to the Project include the following.
 - Order of Conditions executed July 22, 2015 – DEP File #64-596 included as an attachment to this Section.
 - Comply with the Massachusetts Department of Transportation - Highway Division's (referred to as "MassDOT") Construction Specifications (including Interim Supplemental Specifications and Supplemental Specifications but not including Compensation sections), Construction Details (including Standard Drawings), and Design Guides as incorporated into the Specifications and Drawings, and as may be modified therein or superseded by the Owner's requirements through the direction of the Engineer. Specific sections of the

MassDOT documents are referenced in the Specifications and Drawings. References to “Department” in the MassDOT documents shall mean Owner or Engineer for this Project. See MassDOT Highway Division website listing of documents included as an attachment to this Section.

www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms

B. Qualifications

1. Meet or provide capability to meet the criteria specified in Section 01 43 05 and individual Specification sections in connection with various portions of the Work of the Contract Documents.

C. Planting Seasons

1. Spring Planting Season

- April 1 – June 10

2. Fall Planting Season

- September 1 – October 30

1.05 ATTACHMENTS

A. Project Contact List

B. Transmittal form

C. MassDOT document listing

D. Order of Conditions, executed July 22, 2015 – DEP File #64-596

END OF SECTION

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CONTACT LIST

OWNER

City of Salem, Engineering Dept.
120 Washington Street – 4th Floor
Salem, MA 01970
Attn: David Knowlton, City Engineer
(978-745-9595)

ENGINEER

Woodard & Curran
40 Shattuck Road, Suite 110
Andover, MA 01510
Attn: Michael Hansen P.E.
(978)482-7893
mhansen@woodardcurran.com

SALEM CONSERVATION COMMISSION

120 Washington Street – 3rd Floor
Salem, MA 01970
Contact: Tom Devine

(978) 619-5685

DIG SAFE Call Center

811 or 1-888-344-7233

SALEM POLICE DEPARTMENT

95 Margin Street
Salem, MA 01970
Contact: Chief Paul F. Tucker

(978) 744-0171

SALEM DEPARTMENT OF PUBLIC WORKS

5 Jefferson Avenue
Salem, MA 01970
Contact: Director

(978) 744-3302

SALEM WATER & SEWER DEPARTMENT

120 Washington Street – 4th Floor
Salem, MA 01970
Contact: Julie Rose, Business Manager

(978) 619-5675

SALEM FIRE DEPARTMENT

48 Lafayette Street
Salem, MA 01970
Contact: Chief David Cody

(978) 744-6990

CONTACT LIST (continued)

NATIONAL GRID

40 Sylvan Road

Waltham, MA 02451

Gas Contact: Tommy Fang

(781) 907-2807

Electrical Contact: Mary Ann Ryan

(781) 907-3513

VERIZON

1070 Hancock Street, 4th Floor

Quincy, MA 02169

Contact: Sui Chin

(781) 947-7900

COMCAST

676 Island Pond Road

Manchester, NH 03109



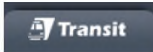

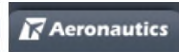
Contact: Jean MacLaren

(603) 695-1461

12/7/2015

Manuals, Publications & Forms - Doing Business With Us - Highway Division

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The Official Website of The Massachusetts Department of Transportation - Highway Division [Mass.gov](#)

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- [Local Aid Programs](#) ▶
- [Permits & Road Access Programs](#)
- [Seasonal](#)
- [Manuals Publications & Forms](#)

MassDOT posts most of its manuals, publications and forms on its website. To view the documents listed below, click on the links. If you can't find what you're looking for below, please [browse by department](#).

- ▶ [Construction Specifications](#)
- ▶ [Project Management Guides](#)
- ▶ [Construction Details](#)
- ▶ [Highway Access Permits](#)
- ▶ [Design Guide and Manuals](#)
- ▶ [Miscellaneous Publications](#)
- ▶ [Environmental Documents](#)

Construction Specifications

Title	Date	File Type/Size
Standard Specification for Highways and Bridges (English Edition)	1988	HTML
Standard Specifications for Highways and Bridges (Metric Edition)	1995	PDF 2.49MB
2015 Supplemental Specifications to the Standard Specifications for Highways and Bridges	7/1/2015	PDF 2.1MB
Interim Supplemental Specifications	9/18/2015	PDF 68KB
Price Adjustments	Updated Monthly	View Pages

Superseded Publications

2012 Supplemental Specifications to the Standard Specifications for Highways and Bridges	6/15/2012	PDF 1.6MB
2010 Supplemental Specifications to the 1988 Standard Specifications for Highways and Bridges (Combined English and Metric Edition) (Combined English and Metric Edition)	2/25/2010	PDF 1MB
2006 Supplemental Specifications to the 1988 Standard Specifications for Highways and Bridges (English Edition)	6/6/2006	PDF 1.73MB
2006 Supplemental Specifications to the 1995 Standard Specifications for Highways and Bridges (Metric Edition)	6/6/2006	PDF 1.41mb

Construction Details

Title	Date	File
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<http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms.aspx>

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**PAYMENT AND ADMINISTRATIVE PROCEDURES
AND QUALITY REQUIREMENTS**

12/7/2015

Manuals, Publications & Forms - Doing Business With Us - Highway Division

		Type/Size
2014 Construction Standard Details	Jun 2014	PDF 15.2MB
Notes on Walks and Wheelchair Ramps for Designers and Construction Engineers	March 2012	PDF 140KB
Traffic Management Plans and Detail Drawings		HTML link
Standard Drawings for Signs and Supports	1990	PDF 7MB
Standard Drawings for Traffic Signals and Highway Lighting	1968	PDF 3.25MB
Superseded Publications		
2012 Construction Standard Details	Mar 2012	PDF 27MB
2012 Construction Standard Details: Drawing History Index	2012	PDF 119KB
2010 Construction Standard Details (English Edition)	2010	PDF 13MB
Metric/English Supplemental Drawings Supplement to the 1996 Metric Edition of the Construction and Traffic Standard Details and the 1977 Mass. Department of Public Works Construction Standards	Apr 2003	PDF 5.6MB
Construction and Traffic Standard Details (Metric Edition)	1996	PDF 7.8MB
1966 Construction Standards 1st Edition (Obsolete)	May 1966	PDF 10MB

Design Guide and Manuals

Title	Date	File Type/Size
Project Development & Design Guide	2006	HTML
Separated Bike Lane Planning and Design Guide	2015	
LRFD Bridge Manual - 2013 Edition	Jun 2013	HTML
2005 Bridge Manual, Revised August 2007	Aug 2007	HTML
CAD Standards		
Manual on Uniform Traffic Control Devices		FHWA Link
Massachusetts Amendments to the 2009 Manual on Uniform Traffic Control Devices and the Standard Municipal Traffic Code		HTML link
Survey Manual	1996	HTML
Historic Parkway Preservation Treatment Guidelines (DCR)	Mar 2007	PDF 28MB
Superseded Publications		
Addenda to the 1997 Highway Design	Apr	PDF

<http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms.aspx>

2/3

12/7/2015

Manuals, Publications & Forms - Doing Business With Us - Highway Division

Manual	2003	2.7MB
Highway Design Manual	1997	PDF 6.65MB

Miscellaneous Publications

Title	Date	File Type/Size
Bridge Inspection Handbook 2015 Edition	May 2015	HTML
Design Build Procurement Guide	2012	PDF 233KB
Diesel Equipment Retrofit		HTML
English Bid Item Nomenclature List	9/25/2015	PDF 935KB
Metric Bid Item Nomenclature List	9/25/2015	PDF 950KB
Guide Sign Policy for Secondary State Highways	2008	HTML
Identification of Massachusetts Freight Issues and Priorities	Nov 1999	PDF 7.4MB
Procedures for Speed Zoning on State and Municipal Roadways	2012	PDF 2.2MB
Utility Accommodation Policy	May 2013	PDF 6.5MB
Vegetation Management Plans		
District 1 Yearly Operational Plan 2015	2015	PDF 580KB
District 1 Vegetation Management Plan 2012 - 2016	2012	PDF 452KB
Herbicide Alternatives Research	Jul-2008	PDF 8.9MB

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CITY OF SALEM CONSERVATION COMMISSION

July 22, 2015

David Knowlton, City Engineer
City of Salem
120 Washington St.
Salem, MA 01970

Re: Order of Conditions—DEP #64-596—Canal Street Flood Mitigation Project

Dear Mr. Knowlton:

Enclosed, please find the Order of Conditions for the above referenced project. Following the 10-business-day appeal period, this document must be recorded at the Essex County Registry of Deeds (Shetland Park 45 Congress Street, Suite 4100 Salem, Massachusetts). Once recorded, please return a copy of Page 12 of the Order, which will indicate to the Commission that the document has been recorded.

As indicated in the Order, prior to any work commencing:

1. this **Order must be recorded**,
2. a sign must be displayed showing **DEP File # 64-596** within public view, and
3. contact me at least **48 hours prior to any activity** (other than pre-construction activity specifically authorized in the Order) to schedule a pre-construction meeting to review the Order with your hired contractor.

If you have any further questions, please feel free to contact me at 978-619-5682.

Sincerely,

Tom Devine
Conservation Agent

Enclosure

CC: DEP Northeast Regional Office



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:
 64-596
 MassDEP File #

eDEP Transaction #
 Salem
 City/Town

A. General Information (cont.)

6. Property recorded at the Registry of Deeds for (attach additional information if more than one parcel):
 See attached
- a. County _____ b. Certificate Number (if registered land) _____
- c. Book _____ d. Page _____
7. Dates: 6/29/2015 7/9/2015 7/22/2015
 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 attached
- a. Plan Title _____
- 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.



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

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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) _____ 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	16 perm lf, 55 temp	16 perm lf, 55 temp	55 c. linear feet	55 d. linear feet
5. <input checked="" type="checkbox"/> Bordering Vegetated Wetland	155 perm sf, 830 temp	155 perm sf, 830 temp	1573 c. square feet	1573 d. square feet
6. <input checked="" type="checkbox"/> Land Under Waterbodies and Waterways	See report a. square feet	See report b. square feet	c. square feet	d. square feet
	_____ e. c/y dredged	_____ f. c/y dredged		
7. <input type="checkbox"/> Bordering Land Subject to Flooding	_____ a. square feet	_____ b. square feet	_____ c. square feet	_____ d. square feet
Cubic Feet Flood Storage	_____ 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 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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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 checked="" type="checkbox"/> Coastal Banks	10 temp lf, 10 perm	10 temp lf, 10 perm		
16. <input checked="" type="checkbox"/> Rocky Intertidal Shores	82 temp	82 temp		
	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 checked="" type="checkbox"/> Land Containing Shellfish	82 temp	82 temp		
	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 checked="" type="checkbox"/> Land Subject to Coastal Storm Flowage	278300 sf perm, 30400 temp	278300 sf perm, 30400 temp		
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



Massachusetts Department of Environmental Protection
 Bureau of Resource Protection - Wetlands
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B. Findings (cont.)

* #23. If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.5.c (BVW) or B.17.c (Salt Marsh) above, please enter the additional amount here.

23. Restoration/Enhancement *:

 a. square feet of BVW _____ b. square feet of salt marsh _____
24. Stream Crossing(s):

 a. number of new stream crossings _____ b. number of replacement stream crossings _____

C. General Conditions Under Massachusetts Wetlands Protection Act

The following conditions are only applicable to Approved projects.

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.
2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.
3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.
4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
 - a. The work is a maintenance dredging project as provided in the Act; or
 - b. The time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.
 - c. If the work is for a Test Project, this Order of Conditions shall be valid for no more than one year.
5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order. An Order of Conditions for a Test Project may be extended for one additional year only upon written application by the applicant, subject to the provisions of 310 CMR 10.05(11)(f).
6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not extend the issuance date of the original Final Order of Conditions and the Order will expire on 7/22/2018 unless extended in writing by the Department.
7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.



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Bureau of Resource Protection - Wetlands
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Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

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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 64-596 "
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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 Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

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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):

Attached conditions are issued under the Wetlands Protection Act and are sufficient for compliance with the local ordinance

- 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 Salem hereby finds (check one that applies):
 Conservation Commission

- 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:

Wetlands Protection and Conservation Ordinance c. 50
 1. Municipal Ordinance or Bylaw _____ 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):

Attached conditions are issued under the Wetlands Protection Act and are sufficient for compliance with the local ordinance



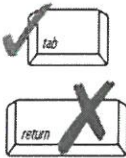
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E. Signatures

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.
 Please indicate the number of members who will sign this form.
 This Order must be signed by a majority of the Conservation Commission.

7/20/2015
 1. Date of Issuance
6
 2. Number of Signers

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy must be mailed, hand delivered or filed electronically at the same time with the appropriate MassDEP Regional Office.

Signatures:

[Handwritten Signature]
[Handwritten Signature]
[Handwritten Signature]

[Handwritten Signature]
[Handwritten Signature]
[Handwritten Signature]

by hand delivery on

7/20/2015
 Date

by certified mail, return receipt requested, on

 Date

F. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate MassDEP Regional Office to issue a Superseding Order of Conditions. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Any appellants seeking to appeal the Department's Superseding Order associated with this appeal will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order, or providing written information to the Department prior to issuance of a Superseding Order.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40), and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal ordinance or bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.



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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.

Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Conservation Commission

Please be advised that the Order of Conditions for the Project at:

Project Location

MassDEP File Number

Has been recorded at the Registry of Deeds of:

County

Book

Page

for: Property Owner

and has been noted in the chain of title of the affected property in:

Book

Page

In accordance with the Order of Conditions issued on:

Date

If recorded land, the instrument number identifying this transaction is:

Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant



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
Request for Departmental Action Fee
Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

DEP File Number:

Provided by DEP

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 <http://www.mass.gov/eea/agencies/massdep/about/contacts/>).
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.



ATTACHMENT TO ORDER OF CONDITIONS

SALEM CONSERVATION COMMISSION

DEP FILE #64-596

CANAL STREET FLOOD MITIGATION PROJECT

Located at:

Hersey Avenue, Ocean Avenue, Meadow Street, Laurel Street, Forest Avenue, Clifton Avenue, Salem State University O'Keefe Center Parking Lot (225 Canal Street), 105 Canal Street, 125 Canal Street, and Forest River Park

City of Salem, Massachusetts

(See attached site locus map and list of owners)

ADDITIONAL FINDINGS

Based on the Estimated Habitats of Rare Wildlife and Certified Vernal Pools Map (7/2/2015, online) from Natural Heritage & Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries and Wildlife, it has been determined that this project does not occur near any habitat of state-listed rare wildlife species nor contain any vernal pools.

This Order permits the construction of the Canal Street Flood Mitigation Project per Notice of Intent and Stormwater Report submitted 6/29/2015, approved plans listed below, and these conditions. Appropriate removal of invasive plants from the Forest River Park pond is permitted, but not required, under this Order.

GENERAL CONDITIONS

1. This Order of Conditions must be recorded in its entirety (**including all 5 pages of Special Conditions**) at the Essex County Registry of Deeds or the Land Court for the district in which the land is located, after the expiration of the 10-day appeal period and within 30 days of the issuance. **A copy of the recording information must be submitted to the Salem Conservation Commission before any work approved in this Order commences.**
2. Approval of this application does not constitute compliance with any law or regulation other than M.G.L Chapter 131, Section 40, Wetlands Regulations 310 CMR 10.00 and the City of Salem Wetlands Protection Ordinance, Salem Code Chapter 50.
3. All work shall be performed in accordance with this Order of Conditions and approved site plan(s). No alteration of wetland resource areas or associated buffer zones, other than that approved in this Order, shall occur on this property without prior approval from the Commission.
4. Prior to any work commencing on site, a DEP Sign showing **DEP File #64-596** must be installed at the entrance to the site and seen from the public way, but not placed on a living tree.



5. No work approved in this Order may commence until the ten (10) day appeal period has lapsed from the date of the issuance of this Order.
6. With respect to this Order, the Commission designates the Conservation Agent as its agent with powers to act on its behalf in administering and enforcing this Order.
7. The Commission or its Agent, officers, or employees shall have the right to enter and inspect the property at any time for compliance with the conditions of this Order, the Wetlands Protection Act MGL Chapter 131, Section 40, the Wetlands Regulations 310 CMR 10.00, and shall have the right to require any data or documentation that it deems necessary for that evaluation.
8. The term "Applicant" as used in this Order of Conditions shall refer to the owner, any successor in interest or successor in control of the property referenced in the Notice of intent, supporting documents and this Order of Conditions. The Commission shall be notified in writing within 30 days of all transfers of title of any portion of the property that takes place prior to issuance of the Certificate of Compliance.
9. It is the responsibility of the applicant to procure all other applicable federal, state and local permits and approvals associated with this project. These permits may include but are not necessarily limited to the following:
 - (1) Section 404 of the Federal Water Pollution Control Act (P.L. 92-500, 86 stat. 816), U.S. Army Corps of Engineers.
 - (2) Water Quality Certification in accordance with the Federal Water Pollution Control under authority of sec. 27(5) of Chapter 21 of the Massachusetts General Laws as codified in 314 CMR 9.00.
 - (3) Sewer Extension Permit from the DEP Division of Water Pollution Control under G. L. Ch. 21A ss7 and 314 CMR 7.00. Any Board of Health permit for septic system design for any portion of the septic system within 100 feet of wetlands shall be submitted to the Commission prior to construction initiation.
 - (4) Design Requirements for Construction in Floodplains under the State Building Code (780 CMR 744.).
10. If there are conflicting conditions within this Order, the stricter condition(s) shall rule.
11. All work shall be performed so as to ensure that there will be no sedimentation into wetlands and surface waters during construction or after completion of the project.
12. The Commission or its Agent shall have the discretion to modify the erosion/siltation control methods and boundary during construction if necessary.
13. The Commission reserves the right to impose additional conditions on portions of this project or this site to mitigate any actual or potential impacts resulting from the work herein permitted.
14. The work shall conform to the following attached plans and special conditions:

Final Approved Plans

CITY OF SALEM, MASSACHUSETTS, DEPARTMENT OF PUBLIC WORKS, CANAL STREET FLOOD MITIGATION PROJECT, sheets G-000 to G-002, C-200 to C-222, C-500 to C-507, and S-500

(Title)



6/20/2015

(Dated)

David A. White

(Signed and Stamped by)

City of Salem Conservation Commission

(On file with)

15. Any proposed changes in the approved plan(s) or any deviation in construction from the approved plan(s) shall require the applicant to file a Notice of Project Change with the Commission. The Notice shall be accompanied by a written inquiry prior to their implementation in the field, as to whether the change(s) is substantial enough to require filing a new Notice of Intent or a request to correct or amend this Order of Conditions. A copy of such request shall at the same time be sent to the Department of Environmental Protection.
16. In conjunction with the sale of this property or any portion thereof before a Certificate of Compliance has been issued, the applicant or current landowner shall submit to the Commission a statement signed by the buyer that he/she is aware of an outstanding Order of Conditions on the property and has received a copy of the Order of Conditions.
17. [Reserved].

PRIOR TO CONSTRUCTION

18. **Prior to the commencement of any activity on this site other than activities listed above, there must be a Pre-Construction Meeting** on site between the project supervisor, the contractor responsible for the work, and the Conservation Agent and/or a member of the Conservation Commission to ensure that the requirements of the Order of Conditions are understood. The staked erosion control line shall be adjusted, if necessary, during the pre-construction meeting. **Please contact the Conservation Agent at (978) 619-5685 at least forty-eight (48) hours prior to construction to arrange for the Pre-Construction Meeting.**
19. Prior to the pre-construction meeting and commencement of any activity on this site, sedimentation and erosion control barriers shall be installed as shown on the approval plan(s) and detail drawings. The Commission and/or its Agent **shall inspect and approve such installation at the pre-construction meeting.**
20. No clearing of vegetation, including trees, or disturbance of soil shall occur prior to the pre-construction meeting. Minimal disturbance of shrubs and herbaceous plants shall be allowed prior to the pre-construction meeting if absolutely necessary in order to place erosion control stakes where required.
21. There shall be adequate additional erosion and sediment controls stored onsite for emergency purposes.

EROSION CONTROL

22. Appropriate erosion control devices shall be in place prior to the beginning of any phase of construction, and shall be maintained during construction in any wetland resource area and/or buffer zones. The erosion control measures shown on the approval plan(s) and provisions in the Order will be the minimum standards for this project; the Commission or its Agent may require additional measures.



23. All debris, fill and excavated material shall be stockpiled a location far enough away from the wetland resource areas to prevent sediment from entering wetland resource areas.
24. Erosion and sedimentation control devices shall be inspected after each storm event and repaired or replaced as necessary. Any accumulated silt adjacent to the barriers shall be removed.
25. The area of construction shall remain in a stable condition at the close of each construction day.
26. Any de-watering of trenches or other excavation required during construction shall be conducted so as to prevent siltation of wetland resource areas. All discharge from de-watering activities shall be filtered through straw bale sediment traps, silt filter bags or other means approved by the Commission or its Administrator.
27. Within thirty (30) days of completion of construction on any given portion of the project, all disturbed areas in the completed portion of the site shall be permanently stabilized with rapidly growing vegetative cover, using sufficient top soil to assure long-term stabilization of disturbed areas.
28. If soils are to be disturbed for longer than two (2) months, a temporary cover of rye or other grass should be established to prevent erosion and sedimentation. If the season is not appropriate for plant growth, exposed surface shall be stabilized by other appropriate erosion control measures, firmly anchored, to prevent soils from being washed by rain or flooding.

DURING CONSTRUCTION

29. A copy of this Order of Conditions and the plan(s) approved in this Order shall be available on site at all times when work is in progress.
30. No alteration or activity shall occur beyond the limit of work as defined by the siltation barriers shown on the approved plan(s).
31. All waste products, grubbed stumps, slash; construction materials, etc. shall be deposited at least 100 feet from wetland resource areas and 200 feet from river.
32. Cement trucks shall not be washed out in any wetland resource or buffer zone area, nor into any drainage system. Any deposit of cement or concrete products into a buffer zone or wetland resource area shall be immediately removed.
33. All exposed sub-soils shall be covered by a minimum of three (3) inches of quality screened loam topsoil prior to seeding and final stabilization.
34. Immediately following drainage structure installation all inlets shall be protected by silt fence, strawbale barriers and/or silt bags to filter silt from stormwater before it enters the drainage system.
35. There shall be no pumping of water from wetland resource areas.
36. All equipment shall be inspected regularly for leaks. Any leaking hydraulic lines, cylinders or any other components shall be fixed immediately.
37. During construction, all drainage structures shall be inspected regularly and cleaned as necessary.
38. The applicant is hereby notified that failure to comply with all requirements herein may result in the issuance of enforcement actions by the Conservation Commission including, but not limited to, civil administrative penalties under M.G.L Chapter 21A, section 16.



AFTER CONSTRUCTION

39. Upon completion of construction and final soil stabilization, the applicant shall submit the following to the Conservation Commission to request a Certificate of Compliance (COC):
- (1) A Completed Request for a Certificate of Compliance form (WPA Form 8A or other form if required by the Conservation Commission at the time of request).
 - (2) A letter from a Registered Professional Engineer certifying compliance of the property with this Order of Conditions.
 - (3) An "As-Built" plan signed and stamped by a Registered Professional Engineer or Land Surveyor showing post-construction conditions within all areas under the jurisdiction of the Massachusetts Wetlands Protection Act. This plan shall include at a minimum:
 - (a) All wetland resource area boundaries with associated buffer zones and regulatory setback areas taken from the plan(s) approved in this Order of Conditions;
 - (b) Locations and elevations of all stormwater management conveyances, structures and best management designs, including foundation drains, constructed under this Order within any wetland resource area or buffer zone;
 - (c) Distances from any structures constructed under this Order to wetland resource areas - "structures" include, but are not limited to, all buildings, septic system components, wells, utility lines, fences, retaining walls, and roads/driveways;
 - (d) A line delineating the limit of work - "work" includes any filling, excavating and/or disturbance of soils or vegetation approved under this Order;
40. When issued, the Certificate of Compliance must be recorded at the Essex County Registry of Deeds and a copy of the recording submitted to the Salem Conservation Commission.
41. If the completed work differs from that in the original plans and conditions, the report must specify how the work differs; at which time the applicant shall first request a modification to the Order. Only upon review and approval by the Commission, may the applicant request in writing a Certificate of Compliance as described above.
42. Erosion control devices shall remain in place and properly functioning until all exposed soils have been stabilized with final vegetative cover and the Conservation Commission and/or its Agent has authorized their removal.

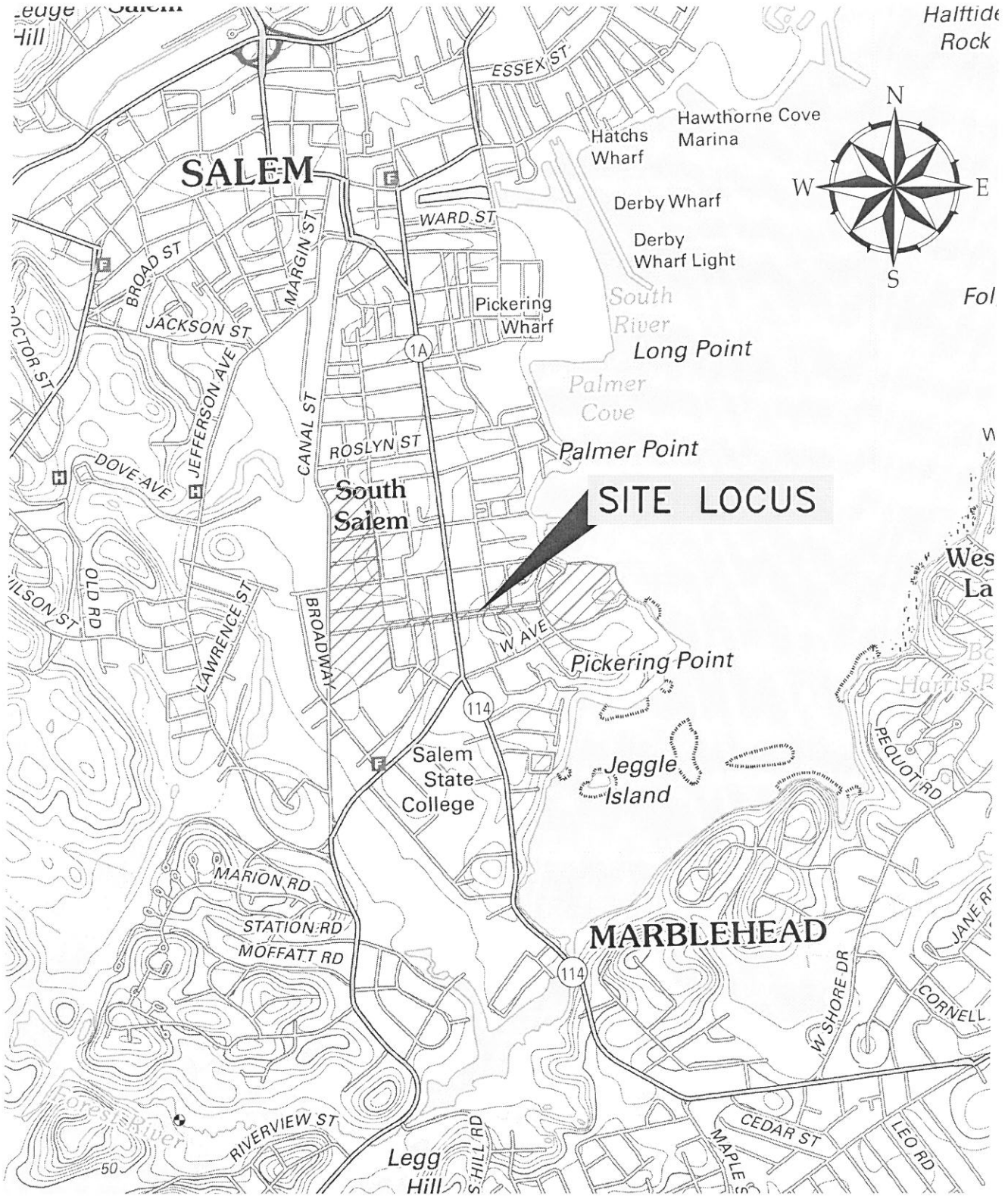
ADDITIONAL CONDITIONS

43. A swale and/or appropriate grading shall be constructed to direct runoff from the parking lot adjacent to the Forest River Park pond into the bioretention area.
44. Any pipe openings that are larger than 12" and accessible to the public shall be covered with a grate.


PERPETUAL CONDITIONS

45. [Reserved]

MAP-BLOCK- LOT	STREET NUMBER	LOCATION	OWNER	MAILING ADDRESS	CITY	STATE	ZIP	BOOK	PAGE	CITY CONTROLLED
33-743	32	Clifton Ave/ Forest River Park	City of Salem	93 Washington Street	Salem	MA	01970	--	--	YES
32-124	225	Canal Street	Commonwealth of Massachusetts	352 Lafayette Street	Salem	MA	01970	17145	407	NO/Letter of Authorization Provided
33-105	125	Canal Street	Crosby Salem Realty LLC	28 Meadow Street	Georgetown	MA	01833	25179	203	NO/Letter of Authorization Provided
33-132	105	Canal Street	J&D Canal LLC	PO Box 555	Salem	MA	01970	5574	741	NO/Letter of Authorization Provided



SOURCE: USGS TOPOGRAPHIC MAP



40 Shattuck Road, Suite 110
Andover, Massachusetts 01810
855.347.6788 | www.woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS

SITE LOCUS MAP

DESIGNED BY: BTP/MH	CHECKED BY: DAW
DRAWN BY: BTP	FIGURE 1 - SITE LOCUS.dwg

CITY OF SALEM, MASSACHUSETTS

FLOOD MITIGATION PROJECT

JOB NO: 228340
DATE: JUNE 25, 2015
SCALE: 1:1,500'

Fig 1

SECTION 01 20 25

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section describes the measurement and payment for the Work to be completed under each item in Section 00 43 22 Unit Prices Form, which may also be referred to as “pay item”.
- B. Payment procedures are in accordance with the Agreement, Article 14 of the General Conditions, the Supplementary Conditions (if any), and the General Requirements.
- C. Measurement: as determined, verified, or approved by Engineer or Owner in accordance with Paragraph 11.03 of the General Conditions, the Supplementary Conditions (if any), and the General Requirements, except as otherwise specified.
- D. The Work described in each pay item shall be as described in the as specified and shown on the Drawings and not included in other pay items.
 - 1. Pay item descriptions are general and may not specifically describe all associated Work or elements thereof, do not constitute as specified, and do not supersede the content of the as specified and Drawings.
 - 2. Review the as specified and Drawings for Work associated with each pay item. Claims for being unfamiliar with the content of the as specified and Drawings will not be considered.
- E. The following Work is not specifically described or designated as a pay item, is considered incidental to all pay items, and shall not be measured separately for payment.
 - 1. Division 01 General Requirements (EXCEPT those items included in Mobilization/Demobilization and included as a separate pay items).
 - a. Temporary bypass pumping and plugging of flows including sewer, drainage and groundwater.
 - b. Dewatering & shoring

2. Materials, equipment, and services necessary to verify existing field conditions and the location, size, type, material, and orientation of existing pipes and utilities shown on the Drawings including test pits.
 3. Restoration of all areas disturbed by the Contractor within the limits of Work, including plantings.
 4. Field and laboratory testing and reporting by independent laboratory, including but not limited to compaction of backfill materials, aggregate gradation, and concrete testing, except that provided by Owner.
- F. Payment will not be made for restoration of areas disturbed by the Contractor outside the limits of Work.
- G. Payment will only be made for those utility services, including water and fire services, specifically identified for replacement on the Drawings. Relocation or replacement for the Contractor's convenience or due to breakage by the Contractor of any other utility services shown on the Drawings, or at locations which could reasonably be assumed, shall be at no cost to Owner.
- H. Design, installation and removal of temporary excavation support systems, temporary and permanent utility/structure support systems associated with a pay item shall be considered incidental to that pay item.
- I. Additional dewatering and erosion control (including installation, operation, maintenance, removal and off Site disposal of erosion control devices) associated with a pay item shall be considered incidental to that pay item.
- J. Pay items identified as Owner's Contingency Allowance will be processed per Article 11.02 of the General Conditions.
- K. Police details will be direct billed by the police department to Owner. Provide daily detail slips to the Engineer. Police details scheduled and not used by the Contractor will be back-charged to Contractor.

1.02 MEASUREMENT AND PAYMENT BASIS

Item 1 – Mobilization and Demobilization	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	50% at Project commencement - 25% at Substantial Completion, 25% at Final Completion
<p>Includes delivery to and removal of equipment from the Project Site, temporary utilities, facilities and controls, obtaining necessary permits including associated fees, insurance and bond costs, signage, development of pre-construction schedules and plans required by the General Conditions, Supplementary Conditions and General Requirements, necessary pre-construction investigations, verifying existing field conditions, coordination, utility coordination, and Site clean-up, restoration and closeout.</p> <p>Note: Owner will waive fees associated with road opening and trench permits and costs for these permits shall not be included in this item. Do not include police details direct billed to Owner.</p>	

Item 2a – 6-inch PVC Sewer Pipe Item 2b – 8-inch PVC Sewer Pipe Item 2c – 15-inch PVC Sewer Pipe	
Measurement	Along the horizontal projection of the centerline of the pipe, measured from either (1) inside face of manhole to center of coupling to existing pipe or (2) center of coupling to center of coupling
Payment	Unit price per linear foot
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the sewer pipe, pipe connections, rubber sleeve connections, wye connections, coring of pipe, pipe fittings, concrete and brick collars, and mortar sealing of pipe and structure, flow barriers, bedding, backfill, gravel roadway base, backfill compaction and material testing, re-connection to existing pipe (including shop and field coring of new penetrations and plugging abandoned penetrations), provision & reconfiguration of brick invert of new & existing manholes, removal and off-Site disposal of old sewer pipe, capping and abandonment of old sewer pipe, removal and off-Site disposal of bituminous concrete pavement, concrete and excess soils, remove and replace retaining wall in kind as shown on Drawing C-500, and other incidental Work, as shown on the Drawings and as specified.</p>	

Item 3 – 4-inch PVC Sewer Service	
Measurement	As measured along the horizontal projection of the centerline of the pipe
Payment	Unit price per linear foot installed complete in place and tested.
Schedule of Payment	Monthly based on progress; 80% upon installation, 10% upon receipt of positive test results, 10% upon final cleanup and acceptance.
<p>Includes but is not limited to all labor, tools, equipment, watertight end cap, excavation and backfill, bedding, shoring/bracing and wood sheeting left in place, saw cutting, furnishing, handling and installation of materials, pressure testing, couplings, loam and seed, tree trimming, removing and replacing signs, fences and mailboxes, removing and replacing stone walls, removing and replacing irrigation systems and dog fences, connection to existing service, driveway repairs, removal and replacing guardrails, up to 3 feet of asphalt aprons for driveways and gravel resurfacing, dust controls, furnishing and installing the pipe; pavement cutting, removal and disposal of pavement, clearing and grubbing, pipe bedding and blanket, backfill and compaction, shoring and bracing, clay dams, wyes, replacement of marked utility services to the property line, replacement of marked drain lines, pipe jacking, horizontal directional drilling, carrier pipes, if needed, to meet horizontal and vertical separation requirements from water mains or to cross culverts, bypass pumping of sewer flows, testing, insulation as specified and shown on the Drawings or as directed by the Engineer, also includes landscape restoration, loam and seed and all other Work incidental to installing pipe not specified to be paid for under a separate pay item.</p>	

Item 4 – 4-foot Diameter Sewer Manhole	
Measurement	Actual manhole furnished and installed
Payment	Unit price per each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the manholes regardless of depth including, anti-floatation slab, pipe connections, joint sealant, unclassified excavation, shoring and bracing, bedding, dewatering, backfill, gravel roadway base, backfill compaction and material testing, removal and off-Site disposal or abandonment of old manholes and pipe, removal and off-Site disposal of bituminous concrete pavement and excess soils, and other incidental Work, as shown on the Drawings and as specified.</p> <p>*Excludes frame and cover included in Item 5*</p>	

Item 5 – Sewer Manhole Frame and Cover	
Measurement	Set installed
Payment	Unit price per set
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the sewer manhole frame and cover, including brick & mortar to raise manhole cover to grade, or concrete grade rings, concrete collars and other incidental Work, as shown on the Drawings and as specified.	

Item 6a – 6-inch PVC Drain Pipe Item 6b – 12-inch PVC Drain Pipe Item 6c – 18-inch PVC Drain Pipe Item 6d-42” Class III RCP Drain Pipe Item 6e-48” Class III RCP Drain Pipe	
Measurement	Along the horizontal projection of the centerline of the pipe, measured from (1) inside face of manhole to inside face of manhole or (2) inside face of manhole to center of coupling.
Payment	Unit price per linear foot
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the drainage pipe, pipe connections, pipe bends, rubber sleeve connections and mortar sealing of pipe and structure, flow barriers, bedding, backfill, gravel roadway base, backfill compaction and material testing, re-connection to existing pipe (including field and shop coring of new penetrations and plugging abandoned penetrations), provision & reconfiguration of brick invert of new & existing manholes, geotextile fabric, removal and off-Site disposal of old drainage pipe, capping and abandonment of old drainage pipe, removal and off-Site disposal of bituminous concrete pavement, concrete and excess soils, and other incidental Work, as shown on the Drawings and as specified.	

Item 7 – 30-inch Cement Lined Ductile Iron Drain Pipe	
Measurement	Along the horizontal projection of the centerline of the pipe, measured from and to face to pipe fittings and valves
Payment	Unit price per linear foot
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the drainage force main pipe, flow barriers, bedding, backfill, gravel roadway base, backfill compaction and material testing, re-connection to existing pipe (including coring of new penetrations and plugging abandoned penetrations), removal and off-Site disposal of old drainage pipe, geotextile fabric, capping and abandonment of old drainage pipe, removal and off-Site disposal of bituminous concrete pavement, concrete and excess soils, and other incidental Work, as shown on the Drawings and as specified. *Excludes cement lined ductile iron fittings, fittings paid through Item 22a*	

Item 8 – Forest River Park Pre-Cast Concrete Box Culvert Area	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Monthly based on progress
Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing, pond outlet structure, precast box culvert, box culvert outfall construction and seawall modification & construction, trash racks, grates, rubber sleeve connections and mortar sealing of pipe and structure, flow barriers, bedding, backfill, gravel base, backfill, loam and seed, compaction and material testing, re-connection to existing pipe (including coring of new penetrations and plugging abandoned penetrations), manhole access point, riser sections, frame and covers, concrete collars, geotextile fabric, bedding, crushed stone, backfill, backfill compaction and material testing, removal and off-Site disposal of excess soils, and other incidental Work, as shown on the Drawings and as specified. *Item does not include new chain link or new wood stockade fencing*	

Item 9 – 4-foot Diameter Catch Basin	
Measurement	Actual catch basin furnished and installed
Payment	Unit price per each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the catch basins regardless of depth including, anti-floatation slab, pipe connections, geotextile fabrics, catch basin hoods, joint sealant, bedding, dewatering, backfill, gravel roadway base, backfill compaction and material testing, removal and off-Site disposal of old catch basins and pipe, removal and off-Site disposal of bituminous concrete pavement and excess soils and other incidental Work, as shown on the Drawings and as specified. *Excludes frame and grate covered in Item 11*	

Item 10a – 4-foot Diameter Drainage Manhole Item 10b – 5-foot Diameter Drainage Manhole Item 10c – 6-foot Diameter Drainage Manhole Item 10d – 8-foot Diameter Drainage Manhole	
Measurement	Actual manhole furnished and installed
Payment	Unit price per each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the manholes regardless of depth including, anti-floatation slab, pipe connections, joint sealant, unclassified excavation, geotextile fabrics, shoring and bracing, bedding, dewatering, backfill, gravel roadway base, backfill compaction and material testing, removal and off-Site disposal or abandonment of old drain manholes and pipe, removal and off-Site disposal of bituminous concrete pavement and excess soils, and other incidental Work, as shown on the Drawings and as specified. *Excludes frame and cover included in Item 12*	

Item 11 – Catch Basin Frame and Grate	
Measurement	Set installed
Payment	Unit price per set
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the catch basin frame and grate, including brick & mortar, concrete grade rings to raise catch basin grate to grade, concrete collars and other incidental Work, as shown on the Drawings and as specified.	

Item 12a – Drainage Manhole Frame and Cover Item 12b – Bolted Drainage Manhole Frame and Cover	
Measurement	Set installed
Payment	Unit price per set
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for furnishing and installing the drain manhole frame and cover, bolted frame and cover, including brick & mortar to raise manhole cover to grade, or concrete grade rings, concrete collars and other incidental Work, as shown on the Drawings and as specified.	

Item 13 – Plunge Pool	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Completion of Work - 100%
Material and equipment, services, installation, construction and testing inherent to the Work for clearing & grubbing including tree removal and disposal, strip, unclassified excavation, grading, importing soils, backfill compaction and material testing, removal and off-Site disposal of excess soils, installation of rip-rap material, fabric protection layer of geotextile fabric and other incidental Work, as shown on the Drawings and as specified.	

Item 14 – Grassed Channel & Forest River Park Earthwork	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Monthly based on quantity installed and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for clearing, grubbing, root ball disposal, disposal of trash, debris and vegetation, importing suitable fill, grading & compaction, low flow rip-rap channel, remove and dispose basketball court, ballfield and associated items as shown on the Drawings, remove and dispose fencing, relocate & install light posts, relocate benches, fence, and all other surface improvements, fill soils to achieve proposed park and swale grades, loam and seed, geotextile fabric, erosion control blanket, grassed drainage channel complete in place, and other incidental Work, as shown on Drawings including C-500 through C-509, and C-608 and as specified. *Does not include surface site improvements shown within limits of other Lump Sum Items and does not include Work covered under Items 2 through 6, 8, 13, 17, 18, 20 through 23, 40a, 41 through 46, 48 through 51, and 55*	

Item 15 – Remove and Reinstall Masonry Wall	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Completion of Work - 100%
Material and equipment, services, installation, construction and testing inherent to the Work to remove, store, protect and rebuild existing masonry retaining walls at the locations and limits indicated on the Drawings to allow drainage, water and sewer improvements construction at the intersections of Shore Avenue and Clifton Ave and Forest River Park Entrance and other incidental Work, as shown on the Drawing C-404 and as specified.	

Item 16 – 8-inch Cement Lined Ductile Iron Manhole Vent	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Completion of Work - 100%
Material and equipment, services, installation, construction and testing inherent to the Work to furnish and install cement lined ductile iron pipe including but not limited to, joint restraints, mega-lug fittings, bends, elbows, boots, bollards, other incidentals necessary to furnish and install the pipe, complete in place, and other incidental Work, as shown on the Drawings and as specified or required by field conditions.	

Item 17a – 6-inch Cement Lined Ductile Iron Water Pipe Item 17b – 8-inch Cement Lined Ductile Iron Water Pipe Item 17c – 12-inch Cement Lined Ductile Iron Water Pipe	
Measurement	As measured along the horizontal projection of the centerline of the pipe, measured from and to face of water pipe fittings and valves
Payment	Unit price per linear foot of pipe installed, complete in place
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work to furnish and install cement lined ductile iron pipe including clearing and grubbing, saw cutting, excavation, removing and disposing of excess material, removing and disposing of existing concrete encasement, shoring/bracing, dewatering, removing and disposing existing pipe, hydrants, valves and appurtenances, capping existing water mains abandoned in place, support of existing utilities, restraining thrust with rods and/or concrete, joint restraints, mega-lug fittings, pipe bedding, blanket and backfill, gravel roadway base, geotextile fabric, connecting to existing water mains (as applicable), compaction & testing, crossing utilities, support of existing utilities, chlorination, testing, bypass & water services, tree trimming, removing and replacing signs, fences and mail boxes, replacement of bituminous and concrete curbing, and other incidental Work, as shown on the Drawings and as specified or required by field conditions.</p> <p>*Excludes cement lined ductile iron fittings, fittings paid through Item 22b*</p>	

Item 18a – 6-inch Gate Valve and Box Item 18b – 8-inch Gate Valve and Box Item 18c – 12-inch Gate Valve and Box	
Measurement	Units installed complete in place
Payment	Unit price each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work to furnish and install valves and valve boxes, cutting valves into existing mains where required, verifying outside diameter of existing pipe, clearing and grubbing, saw cutting, excavation, removing and disposing of excess materials, shoring/bracing, dewatering, cutting valves in to existing pipe, removing and disposing existing pipe, valves and appurtenances, plugging and capping existing water mains abandoned in place, valve installation, restraining thrust with rods, mega-lug fittings or concrete thrust blocks, blocking for support of valve, bedding, backfill and compaction, gravel roadway base, geotextile fabric, crossing of underground utilities, support of existing utilities, tree trimming, removing and replacing signs, fences and mail boxes, resurfacing gravel surfaces, and other incidental Work, as shown on the Drawings and as specified or required by field conditions.</p>	

Item 19 – Hydrants	
Measurement	Each installed, complete in place, set in true horizontal and vertical alignment and with bury line at finish grade
Payment	Unit price per each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work to furnish and install hydrants, coordinate with City Water Department, clearing and grubbing, saw cutting, excavation, shoring/bracing, removing and disposing existing pipe, valves, fittings and hydrants, plugging and capping existing water mains abandoned in place, restraining thrust with rods and/or concrete, restrained joint fittings, mega-lug fittings, connecting existing water mains (as applicable), ductile iron pipe for hydrant assembly, crushed stone dry well, roofing felt, bearing stone, installation of off-sets and extensions to set bury line to finished grade, thrust blocks, geotextile fabric, drainage sump setting true in vertical and horizontal plane, setting bury line at finish grade, bedding, backfill and compaction, gravel roadway base, crossing of underground utilities, support of existing utilities, replacement of existing pipe bollards, painting hydrant, tree trimming, fences, and mailboxes, and other incidental Work, as shown on the Drawings and as specified or required by field conditions.</p>	

Item 20a – 3/4-inch Type K Copper Service Tubing Item 20b – 1-inch Type K Copper Service Tubing	
Measurement	As measured along the centerline of the pipe, from outside face of corporation stop outside face of curb stop.
Payment	Unit price per linear foot installed
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>All labor, tools, equipment and materials to furnish and install copper service tubing, saw cutting, excavation, shoring/bracing, disposing of existing service piping, sand bedding and blanket, backfill, compaction crossing of underground utilities, support of existing utilities as specified, loam and seed, tree trimming, removing and replacing signs, fences, and mailboxes, removing and resetting granite and bituminous curbs, removing and resetting guard rails, and all other incidentals necessary to furnish and install water service fittings, complete in place, as specified, shown on the Drawings or required by field conditions.</p>	

Item 21a – 3/4-inch Corporation Stop Item 21b – 1-inch Corporation Stop Item 21c - 3/4-inch Curb Stop and Box Item 21d - 1-inch Curb Stop and Box	
Measurement	Units installed complete in place
Payment	Unit price each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>All labor, equipment, tools, and materials to furnish and install corporation stop and saddles, curb stops and boxes, couplings, unions, clearing and grubbing, saw cutting, excavation, shoring/bracing, removing and disposing of excess material, tapping pipe, connecting to existing service, crossing of underground utilities, support of existing utilities as specified in the bid documents, sand bedding and blanket, gravel roadway base, backfill, compaction, loam and seed, tree trimming, removing and replacing signs, fences, and mailboxes, removing and resetting granite and bituminous curbs, removing and resetting guard rails, and all other incidentals necessary to furnish and install water service fittings, complete in place, as specified, shown on the Drawings or required by field conditions.</p>	

Item 22a – Cement Lined Ductile Iron Fittings – Force Main Item 22b – Cement Lined Ductile Iron Fittings – Water Distribution	
Measurement	Ductile iron fittings (tees, bends, crosses, reducers, couplings, off-sets and solid sleeves) complete in place shall be measured by the pound based on tabular weights obtained from current ANSI as specified. The weight of the fittings shall not include the weight of any glands, megalugs, bolts, nuts, gaskets and/or accessories. Glands, megalugs, bolts, nuts, gaskets and/or accessories shall be considered incidental to the fitting.
Payment	Unit price per pound
Schedule of Payment	Monthly based on quantity installed
<p>Material and equipment, services, installation, construction and testing inherent to the Work to furnish and install fittings on new and existing water mains, clearing and grubbing, saw cutting, excavation, removing and disposing of excess materials, removing and disposing of concrete encasement shown on Drawings, removing and disposing of existing thrust restraints, shoring/bracing, dewatering, removing and disposing existing pipe, valves and appurtenances, plugging and capping existing water mains abandoned in place, restraining thrust with rods, mega-lug fittings, bedding and backfill, geotextile fabric, connecting existing water mains (as applicable), compaction, crossing of underground utilities, loam and seed, tree trimming, removing and replacing signs, fences and mail boxes, support of existing utilities, and other incidental Work, as shown on the Drawings and as specified or as required by field conditions.</p>	

Item 23 – Forest River Park Meter Vault and Piping	
Measurement	Work completed to date
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to install the Forest River meter pit vault, associated piping and appurtenances and other incidental Work, as shown on the Drawings and as specified. *Excludes general grading, topsoil and seeding which is incidental to Item 14.	

Item 24 – Disinfection, Pressure and Bacteria Testing of Water Mains	
Measurement	Percent of total installed water main length tested and passed
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to disinfect, pressure test and bacteria test water mains, including furnishing and installing temporary blow-off/sample lines, flushing, introducing chlorine, hydrostatic testing, neutralizing flushed chlorinated water, sampling, delivery of samples for water quality analysis, analysis by qualified laboratory, providing results to Engineer and Owner, and removing blow off/sample line to corporation. Also includes pumps, injectors, gauges, neutralizing chlorine residual, and incidentals necessary to flush, chlorinate, perform hydrostatic testing, neutralize chlorine residual, sample and obtain satisfactory water quality test results, and other incidental Work, as shown on the Drawings and as specified. Excludes Work associated with disinfection, hydrostatic tests and water quality tests that fail to produce satisfactory results and hydrostatic tests performed by Contractor for convenience. Flushing, chlorinating, hydrostatic testing, neutralizing chlorine, sampling and water quality testing that produce unsatisfactory results are considered incidental to the Work.	

Item 25a - 2-inch Temporary Bypass Water Mains Item 25b - 6-inch Temporary Bypass Water Mains	
Measurement	As measured along the horizontal projection centerline of the pipe
Payment	Unit price per linear foot installed
Schedule of Payment	Monthly based on progress; up to 75% upon installation and 25% upon successful testing
<p>All labor, equipment, tools and materials to install temporary by-pass piping, saw cutting, excavation, backfill compaction, joining of pipe, bypass fittings, valves and hydrants, connecting to existing hydrants, tapping existing water mains with cut-in tees or tapping sleeves and valves, plates, ramping material, cold patch for ramping, burying bypass pipe as required, flushing, chlorinating, neutralizing chlorine residual, providing and removing temporary blow-off/sample lines, sampling, performing analysis of water quality, delivery of samples, water quality analysis in accordance with the latest revision of AWWA C651 - Disinfecting Water Mains by qualified laboratory, providing analysis results to the Engineer and Owner, delivery of notification, scheduling service connections with property owner, service connections, providing wye connections for all sillcocks, loam and seed, resetting curbing, sidewalk restoration, temporary and permanent patching of bypass trenches with hot mix asphalt, and all other incidentals necessary to install temporary by-pass piping complete in place.</p>	

Item 26 – Control Density Fill	
Measurement	Per cubic yard delivered & placed based on plant slips
Payment	Unit price per cubic yard
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work for placing Control Density Fill, for preventative trench settlement or shallow cover pipe installations and other incidental Work, as shown on the Drawings and as specified or as required by field conditions or as directed.</p>	

Item 27 – Granite Curb Returns	
Measurement	Actual curb return installed
Payment	Unit price each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work for removing existing granite curb, installing new curb returns, storing existing curb, saw cutting of the existing pavement where indicated or directed, removal of the existing pavement, excavation, removal & resetting of granite curb to install curb returns, handling, cutting ends square, trimming exposed and hidden faces, cleaning sections to be reset, gravel borrow, including grading and compacting and/or placement of concrete base, pavement materials between the reset curb and existing or proposed pavement, delivery of surplus (excess) curbing in good condition to Owner at the City DPW yard, and other incidental Work, as shown on the Drawings and as specified.</p>	

Item 28a – Remove and Reset Granite Curb Item 28b – Granite Curb (New) Item 28c – Remove, Stack and Reuse Granite Curb Item 28d – Granite Curb Filler (New)	
Measurement	Actual curb installed, remove and reset
Payment	Unit price per linear foot
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for removing existing granite curbs, removing and resetting granite curb, installing new granite curb where indicated or directed (after removed and reused curb has been exhausted), storing, saw cutting of the existing pavement, the removal of the existing pavement, excavation, removal, handling, cutting ends square, trimming exposed and hidden faces, cleaning sections to be reset, gravel borrow, including grading and compacting and/or placement of concrete base, pavement materials between the reset curb and the existing or proposed pavement, loam and seed, delivery of surplus (excess) curbing in good condition to Owner at the City DPW yard, and other incidental Work, as shown on the Drawings and as specified.	

Item 29 – Bituminous Curb	
Measurement	Linear foot of bituminous curbing installed
Payment	Unit price per linear foot
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for installing bituminous curbs, saw cutting of the existing pavement where indicated or directed, the removal of the existing pavement, curb installation, including grading and compacting and/or placement of pavement materials between the curb and the existing or proposed pavement, replacement and compaction of gravel borrow subgrade, grading around new curb including loam and seed, setting of curbing to match adjacent existing curbing where applicable to pre-construction conditions, and other incidental Work, as shown on the Drawings and as specified.	

Item 30 – Remove Existing Sidewalk	
Measurement	Per square yard measured in place
Payment	Unit price per square yard
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to saw cut as indicated, demolish, tree protection, sign disposal, remove and dispose concrete or asphalt sidewalk at the locations and limits indicated on the Drawings and other incidental Work, as shown on the Drawings and as specified.	

Item 31 – Concrete Sidewalk	
Measurement	Square yard of concrete sidewalk installed
Payment	Unit price per square yard
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for installation of new concrete sidewalks, welded wire mesh, sidewalk subgrade, vertical granite curb fillers, tree protection, tree trimming, loam and seed, removing and replacing signs, fences and mail boxes, gravel base and compaction, grading and matching of new concrete sidewalk to adjacent existing concrete materials as necessary to meet and match pre-construction or proposed conditions, feather sidewalk grade to meet surrounding sidewalk elevation, and ensure smooth transition, provision and construction of expansion and control joints, surface finishing, and other incidental Work, as shown on the Drawings and as specified.	

Item 32 – Bituminous Asphalt Concrete Sidewalk	
Measurement	Square yard of concrete sidewalk installed
Payment	Unit price per square yard
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for installation of new asphalt concrete sidewalks, sidewalk subgrade, gravel base and compaction, tree trimming, loam and seed, removing and replacing signs, fences and mail boxes, removing and replacing signs, matching of new bituminous asphalt concrete sidewalk to adjacent existing materials as necessary to meet and match pre-construction or proposed conditions, feather sidewalk grade to meet surrounding sidewalk elevation, and ensure smooth transition, provision and construction of expansion and control joints, surface finishing, and other incidental Work, as shown on the Drawings and as specified.	

Item 33 – Accessible Curb Ramps (Type A, B, C, D, E, F)	
Measurement	Actual accessible curb ramp installed
Payment	Unit price per each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for installation of all components associated with new accessible curb ramps from the limits of the ramp tie-in to the adjacent surface(s) including, granite curbing, detectable warning panels, saw cutting of the existing pavement where indicated or directed, handling, cutting curb ends square, trimming exposed and hidden faces, cleaning sections to be set, gravel borrow, including grading and compacting and/or placement of concrete base, welded wire mesh, ramp concrete sidewalk, materials necessary to meet and match adjacent surfaces to ensure smooth transition to proposed or pre-construction conditions, feather sidewalk grade to meet surrounding sidewalk elevation, and, provision and construction of expansion and control joints, surface finishing, and other incidental Work, as shown on the Drawings and as specified.	

Item 34 – Detectable Warning Panels	
Measurement	Actual detectable warning panel installed
Payment	Unit price per each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Includes labor, services, material and equipment associated with installation only of detectable warning panels as shown on the drawings with all of the components associated with new detectable warnings, saw cutting of the existing pavement, all handling, cutting curb ends square, trimming exposed and hidden faces, cleaning all sections to be set, including placement of concrete base, ramp concrete sidewalk, materials as necessary to meet and match adjacent surfaces to ensure smooth transition to proposed or pre-construction conditions, and other incidental Work, as shown on the Drawings and as specified.</p> <p>*Excludes detectable warning panels to be installed as part of Item 33.</p>	

Item 35 – Concrete Driveway Apron	
Measurement	Actual concrete driveway apron installed
Payment	Unit price per each
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work for installation of new concrete driveway aprons, welded wire mesh, driveway apron subgrade, gravel base and compaction, matching of new concrete driveway to adjacent existing materials as necessary to meet and match pre-construction or proposed conditions, feather driveway grade to meet surrounding sidewalk elevation, and ensure smooth transition, provision and construction of expansion and control joints, surface finishing, and other incidental Work, as shown on the Drawings and as specified.</p>	

Item 36 – Temporary Trench Pavement	
Measurement	Actual temporary pavement installed at depths indicated on the Drawings.
Payment	Unit price per ton, complete in place. Contractor shall submit Certified Weigh Slips for Hot Mix Asphalt installed before pavement will be considered for payment.
Schedule of Payment	Monthly based on quantity installed, tested and accepted
<p>Material and equipment, services, installation, construction and testing inherent to the Work for temporary trench pavement, including saw cutting, disposal of pavement, gravel for pavement sub-base to depth shown on the Drawings, within area shown to be Mill and Overlay, grading, fine grading and compacting gravel for pavement sub-base, emulsion, bituminous tack coat, adjusting of roadway castings, placement and compaction of binder course to depths shown on the Drawings and in required lift depths, restoring pavement markings and other incidental Work, as shown on the Drawings and as specified.</p>	

Item 37 – Permanent Trench Pavement	
Measurement	In place within pay limits and depths shown on the Drawings
Payment	Unit price per square yard, complete in place. Contractor shall submit Certified Weigh Slips for Hot Mix Asphalt installed before pavement will be considered for payment.
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for permanent trench pavement, including saw cutting, disposal of pavement, gravel for pavement sub-base to the depth shown on the Drawings, grading, fine grading and compacting gravel for pavement sub-base, emulsion, bituminous tack coat, adjusting of roadway castings, placement and compaction of binder course and top course to the depths shown on the Drawings and in the required lift depths, restoring pavement markings and other incidental Work, as shown on the Drawings and as specified.	

Item 38a – Forest Ave/ Clifton Ave Area Mill and Overlay Item 38b – Forest Park Drive Area Mill and Overlay	
Measurement	In place within pay limits and depths shown on the Drawings
Payment	Unit price per square yard, complete in place. Contractor shall submit Certified Weigh Slips for Hot Mix Asphalt installed before pavement will be considered for payment.
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to mill pavement to the depth and limits shown on Drawings or required by Owner, to roadways and intersections, to furnish and install full width pavement including emulsion, key ways, milling of gutter lines, repairing driveway abutments to meet new grade, butt joints, bituminous tack coat, joint sealant, milling and/or adjusting roadway castings & structures, furnish, installation and compaction of Type I-1 top course to the required depths, repairing or replacing loop detectors, dispose of pavement millings, backing sides of pavement up with gravel base, loam and seeding, and other incidental Work, as shown on the Drawings and as specified.	

Item 39 – Pavement Marking	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Completion of Work -100%
Material and equipment, services, installation, construction and testing inherent to the Work for removal of pavement markings and the provision of pavement markings indicated on the Drawings, surface cleaning and preparation, symbols, lines & words and other incidental Work, as shown on the Drawings and as specified.	

Item 40a – Full Depth Pavement and Road Subbase - Forest River Park Ballfield Access Roadway	
Item 40b – Full Depth Pavement and Road Subbase - Clifton Ave Roadway Widening	
Measurement	Work completed to date
Payment	Unit price per square yard, complete in place. Contractor shall submit Certified Weigh Slips for Hot Mix Asphalt installed before pavement will be considered for payment.
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to furnish and install full depth pavement including removal of existing pavement and subbase, emulsion, key ways, milling of gutter lines, repairing driveway abutments to meet new grade, butt joints, bituminous tack coat, joint sealant, adjusting roadway castings & structures, furnish, installation and compaction of top and base course and roadway subbase to the required depths, backing sides of pavement up with gravel base, loam and seeding, and other incidental Work, as shown on the Drawings and as specified.	

Item 41 – Pavement Overlay - Forest River Park Roadway	
Measurement	Work completed to date
Payment	Unit price per square yard, complete in place. Contractor shall submit Certified Weigh Slips for Hot Mix Asphalt installed before pavement will be considered for payment.
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to furnish and install full width pavement including emulsion, key ways, milling of gutter lines, repairing driveway abutments to meet new grade, butt joints, bituminous tack coat, joint sealant, adjusting roadway castings & structures, furnish, installation and compaction of Type I-1 top course to the required depths, repairing or replacing loop detectors, backing sides of pavement up with gravel base, loam and seeding and other incidental Work, as shown on the Drawings and as specified.	

Item 42 – Remove and Reset Bollards	
Measurement	Work completed and accepted
Payment	Unit price per each
Schedule of Payment	Completion of Work -100%
Material and equipment, services, installation, construction and testing inherent to the Work for removing of existing bollards, disposal of excess materials, removal, transportation, storage and protection, resetting existing bollards as shown on the Drawings or as directed, excavation, gravel, backfill, compaction, concrete foundation, restoration of disturbed surfaces, and other incidental Work, as shown on the Drawings and as specified.	

Item 43 – 6-Foot High Wooden Stockade Fence at Forest River Park	
Measurement	Per linear foot measured in place
Payment	Unit price linear foot
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to provide and install wooden stockade fence at the locations and limits indicated on the Drawings. Provide posts, post foundations, top, bottom and intermittent crossing and support bars, hardware and appurtenances and other incidental Work, as shown on the Drawings and as specified.	

Item 44 – 6-Foot High, 10-Foot Wide Wooden Stockade Fence Gate at Forest River Park	
Measurement	Work completed to date
Payment	Unit price each gate
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to provide and install wooden stockade fence gate at the locations and limits indicated on the Drawings. Provide posts, post foundations, top, bottom and intermittent crossing and support bars, hardware and appurtenances and other incidental Work, as shown on the Drawings and as specified.	

Item 45 – 6-Foot High Chain Link Fence at Forest River Park Outfall	
Measurement	Per linear foot measured in place
Payment	Unit price linear foot
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to provide and install chain link fence at the locations and limits indicated on the Drawings. Provide posts, post foundations, top, bottom and intermittent crossing and support bars, hardware and appurtenances and other incidental Work, as shown on the Drawings and as specified.	

Item 46 – 6-Foot High, 12-Foot Wide Chain Link Fence Gate at Forest River Park Outfall	
Measurement	Work completed to date
Payment	Unit price each gate
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to provide and install chain link fence gate at the locations and limits indicated on the Drawings. Provide posts, post foundations, top, bottom and intermittent crossing and support bars, hardware and appurtenances and other incidental Work, as shown on the Drawings and as specified.	

Item 47 – Tree Removal and Disposal	
Measurement	Work completed to date
Payment	Unit price per each tree or tree stump removed and disposed of
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work to cut existing trees and expose by excavation, remove tree stumps and root systems, protection of adjacent surface features, within limits of Work as shown on the Drawings and as directed, removal and disposal of tree stumps, roots, organic matter and the other unsuitable materials resulting from the operation and other incidental Work, as shown on the Drawings and as specified. *Excludes tree removal covered in Lump Sum areas*	

Item 48 – Forest River Park Benches	
Measurement	Actual bench furnished and installed
Payment	Unit price per bench
Schedule of Payment	Monthly based on quantity installed, tested and accepted
Material and equipment, services, installation, construction and testing inherent to the Work for installing benches, excavation, installation, handling, including grading and compacting and/or placement of concrete foundations, and other incidental Work, as shown on the Drawings and as specified. *Does not include proposed benches located within Items 49, 50, and 51*	

Item 49 – Forest River Park Baseball Field Area Improvements	
Measurement	Portion of Work completed and accepted within area delineated on Drawings C-500 through and including C-509 complete in place.
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Monthly based on progress
Material and equipment, services, installation, construction and testing inherent to the Work for the Forest River Park Baseball Field Improvement Area as specified and shown on the Drawings. Includes Work shown within area delineated on Drawings C-500 through and including C-509, including incidental Work and as specified. *Excludes general grading, topsoil and seeding which is incidental to Item 14. Excludes Work covered in Item 55.	

Item 50 – Pond Area Site Improvements	
Measurement	Portion of Work completed and accepted within area delineated on Drawing C-500 through and including C-509 complete in place.
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Monthly based on progress
<p>Material and equipment, services, installation, construction and testing inherent to the Work for the Pond Area Site Improvements as specified and shown on the Drawings. Includes Work shown within area shown on Drawing C-500 through and including C-509, including incidental Work and as specified.</p> <p>*Excludes wooden stockade and chain-link fencing and gates covered in Items 43 through 46*</p>	

Item 51 – Forest River Basketball Court Area Improvements	
Measurement	Portion of Work completed and accepted within area delineated on Drawing C-502, C-504 and 506 complete in place.
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Monthly based on progress
<p>Material and equipment, services, installation, construction and testing inherent to the Work for the Forest River Basketball Court Improvement Area as specified and shown on the Drawings. Includes Work shown within area shown on Drawing C-502, C-504 and 506 including incidental Work and as specified.</p> <p>*Excludes general grading, topsoil and seeding which is incidental to Item 14. Excludes Work covered in Item 55.</p>	

Item 52 – Geotechnical Instrumentation and Monitoring	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Completion of Work -100%
<p>Material and equipment, services, installation, monitoring, construction and testing inherent to the Work for the geotechnical instrumentation monitoring as specified in Section 31 09 00 and other incidental Work, as shown on the Drawings and as specified.</p>	

Item 53 – Unsuitable Material Excavation and Replacement Below Normal Grade	
Measurement	Per cubic yard of replacement material imported to the site
Payment	Unit price per cubic yard, complete in place based on Certified Weigh Slips for materials installed. If no cubic yard is indicated on slips, a conversion factor of 1.35 tons per cubic yard will be used.
Schedule of Payment	Monthly based on quantity excavated and replaced
Material and equipment, services, installation, construction and testing inherent to the Work for excavation and replacement of materials determined by Engineer or Owner as Unsuitable for structure subgrade, including required testing, documentation, and legal disposal of spoils not containing oil or hazardous materials.	

Item 54 – Rock/Boulder Excavation	
Measurement	Per cubic yard measured in place prior to excavation within pay limits
Payment	Unit price per cubic yard
Schedule of Payment	Per cubic yard of soil removed and replaced as measured in place
Material and equipment, services, installation, construction and testing inherent to the Work to remove rock and boulders, including excavation, removal, and disposal of the rock and replacement as necessary with Suitable backfill material as directed by Engineer and other incidental Work, as shown on the Drawings and as specified.	

Item 55 – Forest River Park Electrical	
Measurement	Portion of Work completed and accepted
Payment	Percent of lump sum price based on Schedule of Values
Schedule of Payment	Monthly based on progress
Includes all labor, services, material and equipment associated with new service entrance, power and communication from utility pole, new pad mount equipment, branch circuiting and underground work as indicated on the Electrical Drawings and as specified. Contractor shall reuse specified equipment as indicated on the Electrical Drawings (E-001, E-101, E-102, & E-201). *Excludes items identified in Item 49 and 51.	

Item 56 – Conformed to Construction Record Drawings and As-Builts	
Measurement	As determined
Payment	Lump sum price per Schedule of Values
Schedule of Payment	Completion of Work – 100%
Includes all labor, services, material and equipment associated with preparing Conformed to Construction Record Drawings as specified in the General Requirements.	

Item 57 – Additional Hours of Work Fee (Deduction)	
Measurement	Each hour worked outside of the allowable Work hours approved by Owner
Payment	Deduction of \$130 per each hour per person
Schedule of Payment	Deduction on each Application for Payment containing hours worked outside of the allowable Work hours approved by Owner
The Contract Price shall be reduced by \$130 for each approved hour per person worked outside of the specified allowable work hours to cover additional engineering costs incurred by the Owner for services of the Resident Project Representatives. Any Work conducted by the Contractor outside of the specified allowable work hours must be approved by Owner.	

Item 58 – Owner’s Contingency Allowance for Temporary Signage	
Measurement	Portion of Owner’s contingency allowance amount authorized per Paragraph 11.02 of the of the General Conditions
Payment	Percent of not to exceed contingency amount authorized by Change Order
Schedule of Payment	Monthly as authorized by Change Order
For furnishing and installing Owner or Engineer requested traffic and non-traffic related control related signs, such as, signs notifying the public that businesses are open during construction activities, way findings signs, etc. as directed by the Owner.	

Item 59 – Owner’s Contingency Allowance for Materials Escalation Price Adjustment (Statutory)	
Measurement	Portion of Owner’s contingency allowance amount authorized per Paragraph 11.02 of the General Conditions and Supplementary Conditions
Payment	Percent of not to exceed contingency amount authorized by Change Order
Schedule of Payment	Monthly as authorized by Change Order
For price adjustments for materials escalation of Liquid Asphalt, Diesel Fuel, Gasoline, and Portland Cement per statutory requirements in accordance with Section 00 73 73.	

PART 2 - PRODUCTS (not used)

PART 3 – EXECUTION (not used)

END OF SECTION

SECTION 01 43 05

QUALIFICATION REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Meet or provide capability to meet the criteria specified below and in individual Specification sections in connection with various portions of the Work of the Contract Documents.

1.02 MINIMUM REQUIREMENTS

- A. Completed a minimum of 10 projects employing sheeting for excavation support within the last 5 years including at least 2 projects with excavation depth and soil conditions similar to Work specified.
- B. Qualification Data: For Installer and Professional Engineer.
 - 1. Work under this Section shall be performed by a qualified Contractor having a minimum of 5 years' of continuous experience within the past 5 years in support of excavation design and construction.
 - 2. has installed, constructed, and completed work involving the installation of excavation support walls and has competently managed and supervised the manpower, materials, equipment, and tools necessary to complete such work as required by the size and complexity of this contract; and that the work was successfully completed within the time frame allotted; and that the work was done to the satisfaction of the owner.
 - 2. Furnish a project list of satisfactorily completed excavation support wall installations. The project list shall include the name of the owner for whom the Work was performed, the scope and value of the excavation support wall installations, and the names of the Contractor's or Subcontractor's Project Superintendent(s) and Assistant Superintendent(s) and their experience with the installation of excavation support walls. The list shall also include at least three projects of similar height and size where the design and installation of temporary bracing was required.
- C. Contractor shall have been regularly and actively engaged in similar Work as described in the Contract Documents, operating under the same business name and business organization structure, for the last 5 years on at least 5 projects.
 - 1. Contractor shall have regularly engaged experienced engineers/design professionals and land surveyors licensed in the state where the Project is located performing other work similar to that specified.

- D. Contractor shall have successfully completed:
1. at least 5 projects with a total value in excess of \$5 million within the past 10 years;
 2. at least 3 projects, each with a total installation of 1,000 feet of 36 inch minimum pipe size installation within the past 10 years; and
 3. have a full-time on-Site project manager in responsible charge of the Work with at least 10 years' experience as project manager on comparable projects.
- E. Contractor or its Subcontractors shall have successfully completed:
1. at least 3 projects that included a pumping station of at least 0.5 million gallons per day (mgd) installed pumping capacity within the past 10 years;
 2. at least 10 projects with excavation support via sheeting within the past 5 years including at least 2 projects with excavation depth and soil conditions similar to Work specified;
 3. at least 10 projects that included either or a combination of stormwater, water and sewerage utilities within public streets within the last 10 years;
 4. at least 5 projects that included pavement and street repair within public streets within the last 10 years.
- F. Meet or provide capability to meet the following for Work identified.
1. Utility pipe installation and paving: MassDOT pre-qualification.
 2. Dewatering
 - a. Installer qualifications: experienced installer that has specialized in dewatering work in similar subsurface conditions for at least 5 years.
 - b. Designer qualifications: registered professional civil/geotechnical engineer having a minimum 5 years' experience in successfully designing a dewatering system in similar conditions for the past 10 years.
 3. Sewage and stormwater bypass pumping: provided, operated, and maintained by a firm that has been regularly engaged in providing bypass pumping for the last 10 years and having at least 20 successful projects.
 - a. The firm shall have successfully completed at least 10 projects within the last 5 years that involved equipment similar to that proposed for the Project with bypass pumping capacities of not less than 0.5 mgd.

4. Surveying: registered surveyor in Massachusetts that has been regularly and continuously engaged in surveying for the last 10 years.
5. Excavation and shoring: experienced in the Work specified as Sections of Division 31 for a minimum of continuous experience in the last 5 years.
6. Geotechnical monitoring: minimum 5 years' experience in as specified in Section 31 09 00 with professional engineer registration in Massachusetts.

1.03 STATUTORY

- A. Any Work involving the removal, containment, or encapsulation of Asbestos or material containing Asbestos may only be performed by a licensed contractor in accordance with the provisions of MGL Chapter 149, Sections 6A-6E, applicable Laws and Regulations, and requirements as may be included in the Specifications and Drawings.
- B. Sheet metal work must be performed by a contractor licensed in accordance with 271 CMR 1.00, et seq. governing licensing, permitting, and sheet metal work in Massachusetts.

END OF SECTION

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SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section specifies temporary facilities and controls for execution of the Work put into place for use only during the period of construction, that will be removed when no longer required for construction operations, and applies to all Specifications and Drawings.
- B. Additional statutory requirements are included in Section 00 73 19.
- C. Section Includes

1.02 TEMPORARY CONSTRUCTION FACILITIES

- Barriers
- Protection of Work
- Security
- Safety Facilities
- Access Roads
- Parking
- Field Offices
- Staging Area
- Project Identification
- Progress Cleaning and Waste Removal

1.03 TEMPORARY UTILITIES

1.04 TEMPORARY CONTROLS

- Dust Control
- Water Control and Dewatering - per 01 57 05 Temporary Dewatering
- Erosion and Sediment Control – per Section 01 57 13 - Temporary Erosion and Sediment Control
- Noise Control
- Pollution Control
- Traffic Regulation

1.05 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

1.02 TEMPORARY CONSTRUCTION FACILITIES

A. Barriers

1. Comply with the requirements of Paragraph 6.11. of the Standard General Conditions and Supplementary Conditions, if any.
2. Furnish barriers to prevent unauthorized entry to and clear delineation of construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations as recommended by OSHA and as otherwise required for the protection of life and property during construction.
3. Construct barricades and protective facilities in accordance with local and state regulations. Furnish and install signs, lights, reflectors, and such protection facilities as may be required.
4. Furnish barricades required by governing authorities for public rights of way.
5. Provide protection for plant life designated to remain. Replace damaged plant life.
6. Protect non owned vehicular traffic, stored materials, Site and structures from damage.
7. If required, furnish commercial grade, minimum 8 foot high chain link fence around construction Site. Equip with vehicular gates with locks.

B. Protection of Work

1. Protect Work during working and non-working hours.
2. Provide special protection where specified in Specifications or Drawings and in accordance with manufacturer recommendations.
3. Furnish temporary and removable protection for installed equipment and material. Control activity in immediate Work area to minimize damage.
4. Protect exterior areas of Work from damage. Prohibit traffic from landscaped areas.

5. Buildings and Enclosures
 - a. Furnish protective coverings at walls, projections, jambs, sills, and soffits of openings and protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
 - b. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
 6. Whenever gale or high winds are forecast, take measures to secure loose material, equipment or other items that could be blown and be damaged or cause damage. Do not leave such loose items unsecured at end of a working day. Particular attention shall be taken with scaffolding and items placed or stored on roofs or within a structure prior to being enclosed.
 7. Provide for removal of snow and ice which may impede Work, damage the finishes or materials, be detrimental to workers, or impede trucking, delivery, or moving of materials at the Site, or prevent adequate drainage of the Site or adjoining areas.
- C. Security
1. Provide protection to stored items, the Work and operations from unauthorized entry, vandalism, or theft, and against fire, storms and other losses during working and non-working hours.
 2. Provide additional security measures needed for construction operations at an active university campus. Coordinate with Salem State University's Police force and security program. Comply with (if any) requirements set forth by the SSU Police.
- D. Safety Facilities
1. Provide first aid and other safety facilities required by Laws and Regulations during working and non-working hours.
- E. Access Roads
1. Construct and maintain temporary roads accessing public thoroughfares to serve construction area. Control dust and water.
 2. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.
 3. Provide for emergency access and maintain throughout the Work Site.

F. Parking

1. Do not allow construction vehicle parking on existing pavement or sidewalks.
2. Off-Site construction parking area to be established at a location determined by Contractor.

G. Field Offices

1. Furnish weather tight office with lighting, electrical outlets, heating, cooling and ventilating equipment, and equip with furnishings and accessories to accommodate supervision of Work, maintenance of records, and project meetings, including, but not limited to the following.

- Desk and chairs (2 cushioned office desk chairs and 4 metal fold chairs)
- Plan table with light and stool
- 3 locking file cabinets
- Hanging plan rack
- Book case with 4 shelves
- “All-in-one” color copier, wireless printer, scanner and fax machine, capable of 11 by 17 output (OR separate color copier, color printer, color scanner, all capable of 11 by 17 output, and fax machine)
- Paper stock for duration of Project
- Telephone with answering machine (or telephone service with voicemail feature)
- Refrigerator, microwave, and water cooler with 5 gallon bottled water, and 16 oz bottled water supplied for duration of Project
- First aid kit

Furnish separate office for use by Engineer and Resident Project Representative similarly equipped with fully functional equipment and furniture.

2. Maintain utilities per Article 1.03 below for the duration of the Project.
3. Location of Field Offices
 - a. Owner is allowing Contractor to locate field offices within the Forest River Park limit of work at the direction of the Owner or Engineer.

H. Staging Area

- a. Owner is allowing Contractor to locate staging area within the Forest River Park limit of work at the direction of the Owner or Engineer.

I. Project Identification

1. Before any Work commences on Site, install a Project sign at locations determined by the Owner that can be seen from the public way but not on a living tree. Provide 2 Project signs in accordance with the following .
 - a. Size: 4 feet by 8 feet by 3/4-inches.
 - b. Materials: exterior grade/MDO plywood (APA rating A-B).
 - c. Supports: 4-inch by 4-inch by 12-foot posts with 2-inch by 4-inch cross bracing
 - d. Layout: per Figure-1 included as an attachment to this Section.
 - e. Paint: outdoor enamel in colors determined by Owner.
 - f. Installation: per Figure-2 included as an attachment to this Section and set posts a minimum of 3 feet deep in concrete footings at least 12 inches in diameter.
 - g. Maintain signs in good condition, and remove and dispose of signs at the completion of the Project.
2. Order Of Conditions Posting: in accordance with Order of Conditions as shown in Section 01 15 30.

J. Progress Cleaning and Waste Removal

1. Comply with the requirements of Paragraph 6.11. B and C of the Standard General Conditions and Supplementary Conditions, if any.
2. Maintain areas free of waste materials, debris, and rubbish and maintain the Site in a clean and orderly condition.
3. Remove debris and rubbish from spaces and other closed or remote spaces before enclosing the space.
4. Collect and remove waste materials, debris, and rubbish from Site at least weekly and legally dispose off-Site.

1.03 TEMPORARY UTILITIES

A. Power service

Arrange for and pay for required power service from local electric utility for duration of Project. Exercise measures to conserve energy. Furnish and install required equipment including pole of sufficient height to provide proper clearance and install weatherproof box of such size to house service disconnect, overcurrent protection, electric meter, and other required equipment. Locate as approved by Owner.

B. Telephone service and internet access to field offices

1. Arrange for, pay for, and maintain telephone service and internet access to field offices at time of Project mobilization and for duration of Project.
2. Obtain voicemail feature if answering machine not provided.
3. Provide portable wireless, high speed broadband internet access via DSL, cable, satellite, or T1 for each on site Owners Representatives & Engineers for the duration of the project.
4. Provide one (1) cellular smartphone for Owners Representative/Engineer including internet service and camera for the duration of the project equal to Apple iPhone 7.

C. Water service

1. Arrange for, pay for and maintain flushing and supply backflow preventer. Coordinate with Salem Water Department.
2. Supply bottled water for Field Office.

D. Furnish and maintain required sanitary facilities and enclosures. Do not use existing facilities.

E. Furnish lighting for construction operations. Furnish lighting for exterior staging and storage areas and for security purposes. Maintain lighting and provide routine repairs.

F. Furnish heat devices and heat and cooling devices as required to maintain specified conditions for construction operations.

G. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

H. Fire Protection

1. Provide temporary fire protection equipment and services during construction per NFPA and local fire code and regulations, and fire marshal's requirements.
2. Use Work procedures that minimize fire hazards to the extent practicable and materials that are fire resistant where possible. Collect and remove combustible debris and waste materials from the Site each day. Store fuels, solvents, and other volatile or flammable materials away from the construction and storage areas in well-marked, safe containers in accordance with Laws and Regulations.

1.04 TEMPORARY CONTROLS

- A. Dust Control: Execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere. Utilize the application of sprinkled water to reduce the emission of air-borne soil particulates from the Project Site.
- B. Temporary Water Control and Dewatering: in accordance with Section 01 57 05.
- C. Temporary Erosion and Sediment Control: in accordance with Section 01 57 13.
- D. Noise Control
1. Provide methods, means, and facilities to minimize noise from construction operations.
 2. Provide noise attenuation systems capable of meeting the Department of Environmental Protection Division of Air Quality Control regulations governed by the following policy:

"A source of sound will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source:

- *Increases the broadband sound level by more than 10 dB(A) above ambient, or*
- *Produces a "pure tone" condition when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.*

"These criteria are measured both at the property line and at the nearest inhabited residence. Ambient is defined as the background A-weighted sound level that is exceeded 90% of the time measured during equipment operating hours. The ambient may also be established by other means with the consent of the Department."

3. Construct sound enclosures or utilize other noise reduction techniques if the equipment does not meet the noise level requirements.

E. Pollution Control

1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

a. Water Pollution Control

- 1) Assure that sediment, debris, petroleum, chemicals, or other contaminants will not enter existing drainage facilities and channels. Use construction methods that will prevent entrance of pollutants and wastes into existing streams, rivers, lakes, and flowing and dry watercourses.
- 2) Obtain legal disposal sites and dispose of pollutants and wastes in a legal manner.
- 3) Respond immediately to emergencies as directed when water quality of existing streams, rivers, lakes and flowing and dry watercourses is threatened. Take corrective action to remove or contain pollutants until a permanent solution is determined.

b. Air Pollution Control

- 1) Equipment and vehicles that exhibit excessive exhaust emissions due to poor engine adjustments or inefficient operation will not be permitted to operate until corrective repairs or adjustments are made.
- 2) Burning of materials from clearing or grubbing operations, combustible construction materials, and rubbish will not be allowed.

F. Traffic Regulation

1. Control and maintain traffic within the Project area. Submit traffic control plans and coordinate with Owner and local agencies. Submit plan for traffic control to Owner for review 14 days in advance of any Work within public right-of-way, street closure or detour.
 - a. Utilize a minimum of two electronic portable message boards during construction.

2. Provide and maintain traffic control and maintenance devices in accordance with Part 6, Temporary Traffic Control, of the "*Manual on Uniform Traffic Control Devices for Streets and Highways*", published by the U.S. Department of Transportation, Federal Highway Administration and other applicable codes and standards as specified. Operate devices 24 hours per day as required.
 - a. In addition, comply with applicable portions of the "Massachusetts Amendments to the 2009 Manual on Uniform Traffic Control Devices and the Standard Municipal Traffic Code" published by the Massachusetts Department of Transportation Highway Division.
3. Provide for access by emergency vehicles, such as police, fire, and disaster units at all times. Contractor shall be liable for damages resulting from failure to provide such access.
4. During construction hours, traffic flow must be controlled by uniformed traffic police officers or other traffic controllers allowed by Laws and Regulations. The services of traffic controllers shall in no way relieve the Contractor of its responsibilities under the Contract. Coordinate schedule of police details which will be direct billed to the Owner.
5. Maintain minimum of one moving lane on roadways at all times.
 - a. Where detours are permitted, provide necessary barricades, flashers, flashing arrows and signs in accordance with referenced Manuals and Laws and Regulations.
 - b. Provide gravel borrow and bituminous concrete to maintain temporary passable travel lane ramps, temporary bridging, steel plates, temporary pavement, wood-framed walkways, caution, safety and other necessary signs directing the pedestrian and vehicular traffic towards unblocked and safe areas.
6. Provide safe access/egress to businesses and abutting property owners within the Project area. In areas where the construction activity is in progress, install directional signs in front of businesses indicating "OPEN FOR BUSINESS" or similar for guidance of customers.
 - a. Certain construction operations such as utility work and roadway/sidewalk reconstruction may restrict access/egress on some roads and to businesses and abutting property owners. Under these circumstances, schedule operations during off-peak hours or late evenings with Owner approval so that a particular work activity can be completed in the shortest possible time.
 - b. Provide 48 hours notice to businesses and abutting property owners when access/egress will not be available or restrictions will exist.

- c. At no time shall the Contractor block all access to any businesses.
7. Exercise particular care to establish and maintain such methods and procedures that will not create hazards.
 - a. Remove or properly cover traffic control, safety devices and/or signs having messages that are irrelevant to normal traffic conditions at the end of each Work period. Keep signs clean at all times and provide that legends are distinctive and unmarred.
 - b. Place excavated material and construction equipment so that vehicular and pedestrian traffic is maintained at all times unless road closure permit is obtained. If the Contractor's operations cause traffic hazards, implement appropriate safety measures immediately.
 - c. In areas of high pedestrian and vehicular traffic volume, the remove waste materials and construction equipment from the Work Site on a daily basis. Do not park construction equipment overnight on the Site or the adjacent roads unless permitted by Owner.
 - d. Provide night watchmen where special hazards exist.
8. Post signage clearly stating that any vehicle impeding the progress of construction will be towed at the vehicle owner's expense. Towing charges incurred for Contractor's failure to post such signs shall be at no additional cost to Owner.

1.05 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, and facilities before Final Application for Payment inspection or as indicated in Specifications.
- B. Remove temporary underground installations and grade Site as indicated. Clean and repair damage caused by installation or use of temporary utilities, facilities, and controls.
- C. Restore existing facilities and areas used during construction to original condition. Restore permanent facilities used during construction to specified condition.

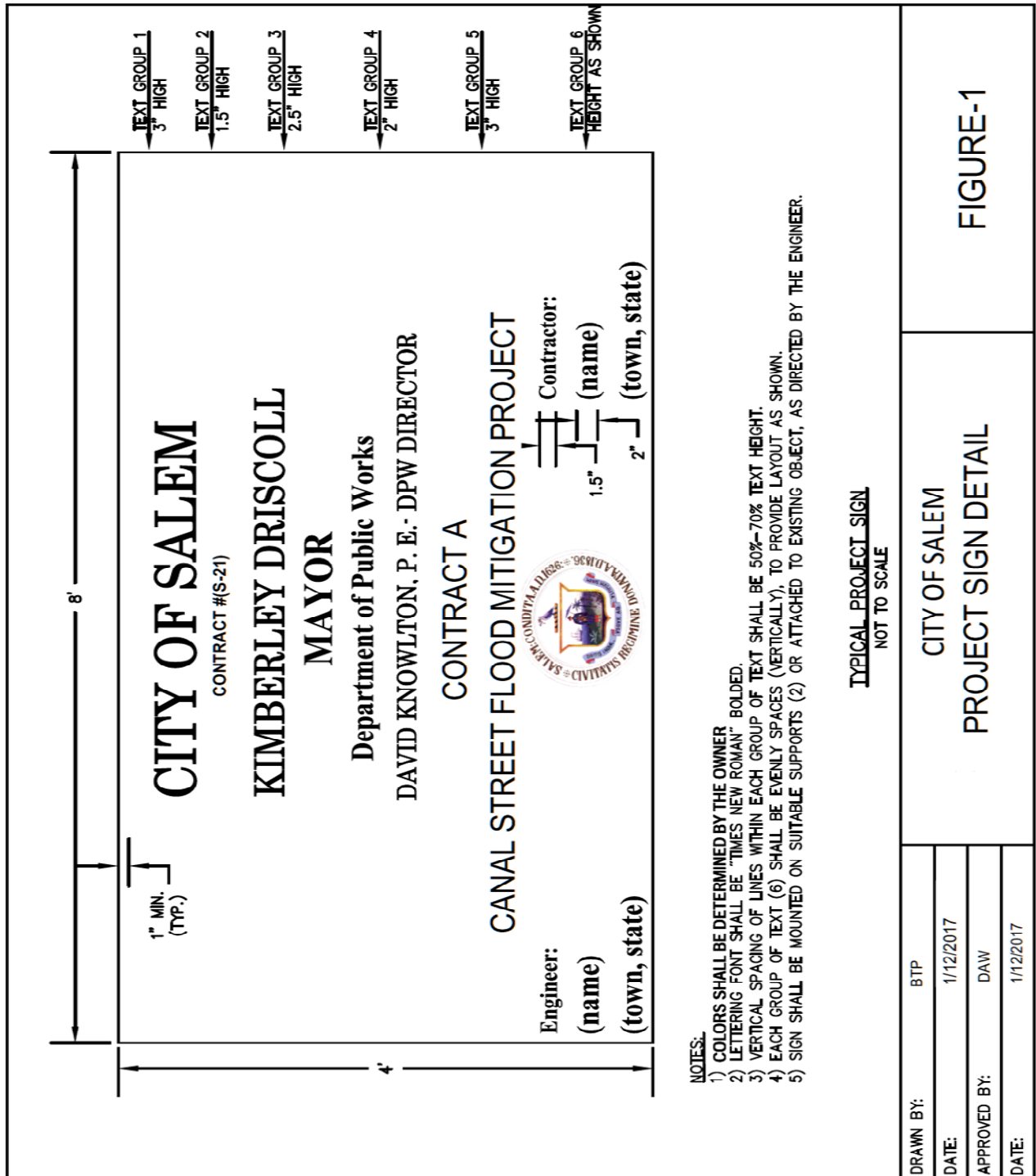
1.06 ATTACHMENTS

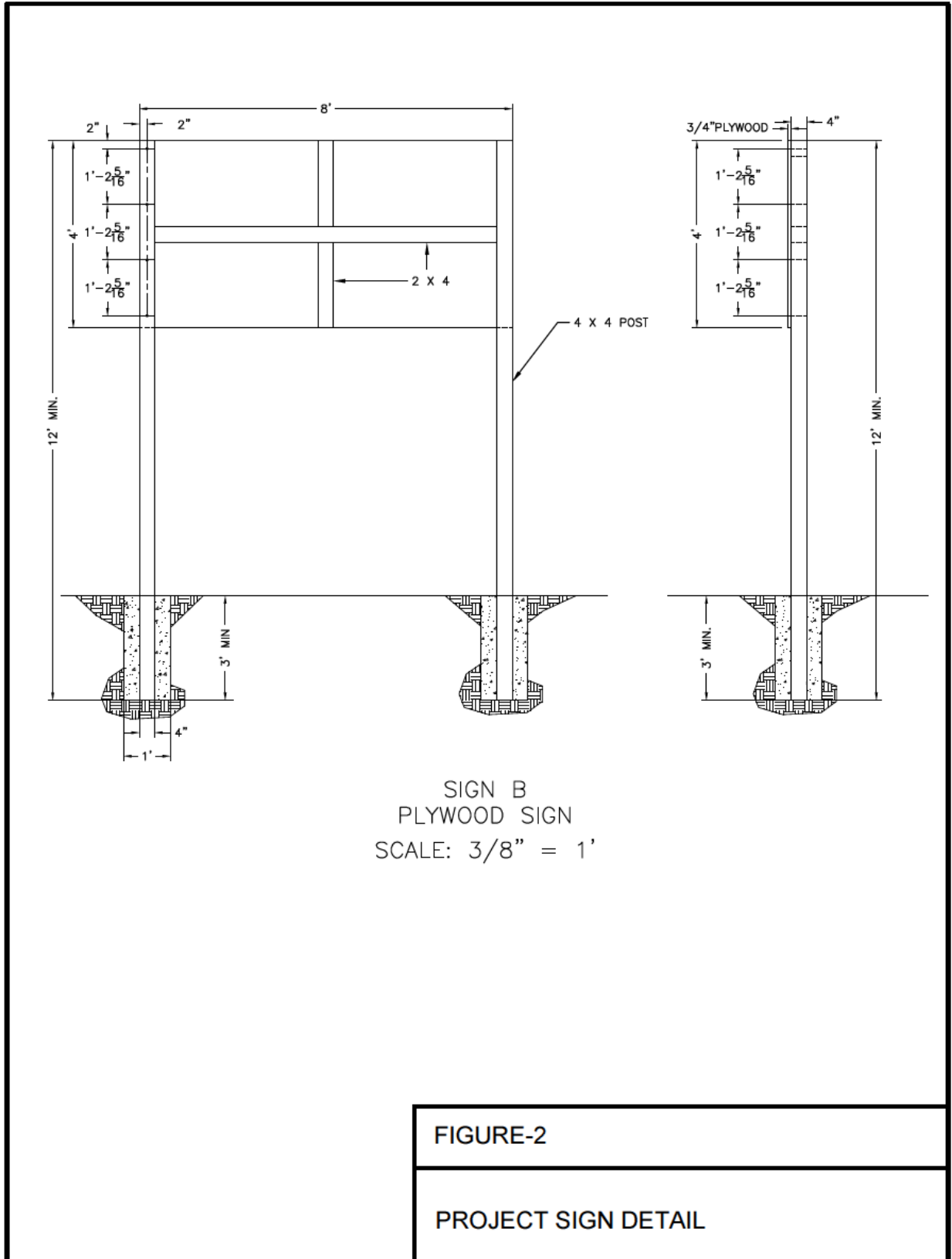
- A. Project Identification Details
 - Figure 1 – Project Sign Layout Detail
 - Figure 2 – Project Sign Installation Detail

END OF SECTION

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PROJECT SIGN





SECTION 01 51 38

TEMPORARY WATER BYPASS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide, test, operate and maintain temporary bypass water mains as shown on the Drawings, or as modified by Contractor and approved, including service connections, tap holes and temporary hydrants to prevent interruption of water service or fire protection during water main construction or bypass installation/removal.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)
 - a. ANSI/NSF 61, Drinking Water System Components – Health Effects
2. American Water Works Association (AWWA)
 - a. AWWA C651
3. ASTM International (ASTM)
 - a. ASTM A135
 - b. ASTM D1248
 - c. ASTM D3350
4. Factory Mutual (FM)
5. NSF International (NSF)
6. Underwriters Laboratories Inc. (UL)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: in accordance with Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
 - 1. Submit a plan and schedule of the proposed temporary bypass of water main system including any alterations, at least 14 days prior to implementation and prior to the start of construction.
 - 2. Minimum contents of water bypass pumping plan and schedule:
 - a. Plan showing the layout of temporary water mains including: connections to existing hydrants, taps to existing water mains and fire services, street crossings, existing water main valves to be operated, and location of temporary hydrants, valves, and sampling locations
 - b. Description of connection procedures for domestic services, details and a description of installation procedures for tap hole connections to existing mains and fire services, and disinfection procedures
 - c. Daily schedule outlining the locations where temporary water mains will be installed and notification procedures for business owners and residents
 - d. List of spare parts for maintenance and repairs to temporary bypass and service connections with location where the spare parts will be stored
 - 3. An emergency contact list with a minimum of 3 employees skilled in the maintenance and repair of the temporary by-pass systems, knowledgeable of the bypass system in use, with specific knowledge of its operational requirements and valve location, and who are available 24 hours per day/ 7 days per week, and able to respond to emergency repair calls within a maximum of 2 hours. Include at a minimum name, address, home and mobile telephone number for each employee listed.
 - 4. Connection/disconnection written notice to property owners

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 TEMPORARY BYPASS WATER MAIN

- A. Temporary bypass water main pipe and fittings
1. High density polyethylene (HDPE) pipe: manufactured from high density, extra high molecular weight compound equaling a PE 3408 designation and conforming to ASTM D1248 and ASTM D3350, with a cell classification of 345434C.
- OR
2. Hot dipped galvanized schedule 40 steel pipe: manufactured to meet the requirements of ASTM A135, UL listed, FM approved.
 3. Do not use any other pipe materials in the temporary bypass water main system.
- B. Minimum working pressure: 150 psi and capable of withstanding vehicular traffic loading.
- C. Minimum wall thickness for HDPE pipe
1. 6-inch pipe: 0.602 inches.
 2. 4-inch pipe: 0.409 inches.
 3. 2-inch pipe: 0.216 inches.
- D. Temporary pipe couplings: restrained joint, designed to resist flexure and torsion loads, UL listed, FM approved with a minimum working pressure of 750 psi. Gaskets: ANSI/NSF 61 approved for use with potable water.

2.02 TEMPORARY WATER SERVICE CONNECTIONS

- A. Temporary water service connections: minimum 3/4-inch polyethylene or rubber hose tubing complying with ANSI/NSF 61 and approved by Owner prior to installation.

2.03 TEMPORARY HYDRANTS AND GATES

- A. Temporary hydrants: acceptable to and supported by a means approved by the local Fire Department to prevent deflection of the hydrant or bypass piping system when the hydrant is in operation.
- B. Provide temporary gate valves that are in good working order and capable of sealing completely when closed.

PART 3 – EXECUTION

3.01 GENERAL

- A. Develop minimum required temporary bypass water mains for approval by Engineer and Owner prior to beginning any Work on the Project.
- B. Do not interrupt water service or fire protection during water main construction or bypass installation/removal.
 - 1. Connect temporary bypass water mains to the existing distribution system at both ends to maintain continuity in the distribution system. Do not “dead-end” bypass system unless approved by Owner.
 - 2. Take necessary measures, including tapping existing water mains and installing gate valves when existing hydrants and existing gate valves are unavailable for use, to ensure continuous water service and fire protection.
- C. Furnish, install, maintain, and remove service hoses or pipes of approved size, to service consumers from gated connections on the bypass pipe.
- D. Provide separate temporary water connection for each building. Directly connecting one building to another is prohibited.
- E. Furnish and install temporary bypass water main, temporary hydrants, temporary in-line gate valves, temporary house service connections, temporary service blow backs and permanent gate valves prior to water main replacement construction. Install temporary bypass water mains as indicated on the Drawings unless otherwise approved or directed by Owner. Provide for fire flow interconnections and water service connections to all businesses and residents affected by the Work.
 - 1. Install temporary hydrants, at a minimum, adjacent to existing hydrants. Provide additional temporary hydrants when required by the local Fire Department at no additional cost to Owner.
 - 2. Provide temporary gate valves that are good working order and seal completely when closed. Locate gate valves where shown on the Drawings or as indicated by Engineer or Owner. If a bypass plan has not

been included on the Drawings, at a minimum install gate valves at hydrant connections, tap hole connections and branch lines. Provide additional temporary gate valves when directed by Engineer at no additional cost to Owner. Install gate valves at hydrant connections after the temporary hydrant to ensure temporary hydrant remains live if this gate is closed.

- F. Supply bypass pipes from connections made to hydrants or existing water mains that are to remain in service. Furnish fittings and make necessary connections required to supply water to the bypass pipes (including services), including approved corporation stops, tapping sleeves, tap holes, bulkheads, and plugs at dead end mains.
- G. Provide minimum inconvenience to property owners during connection and disconnection. Coordinate with and contact property owners by written notice at least 48 hours in advance of performing connections and disconnections. Submit notice to Owner for approval prior to distributing to property owners.
- H. Supply water to homes and businesses (all affected users of water system) continually during shut down.

3.02 PIPING

- A. Provide adequate water tightness. Exercise care throughout installation of temporary mains and service connections to avoid possible contamination of water mains or house services or contamination of the temporary bypass pipe itself. Flush and disinfect temporary mains and services to prevent contamination in accordance with AWWA C651.
- B. Lay temporary piping along the general lines of streets or roadways to cause minimum disruption and avoid damage. Unless otherwise directed, ramp 4-inch or smaller bypass piping with temporary bituminous pavement, cold patch, or other approved material on each side of the pipe at driveways and sidewalks. Bury bypass piping greater than 4-inch in diameter at driveway and sidewalk crossings.
 - 1. Take additional precautions to minimize public inconvenience in areas where bypass and/or service pipe or hoses may be considered an obstruction to safe passage, including installation of additional ramping on both sides of the bypass pipe or burying the bypass pipe at building walkway entrances, at sidewalk crossings, and in other areas where the piping is considered an obstruction to safe passage.

2. At street crossings, cut a narrow trench in the existing pavement sufficiently wide and deep enough to allow placement of the bypass pipe just below the roadway surface, placement temporary hot-mix asphalt surfacing above it, and compaction by approved means. Make flush with the adjacent pavement. Compaction of temporary surfacing by vehicular traffic is not allowed. Upon removal of the bypass piping, backfill trench with gravel material, properly compacted, and restore to service with a permanent hot-mix asphalt surface at no additional cost to Owner.

3.03 OPERATION AND MAINTENANCE

- A. When the bypass water main system has been tested and is approved to be put into service, maintain 24 hours per day, 7 days per week until the Work has been completed and the bypass system has been removed.
- B. Complete sections of the Project in progress before the daily low temperature falls below 35 degrees Fahrenheit. Maintain components of bypass system impacted by freezing conditions, including service connections and take reasonable measures when scheduling Work as cold weather season approaches. Should it become necessary to stop Work and remove the bypass system due to freezing conditions, re-install, chlorinate, test, and return the temporary bypass system to service at no additional cost to Owner.

3.04 REMOVAL

- A. After the existing water mains have been replaced and new water mains put into service, remove components of the temporary bypass system immediately and perform bituminous patching required for temporary lines.

END OF SECTION

SECTION 01 51 40

TEMPORARY SEWAGE BYPASS

PART 1 – GENERAL

1.01 SUMMARY

- A. Provide, operate, and maintain a functional bypass pumping system capable of bypassing each area of Work without leakage or spillage of sewage upon the ground or streets or back up of sewage into any building or onto any property for the duration of the Project.
- B. Design Requirements
 - 1. Provide a bypass pumping plan designed by a Professional Engineer registered in the state in which the Project is located.
 - 2. Provide temporary bypass pumping adequate to handle dry weather and wet weather flows and to protect against surcharging of the existing system upstream of the Work area.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: in accordance with Division 01 General Requirements.

1.04 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Bypass pumping plan for each bypass location, stamped by a Professional Engineer registered in the state in which the Project is located, prior to implementation and prior to the start of construction
- C. Minimum contents of sewage bypass pumping plan
 - 1. Standard Operating Procedure: Describe the normal sequence of events to be followed while pumping and setting up and breaking down pumping equipment. Plan must address strategies and safeguards to ensure public safety and environmental health is constantly maintained, possibility of property damage and wetlands impacts, and overall level of inconvenience is minimized.

2. Bypass routing diagram for each Work zone
 3. Calculations: estimates of anticipated bypass flows.
 4. Layout drawing showing locations of equipment on Site and how access to the Site is maintained
 5. Equipment lists
 6. Pump curves and motor and engine data demonstrating equipment is sufficiently sized to meet all specified and anticipated operating conditions
 7. Notification form
 8. Emergency Response Plan: Describe the intended means of handling the following situations, including response and clean-up measures, and emergency backup power or backup fuel storage. List equipment to be used and where it will be stored.
 - Break or failure of bypass line (pipe)
 - Failure of bypass pump
 - Overflow
 - Back up into dwelling or onto private property
 - Failure of bypass pumping system to accommodate flow
- D. Shop Drawings for equipment and materials including, but not limited to:
- Pumps
 - Engines and/or Motors
 - Sound Enclosures
 - Pipe or hose
 - Joints/couplings
 - Plugs and/or bladders
- E. Emergency contact list with a minimum of 3 employees skilled in the maintenance and repair of the temporary by-pass systems, knowledgeable of the bypass system in use, with specific knowledge of its operational requirements and valve location, and who are available 24 hours per day/ 7 days per week, and able to respond to emergency repair calls within a maximum of 2 hours. Include at a minimum name, address, home and mobile telephone number for each employee listed.

1.05 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per section 01 43 05.

1.06 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.
- B. The Project area consists of active sanitary sewers; therefore, flows and flow data are variable depending on location and conditions. Flows are subject to typical diurnal variations and also increase significantly during wet weather and high groundwater. Provide that the bypass pumping system is capable of handling all of these conditions. Visit the Work locations prior to start of Work to visually inspect flow conditions as necessary.
- C. Portions of the Project are subjected to infiltration and inflow. Account for infiltration and inflow volume in the planning and conduct of the Work.

PART 2 – PRODUCTS

2.01 BYPASS PUMPING SYSTEM

- A. Godwin Pumps (a Xylem brand)
- B. Griffin Dewatering
- C. Rain for Rent
- D. Or equal

2.02 PUMPS

- A. Provide pumps suitable for use with raw, unscreened sewage and capable of conveying the volume of flow anticipated with a sufficient margin of safety. Provide for 100 percent redundancy (2 pumps at the Site for every 1 pump required) if flow cannot be returned to the sewer at any time if pumping system failure occurs.
 - 1. Redundant pumping: suction and discharge piping with quick connect couplings to facilitate change out of pumps.
- B. Provide a temporary enclosure for the bypass pumping system for sound attenuation operating outside of regular working hours meeting state and local Laws and Regulations for noise requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Submit bypass plan to Engineer prior to implementation of such Work and prior to the start of construction.
- B. Maintain flows under all flow conditions. Adequately handle flows, even instantaneous peak flows, without damage or overflow, providing for potential large instantaneous flow contributors connected to the sewer under repair.
- C. Allow for passage of traffic and protect bypass piping at driveway and street crossings.
- D. Continuously monitor bypass operations regardless of duration or timing of bypassing.
- E. Coordinate bypassing with low-flow times to the extent possible. Prevent overflows or backups.
- F. If it is determined that bypass pumping is not required at a location due to lack of flow or determines that a Work item does not require bypass pumping to be performed, and Engineer agrees, protect flows from construction debris and ensure no debris enters the sewer system.
- G. Repair damage to existing pipes and structures to the satisfaction of Engineer.
- H. Prevent sanitary flow from discharging into salt or fresh water body by means of overflow, bypass pumping, or other methods.
- I. Restore normal service to entire system at end of normal working hours each day, if required by Engineer or Owner.
- J. Repair damage that occurs to existing pipes and structures to the satisfaction of Engineer.

3.02 SHUTDOWN

- A. Shutdown is not permitted. Maintain flow of wastewater at all times with no interruption of service.

3.03 TEMPORARY POWER

- A. Provide fuel and power to run bypass pumps at no additional cost to Owner.

3.04 PIPING

- A. Provide that piping system has adequate water tightness. Perform a leakage test with clean water at Engineer's direction, at no additional cost to Owner.
- B. Lay temporary piping along the general lines of streets or roadways in a manner that causes minimum amount of disruption and is least likely to be damaged.
- C. Use temporary bituminous pavement, cold patch, or other approved material to form a ramp on each side of the pipe or depress the pipe at driveways to allow for property owners to drive over the temporary pipe as directed by Engineer.

3.05 OPERATION AND MAINTENANCE

- A. Continuously monitor bypassing operations regardless of duration or timing of bypassing. Unattended bypass pumping is prohibited.
- B. Arrange for bypass pumping past working hours with Engineer and provide adequate sound attenuation and an attendant.
- C. Do not allow leaks in bypass pumping systems. Clean and disinfect leaks at no additional cost to Owner.

END OF SECTION

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SECTION 01 51 42

TEMPORARY STORMWATER DRAINAGE BYPASS

PART 1 – GENERAL

1.01 SUMMARY

- A. Furnish, install and maintain temporary measures for storm drain bypass, including but not limited to, temporary bypass piping, plugs, and pumping.
- B. Design Requirements
 - 1. Provide a bypass pumping plan designed by a Professional Engineer registered in the state in which the Project is located.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
- B. Bypass pumping plan for each bypass location, stamped by a Professional Engineer registered in the state in which the Project is located, prior to implementation and prior to the start of construction
- C. Minimum contents of storm drainage bypass pumping plan
 - 1. Standard Operating Procedure: Describe the normal sequence of events to be followed while setting up, pumping, and breaking down pumping equipment. Plan must address strategies and safeguards to ensure public safety and environmental health is constantly maintained, possibility of property damage and wetlands impacts, and overall level of inconvenience is minimized.
 - 2. Bypass routing diagram including pump location for each Work zone
 - 3. Calculations: estimates of anticipated peak flows, pump rates, pump curves, and other relevant design.

4. Layout drawing showing locations of equipment on Site and how access to the Site is maintained
 5. Equipment lists
 6. Emergency Response Plan: Describe the intended means of handling the following situations, include both response and clean-up measures, and emergency backup power or backup fuel storage. List equipment to be used and where it will be stored in case of emergency:
 - Break or failure of bypass line (pipe)
 - Failure of bypass pump
 - Overflow
 - Back up into dwelling or onto private property
 - Failure of bypass pumping system to accommodate flow
 - High tide events
 - Rainfall events
- D. Shop Drawings for equipment and materials including, but not limited to:
- Pumps
 - Engines and/or Motors
 - Sound Enclosures
 - Pipe or hose
 - Joints/couplings
 - Plugs and/or bladders
- E. Emergency contact list with a minimum of 3 employees skilled in the maintenance and repair of the temporary by-pass systems, knowledgeable of the bypass system in use, with specific knowledge of its operational requirements and valve location, and who are available 24 hours per day/ 7 days per week, and able to respond to emergency repair calls within a maximum of 2 hours. Include at a minimum name, address, home and mobile telephone number for each employee listed.
- F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.05 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 PUMPS, PIPES & FITTINGS

- A. Provide pumps suitable for usage with storm drainage and capable of conveying the volume of flow anticipated with a sufficient margin of safety. Provide for 100 percent redundancy (2 pumps at the Site for every 1 pump required) if flow cannot be returned to the storm drain at any time if pumping system failure occurs.
 - 1. Redundant pumping: suction and discharge piping and quick connect couplings to facilitate change out of pumps.
- B. Pipe and fittings: constructed of carbon steel, or fused high-density polyethylene pipe or approved equal. Fittings: quick-disconnect type.
- C. Lay flat hose: extra heavy duty, highly abrasion resistant and fitted with gasketed couplings. Hose rating: 150 percent of working pressure.
- D. Provide a temporary enclosure for the bypass pumping system for sound attenuation operating outside of regular working hours meeting state and local Laws and Regulations for noise requirements.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Submit bypass plan to Engineer prior to implementation of such Work and prior to the start of construction.
- B. Adequately bypass flow around the affected section of the Work, even instantaneous peak flows, without damage or overflow. Be aware of potential large instantaneous flow contributors connected to the storm drain under repair.
 - 1. Bypass storm drain pumping: a typical manhole to manhole or catch basin to manhole bypass pumping setup.
- C. Allow for passage of traffic. Protect bypass piping at driveway and street crossings.
- D. Maintain roadway drainage system during precipitation events to prevent flooding of public right-of-way and adjacent properties.

1. Protect against surcharging of the existing system upstream during dry weather and wet weather flows.
 2. Protect Site from flooding. Provide measures to adequately isolate the Site from backflow of adjacent waterways to provide dry working conditions.
- E. Continuously monitor bypass operations regardless of duration or timing of bypassing.
- F. Coordinate bypassing with low-flow times, to the extent feasible. Ensure no overflows or backups occur.
- G. Temporary damming of waterways is not allowed.
- H. If it is determined that bypass pumping is not required at a location due to lack of flow or that a Work item does not require bypass pumping to be performed, and Engineer agrees, protect flows from construction debris and ensure that no debris enters the storm drain system.
- I. Restore normal service to entire system at the end of normal working hours every day or post an attendant on Site.
- J. Repair damage that occurs to existing pipes and structures to the satisfaction of Engineer.

3.02 FLOW DATA

- A. Active storm drains exist in the entire Project area and flows and flow data are variable depending on location, weather conditions and tides. Visiting areas of the Site prior to Work to visually inspect flow conditions is encouraged.
- B. Maintain flows as specified under all flow conditions.
1. Portions of the Project area are subject to tidal infiltration and inflow. Account for tide elevations, tide cycles, and tidal I/I volume in the planning and conduct of the Work.
 2. Portions of the Project area are subject to groundwater inflow. Account for groundwater infiltration in the planning and conducting the Work.

3.03 TEMPORARY POWER

- A. Provide fuel and/or power to run pumps associated with the bypass at no additional cost to Owner.

3.04 PIPING

- A. Lay temporary piping along the general lines of streets or roadways in a manner that causes minimum amount of disruption and is least likely to be damaged.
- B. Use temporary bituminous pavement, cold patch, or other approved material to form a ramp on each side of the pipe or depress the pipe at driveways to allow for property owners to drive over the temporary pipe as directed by Engineer.

3.05 OPERATION AND MAINTENANCE

- A. Continuously monitor bypassing operations regardless of duration or timing of bypassing. Unattended bypass pumping is prohibited.
- B. Arrange for bypass pumping past working hours with Engineer and provide adequate sound attenuation and an attendant.

3.06 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.07 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 01 57 05

TEMPORARY DEWATERING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Design, furnish, install, maintain, operate and remove temporary construction dewatering systems as required to control groundwater levels during construction; dispose of pumped water; constructing, maintaining, observing, and, removing equipment and instrumentation for control of the system except where indicated or required to remain in place.
2. Furnish, install, operate, and maintain dewatering equipment and systems as required to provide stable subgrades and dry excavations, including but not limited to construction dewatering at typical open-trench excavations along the drainage pipe alignments and associated drainage structures

B. Related Requirements

1. Section 31 09 00 – Geotechnical Instrumentation and Monitoring

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Order of Conditions
2. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1. Coordinate dewatering work with trenching operations, support of excavation systems, excavation, and geotechnical instrumentation operations, as necessary.

2. Coordinate operation of dewatering systems with geotechnical instrumentation Installer to allow for adequate movement monitoring of adjacent ground, utilities and structures.
- B. Conduct Pre-Installation Conference at Project Site at least 30 days prior to start of dewatering activities.
1. At a minimum, pre-installation conference shall be attended by Owner, Engineer, Contractor's Superintendent, support of excavation Installer, geotechnical instrumentation Installer, and dewatering Installer.
 2. Verify availability of dewatering Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
 4. Review geotechnical reports.
 5. Review proposed site clearing and excavations. Confirm coordination with earth support system, geotechnical instrumental monitoring, and trench excavation activities.
 6. Review requirements for observation, testing, and monitoring of dewatering system.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Approved NPDES Dewatering General Permit (DGP)
- C. Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions
- D. Qualifications for Installer and designer
- E. Dewatering Plan
 1. Submit plan prepared, signed, and sealed by a qualified designer registered in the location of the Project at least 45 calendar days prior to commencement of dewatering Work.
 2. Minimum contents of Dewatering Plan
 - a. Design calculations and analysis data demonstrating adequacy of proposed dewatering system and compliance with performance

requirements specified. Include calculations to estimate quantity of discharge. Include calculations addressing excavation base stability and uplift.

- b. Local Best Management Practices (BMP) for dewatering system conditions
 - c. Plans, elevations, sections, and details
 - d. Arrangement, locations, and details of sumps, well points, deep wells, ditches; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water
 - e. Location of discharge points and method for conveying effluent
 - f. Complete description of equipment and materials, and sequencing for installation, operation, and maintenance in relation to sequence of excavation and backfilling and grouting work
 - g. Methods to be used for drilling, construction, and development of dewatering wells
 - h. Number, location, and screened depths of proposed piezometers and flow-measuring devices for monitoring performance of dewatering system. Install piezometers at locations shown on the Drawings or as specified in Dewatering Plan. Minimum number of groundwater observation wells to install are specified but additional wells may be required by Owner.
 - i. Standby equipment and standby power supply with contingency plan for loss of power to dewatering system
 - j. Proposed locations of points of effluent treatment equipment, effluent flow equalization tanks, if any, and discharge of water
 - k. Discharge metering and reading schedules and details of settling tank and oil/water separator.
 - l. Forms proposed for use during inspection and monitoring of dewatering system
- F. Treatment System Plan
- 1. Submit Treatment System Plan prepared, signed, and sealed, by a qualified designer registered in the location of the Project.
 - 2. Provide treatment system design and operating plan capable of meeting permit requirements (including NPDES DGP) prior to system installation and start-up which includes the following.
 - a. Layout drawings and Site location plan including equipment sizes and capacities

- b. Operating plan including monitoring and maintenance schedule, screening and sampling program, and reporting schedule meeting the sampling requirements of the NPDES DGP
 - c. Name of DEP-certified laboratory to analyze dewatering influent and effluent samples in accordance with the NPDES DGP
 - d. Type of flow meter to measure volume of treated water discharged from the Treatment System including calibration plan and methods
- 3. Treatment system discharge flow meter calibration records and flow readings
 - 4. Laboratory results of dewatering influent and effluent samples
- G. Field Quality Control
- 1. Average flow rate and time of operation of each pump used in dewatering system on a daily basis during period dewatering system is in operation on form approved by the Engineer
 - 2. Volume stored in frac tanks and volume disposed
 - 3. Reports of observations, field reports, including flow rate and groundwater level monitoring and daily field observation/inspection reports
- H. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
- 1. Locations and depths of decommissioned wells and well points and other abandoned-in-place dewatering equipment

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications
 - 1. Installer: specialized in dewatering work continuously for minimum 5 years in similar subsurface conditions.
 - 2. Designer: registered professional civil/geotechnical engineer with minimum 5 years' experience who has successfully designed dewatering systems in similar conditions.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements
 - 1. Review geotechnical and subsurface information provided with Contract Documents.
 - 2. Determine if additional test borings are required and conduct other exploratory operations necessary for dewatering according to performance requirements.
 - 3. Jointly inspect the Site with dewatering Installer, Owner and Engineer to observe and document preconstruction condition of the Site, existing structures, and facilities prior to start of any construction activity.

PART 2 – PRODUCTS

2.01 DEWATERING SYSTEM DESIGN

- A. Design and furnish dewatering system of sufficient scope, size, and capacity to control groundwater levels and to lower, control, remove, treat, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Design dewatering system(s), including comprehensive engineering analysis by a qualified professional engineer, licensed in the state where the Project is located, using performance requirements and criteria indicated.
 - 2. Design dewatering system to:
 - a. maintain groundwater levels inside excavations at a minimum of 2 feet below bottom of excavation and groundwater drawdown at a distance of 15 feet outside excavation limited to no more than 5 feet;
 - b. effectively reducing hydrostatic pressure below excavation subgrade in existing fills, organic peat, organic and inorganic silts/clays and sands and gravel, so that all excavation bottoms are firm and dry and a factor of safety of at least 1.2 is maintained against uplift; and
 - c. be capable of maintaining a dry and stable subgrade until structures, pipes, appurtenances, and drainage pipe and structure bedding to be built therein have been completed to the extent that structures, pipes, and appurtenances will not be floated or otherwise damaged.
 - 3. Basis of design

- a. Base design on existing groundwater levels measured at the Site as reported in geotechnical and subsurface information. Use piezometers installed as part of the geotechnical instrumentation program to confirm groundwater elevation prior to start of excavation.
 - b. Soil permeability values across the Project are highly variable. Reduce the extent of dewatering by installing a temporary cutoff such as steel sheet piling.
 - c. On-Site recharge of dewatering effluent is preferred method for disposal. Review available geotechnical and subsurface information to identify those areas where presence of low permeability soils may require storage in sedimentation tanks and/or transport of dewatering effluent more than 100 feet from buildings.
 - d. Locate groundwater control facilities where they will not interfere with Work or work of other contracts.
 - e. Provide for prevention of surface water from entering excavations by grading, dikes, or other means.
 - f. Provide for dewatering without damaging adjacent streets, utilities, existing buildings, structures, and site improvements adjacent to excavation.
 - g. Provide back-up equipment for the Dewatering System with a minimum capacity equal to the primary equipment and ensure System is available in operating condition at all times. Provide electrically operated dewatering equipment, powered with independent generators adequately sized to operate dewatering system and capable of running on commercial power. Provide standby equipment independent of commercial power and provide for dewatering within 24 hours upon primary pump or power failure.
 - h. Provide materials and equipment adhering to accepted industry standards, in good operating condition and able to perform satisfactorily over required duration of construction dewatering, including pipes, well screens, filter sand, grout, pumps, meters, and controls.
- B. Provide all units and equipment in accordance with approved Dewatering Plan.
- C. Provide dewatering equipment with noise attenuation systems capable of meeting governing noise regulation requirements.

2.02 TREATMENT SYSTEM

- A. Provide units and equipment in accordance with approved Treatment System Plan.
- B. Include properly sized and designed fractionation tank(s) with a bag filtration system.
- C. Provide additional storage units to handle quantities of water in excess of treatment system capacity to allow Work to proceed without interruption.
- D. Provide flow meter at discharge locations to allow accurate measurement of flow rate and cumulative flow volume.

2.03 MONITORING

- A. Provide piezometers as specified in Section 31 09 00.

2.04 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Obtain necessary regulatory approvals and permits for operation of dewatering system and disposal of dewatering flows, including, among others, approval by under NPDES program for construction dewatering activities. Prepare and obtain the NPDES DGP.
- B. Maintain dewatering operations to ensure erosion control, stability of excavations, prevention of uplift, prevention of flooding in excavation, and prevention of damage to subgrades and adjacent structures. Make modifications to dewatering system and/or operations as directed should required performance not be met.
- C. Do not perform Work below pre-construction groundwater level during dewatering system failure.
- D. Do not use dewatering pumps on Site without factory installed sound attenuating equipment.
- E. Perform Work in accordance with approved Dewatering Plan.
- F. Coordinate sequence of installation with Work for support of excavation system and grouting.
- G. Continuously monitor groundwater levels inside and outside excavation.

3.02 INSTALLATION

- A. Install, test, operate, monitor, and maintain dewatering system to control groundwater levels and lower, control, remove, treat, and dispose of groundwater.
 - 1. Maintain groundwater levels inside excavation a minimum of 2 feet below bottom of excavation. Limit groundwater drawdown at a distance of 15 feet outside excavation to no more than 5 feet. Continuously monitor groundwater levels inside and outside excavation.
 - 2. Reduce hydrostatic pressure below excavation subgrade in existing fills, organic peat, organic and inorganic silts and clays, and sands and gravel, so excavation bottoms are firm and dry and maintain safety factor of at least 1.2 against uplift.
 - 3. Maintain dewatering operations to ensure erosion control, stability of excavations, prevention of uplift, flooding in excavation, and damage to subgrades and adjacent structures. Prevent surface water from entering excavations.
 - 4. On-Site recharge of dewatering effluent is preferred method for disposal. Review available subsurface information to identify areas where presence of low permeability soils may require storage in sedimentation tanks or transport of dewatering effluent. Do not dispose of effluent within 100 feet of buildings.
 - 5. Accomplish dewatering without damaging adjacent streets, utilities, existing buildings, structures, and Site improvements adjacent to excavation.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- C. Install dewatering system within limit of Work. Minimize interference with roads, streets, walks, and other adjacent occupied and used facilities. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

- D. Provide temporary grading to facilitate dewatering and control of surface water.
- E. Install dewatering system utilizing sumps, wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material, valves, appurtenances, water disposal, and surface-water controls as indicated on approved Dewatering Plan.
 - 1. Space sumps, well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent loss of fine sands or silts during dewatering activity.
- F. Provide system to lower and control groundwater to permit excavation and construction in the dry for open-cut excavation and excavation inside sheeting. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of carrying pipes and casings.
- G. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- H. Provide standby equipment on site, installed, and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged utilities, structures, foundation soils, and other facilities.
- I. Be prepared to modify dewatering system and methods as required by actual field conditions encountered during construction.
- J. Provide standby equipment and power supply for maintaining uninterrupted construction dewatering.
- K. Install, measure, record, and report water levels at vibrating wire piezometers.
- L. Monitor quality of discharge from dewatering system to determine if soil particles are being removed from the system.
- M. Take measures to prevent damage to adjacent buildings, structures, utility lines, and work resulting from groundwater pumping.
- N. Modify system if, after installation and while in operation, it causes or threatens to cause damage to existing buildings, structures, utilities, or facilities.
- O. Repair damage, disruption, or interference resulting directly or indirectly from dewatering operations as approved by its Engineer.

3.03 OPERATIONS

- A. Operate system continuously until proposed construction is complete and backfill materials have been placed or until dewatering is no longer required in accordance with City of Salem and permits requirements or as indicated by Engineer.
- B. Monitor dewatering systems continuously.
- C. Promptly repair damages to adjacent facilities caused by dewatering.
- D. Operate system to lower and control groundwater to permit excavation, construction of structures, and placement of backfill materials on dry subgrades.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Maintain groundwater water levels a minimum of 24 in. below bottom of excavation, inside excavation.
 - 3. Limit groundwater drawdown outside excavation to no more than 5 feet from preconstruction levels at a distance of 15 feet from excavation.
- E. Maintain a sufficient volume of water in frac tanks to prevent oil, if present, from exiting frac tank. Take steps to remediate oil released from frac tanks.
- F. Furnish, install, operate, maintain, and remove necessary equipment to perform pH adjustments if required to meet pH discharge limits required under the NPDES DGP.
- G. Sample and analyze dewatering influent and effluent to meet system maintenance requirements and the NPDES DGP requirements.
- H. Meet standards and requirements of the NPDES DGP.
- I. Include any other items incidental to placement on Site, operation, maintenance, disconnection, dismantling, and removal of the Treatment System.
- J. Report any sign of subgrade disturbance due to seepage or unaccountable change in effluent flow rate to the Engineer and steps immediately taken to correct condition.
- K. Implement additional treatment and different permits if a sheen or oil is observed in dewatering effluent.
- L. Legally dispose of water removed by dewatering to avoid endangering public health, property, and portions of Work under construction or completed and avoid inconvenience to others and dispose of sediment off Site at an appropriate disposal site.

3.04 MONITORING

- A. Install an adequate number of observation wells to monitor dewatering operations for duration of the Work.
- B. Install piezometers as specified in Section 31 09 00, take measurements, and maintain at least minimum number indicated in approved submittals. Provide additional piezometers or observation wells if required by authorities having jurisdiction. Collect pore pressure data from piezometers on a daily basis during dewatering activities.
- C. Provide continual observation to ensure that subsurface soils are not being removed by dewatering operations.

3.05 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

3.06 DECOMMISSIONING

- A. Remove dewatering system from Project Site upon completion of dewatering.
- B. Remove piezometers and fill well holes with sand-cement grout and cut off wells a minimum of 24 inches below finished grade or as directed by the Engineer.

3.07 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.08 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 01 57 13

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide and maintain devices to control erosion, siltation, sedimentation, and dust that occur during construction operations, as may be shown on Drawings, and in accordance with this Section and applicable reference standards listed in Article 1.03
- B. Related Requirements
 - 1. Section 01 15 30 – Payment and Administrative Procedures and Quality Requirements
 - 2. Division 31 Earthwork, all Sections.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. Massachusetts Executive Office of Environmental Affairs, Massachusetts Erosion & Sedimentation Control Guidelines for Urban and Suburban Areas
 - 2. Order of Conditions
 - 3. MassDOT Standard Specifications and Supplements and Construction Details
 - a. M6.04.2 Straw Mulch
 - b. 767 Mulching; Seed for Erosion Control
 - 4. U.S. Composting Council (USCC)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1. Prior to commencement of any activity on-Site, arrange and attend preconstruction on-Site conference with the Conservation Agent and/or a member of the Conservation Commission in accordance with Section 01 15 30.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 1. Siltation Fence
 2. Erosion Control Mulch Sock/Tube
 3. Temporary Erosion Control Matting
 4. Siltation Control Devices
- C. Erosion and sediment control plan prior to the start of construction
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Conform to all requirements of applicable federal, state and local permits, including the “Erosion and Sedimentation Control Details”, and the local Conservation Commission.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Composting materials: provided with a Certificate of Compliance from an STA Program Certified Laboratory, verifying that the compost meets the parameters listed herein and certification not older than 90 days.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Acceptable level of quality for siltation fence: equivalent to Mirafi Environfence or Amoco 1380 Silt Stop.

- B. Mulch Sock/Compost Filter Tube: type and use as specified by the Massachusetts Erosion & Sedimentation Control Guidelines for Urban and Suburban Areas.
1. Long fibered hay, grass mowing's, or straw, in dry condition and which are relatively free of weeds and foreign matter detrimental to plant life.
 2. Mulch binder: asphalt emulsion mulch binder of type acceptable to the Engineer.
 3. Mulch netting: plastic or nylon mesh netting with approximate openings of 1/8 inch; or other netting approved by the Engineer.
 4. Color: orange or orange striped for visibility.
 5. Tensile strength: minimum 202 psi per ASTM D5035 with ultra-violet exposure resistance of 100 percent at 1,000 hours per ASTM G155.
 6. Stakes for installing compost filter tubes: 1-1/2 inches square hard wood stakes, trimmed to a blunt end.
 7. Compost fill material for the compost filter tube: certified though the USCC's Seal of Testing Assurance (STA) Program and not derived from agricultural, food, or industrial residues; bio-solids (treated sewerage sludge); yard clippings; source-separated or mixed solid waste, free from man-made foreign matter, and without objectionable odors.

C. Seeding

1. Select seed variety and applied rates based upon the date of application per the following table. Equivalent seed mixture based on suitability for use in controlling erosion of the various soil types and slopes may be used as approved by the Engineer.

Dates	Seed	Applied Rate (pounds per 1,000 feet ²)
4/1 to 7/1 8/15 to 9/15	Oats	1.8
4/1 to 7/1	Annual Ryegrass	0.9
5/15 to 8/15	Sundangrass	0.9
9/15 to 10/15	Winter Ryegrass	2.6

- D. Sod: grown from certified seed of adapted varieties to produce high quality sod free of any serious thatch, weeds, insects, diseases and other pest problem, be at least 1-year-old and not older than 3 years, and cut with a 1/2 inch to 1-inch layer of soil.
- E. Drains: Flexible drains consisting of collapsible neoprene pipe, minimum 8-inch diameter.

- F. Stone check dam: aggregate consisting of hard, durable rock, sieve analysis by weight.

Sieve Size	Percent Passing by Weight
6 inch	90 - 100
1.5 inch	0 - 40
No. 4	0 - 5

- G. Hay Bales: rectangular shaped bales of hay or straw weighing at least 40 pounds per bale, free from noxious weed seeds and rough or woody materials.

- H. Siltation Control Devices

1. Dirtbag® or Engineer approved equivalent, to be used on the discharge of any excavation dewatering setup.
2. Inlet Protection (Silt Sack) Acceptable Manufacturers
 - a. ACF Environmental, Wilmington, MA
 - b. Atlantic Construction Fabrics, Inc., Richmond VA
 - c. ESS Brothers & Sons Inc., Loretto, MN
 - d. Bowhead Manufacturing Company, Seattle, WA
3. Material: woven polypropylene geotextile material with built-in high-flow relief systems (overflow weirs). Manufacture for a 24 inch by 24 inch opening under regular flow conditions and to fit the catch basin or drop inlet to which it is to be installed with capability of being removed, emptied and reinstalled.

- I. Silt Curtain: manufactured for regular flow conditions and to fit the brook section which it is to be installed.

Parameters	Values
Floatation Element	Cylindrical, internal closed cell foam
Floatation Cover	PVC coated polyester
Ballast	5/16 in galvanized chain 1.1 lbs/ft
End Connectors	Grommeted end/tow plates and lacing grommets
Skirt Material	
Weight	6.2 oz/yd ²
Tensile Strength	390-280 lb
Elongation Break	25 %
Mullen Burst	530 psi
Puncture Strength	140 lb
Tear Strength	100-80 lb
Eos US Std Sieve	210 μ 70 μ

J. Erosion Control Blanket

1. Provide erosion control blanket for slope stabilization as shown on the Drawings or as directed by the Engineer in accordance with this Specification and in compliance with the Order of Conditions.
2. Provide with soft pine wood wedges and stakes of entirely of biodegradable materials as recommended by the manufacturer.
3. Erosion control blanket (coir log): coconut fiber mats woven into a matrix complying with the following.

PROPERTY	Test Method	Parameter
Weight	ASTM D 3776	17.8 oz/SY (600 g/m ²)
Wide width tensile strength Wet Machine direction Cross direction	ASTM D 4595	910 lbs/ft (13.3 kN/m) 870 lbs/foot (12.7 kN/m)
Wide width tensile strength Dry Machine direction Cross direction	ASTM D 4595	1130 lbs/foot (16.5 kN/m) 1040 lbs/foot (15.2 kN/m)
Elongation at failure Wet Machine direction Cross direction	ASTM D 4595	32 percent 26 percent
Open area	Calculated	58 percent
Thickness	ASTM D 177	0.35 inch (9 mm)
Recommended shear stress		4 lbs./sq. ft. (192 N/sq.m.)
Recommended flow		10 fps (3 m/s)
Recommend slope		2:1

- K. Straw mulch: MassDOT M6.04.2, long fibered straw, 100 percent certified weed free, free from foreign matter detrimental to plant life, and in dry condition.
- L. Tackifier: biodegradable and non-toxic bonding adhesive agent during hydraulic seeding or straw mulching to minimize wind and water effects.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Undertake reasonable precaution to avoid erosion of soil and to prevent silting of drainage ditches, storm sewers, rivers, streams, and lakes.
- B. Plan and execute construction using methods to control surface drainage from cuts and fills, from borrow and waste disposal areas and prevent erosion and sedimentation. Coordinate temporary erosion controls with permanent erosion controls to the extent practical.
- C. Employ pollution prevention measures, erosion and sedimentation control, before, during and after soils are exposed. Prior to soil disturbance or soil storage, ensure measures are in place before activity occurs. Employ additional measures as the Work progresses. Implement and maintain erosion and sedimentation control measures as necessary until the site is permanently stabilized.
- D. Provide measures to control dust caused whether on or off the Project Site.
- E. Keep exposure of soils on embankments, excavations, and graded areas to as short a duration as possible. Initiate mulching, seeding and other temporary erosion control practices as specified.
- F. Install erosion control measures in any ditch, swale or channel before runoff is allowed to flow to the waterway.
- G. Dewater trench to install materials in the dry.
- H. Contain water pumped from trenches and excavations. Do not discharge trench dewatering and pipe dewatering to the waterway.
- I. Employ the use of siltation control devices at all times to prevent runoff from entering waterway.
- J. Stabilize disturbed areas with temporary and permanent erosion control practices as soon as practicable, but no more than 14 days after construction activity on a particular portion of the Site has temporarily or permanently ceased except where

construction activities will resume on the particular portion of the Site within 21 days; and where snow cover precludes initiation of stabilization measures.

- K. Perform inspections of disturbed soil areas, material storage areas exposed to precipitation, and erosion control measures with Engineer a minimum of once every 14 days and also within 24 hours after any storm event greater than 0.5-inches of rainfall. Immediately correct deficiencies in the erosion control measures identified or indicated by failures or erosion by implementing additional measures or different techniques to correct and prevent subsequent erosion at no additional cost to Owner.
- L. Control dust in accordance with Division 01 General Requirements. Utilize the application of sprinkled water and calcium chloride to reduce the emission of air-borne soil particulates from the Site.

3.02 PREPARATION

- A. Temporary Erosion Control Blanket
 - 1. Conform to grades and cross sections for slopes and ditches shown on the Drawings.
 - 2. Finish to a smooth and even condition with all debris, roots, stones, and lumps raked out and removed.
 - 3. Apply seed prior to placement unless otherwise directed.
 - 4. Dewater trenches and swales to install materials in the dry.

3.03 INSTALLATION

- A. Siltation Fence
 - 1. Construct as shown on Drawings. Install parallel to contours where possible, prior to site clearing and grading activities.
 - 2. Bury lower edge of fabric at least 6 inches below ground surface to prevent underflow.
 - 3. Curve ends of fence uphill to prevent flow around ends.
 - 4. Inspect frequently; repair or replace any damaged sections.
 - 5. Remove fence only when adequate grass catch has been established.
- B. Mulch Sock/Tube

1. Install compost filter tubes, also referred to as sedimentation barriers consisting of a 9-inch diameter filter tube filled with approved mulch and compost materials.
2. Undertake immediately after each area has been properly prepared.
3. Fill sedimentation barriers by truck mounted blowers with an adequate volume of material to provide a firm barrier that slumps not more than 20 percent of the height measured in place. Fill tubes of compost on or off Site. Place, fill and stake tubes in place to ensure stability against water flows and tamp to ensure good contact with soil.
4. Hay mulch should cover the ground enough to shade it, but should not be so thick that a person standing cannot see ground through the mulch.
5. Remove matted mulch or bunches.
6. Install sedimentation barriers in the locations shown on Drawings and as directed by Engineer. Install in continuous lengths not to exceed 100 feet. Shorter lengths may be used as needed to finish a line of barrier, but not be shorter than 10 feet.
7. Overlap barrier sections not less than 2 feet at section ends, with the ends pressed firmly together. Stake section ends with the fabric ends tied off.
8. Drive stakes into the existing grade not less than 1 foot, spaced minimum of 8 feet on center. Provide additional stakes as needed for the ends of each section and for overlapping sections.

C. Erosion Control Blanket (Matting)

1. Install erosion control blanket and straw mulch in accordance with manufacturer's instructions and the following where shown on Drawings or as directed by Engineer. Submit manufacturer's instructions to Engineer prior to installation. Place immediately following seeding.
2. Install an erosion control blanket onto slopes that have been graded, seeded, completed to required line and where grades are steeper than or equal to 3:1 as shown on the Drawings and directed by Engineer.
3. Place strips lengthwise in the direction of the flow of water.
4. Overlap ends at least 6 inches in a shingle fashion.
5. Turn down up-slope end of each strip of the matting and bury to a depth of not less than 6 inches with the soil firmly tamped against it.
6. Engineer may require that any other edge exposed to more than normal flow of water be buried in a similar manner.

7. Build check slots at right angles to the direction of the flow of water. Space so that one check slot or one end occurs within each 50 feet of slope length. Construct by placing a tight fold of the matting at least 6 inches vertically into the ground, and tamp the same as up-slope ends.
 8. When ordered, spread additional seed over matting, particularly at those locations disturbed by building the slots. Press matting onto the ground with a light lawn roller or by other satisfactory means.
 9. Use pine wedges to fasten coir to ground. Do not use metal staples. Pound vertically flush to the surrounding surface and shall not protrude above finished grade. Place pine wedges in the same locations as manufacturer recommended staple locations.
 10. On grades 4:1 or steeper, place pine wedges in the same 3 rows, but spaced 2 feet apart.
 11. On overlapping or butting edges, double the number of pine wedges, with the spacing halved; secure ends of matting and required check slots spaced every foot.
 12. In combination with the erosion control blanket, apply weed free straw mulch on side slopes steeper than 3:1.
 13. Place mulch according to MassDOT 767. Do not use short fibered material or material which is so wet or decayed that it cannot be properly spread. Apply tackifier as needed.
- D. Sod
1. Lay sod strips on the prepared soil, perpendicular to the slope or direction of water flow, starting at the lowest elevation. Butt the edges and ends of the sod strips together and tamp or roll. Stagger joints.
 2. Staple sod strips at ends and at 3-foot intervals along the center of the strip.
 3. Irrigate sodded area immediately after installation.
- E. Temporary Seeding
1. Seed with appropriate seeds and application rates specified in the table in Part 2 of this Section. Sow seed at the rate indicated, on the pure live seed basis.
 2. Mulch areas where temporary seeding has been applied. Do not mulch seeded areas where matting will be immediately installed.

3. If temporary seeding does not achieve adequate growth by November 1, apply an additional layer of mulch at that time.
- F. Topsoil Storage
1. Place topsoil which is stockpiled on the site for use in loam applications out of natural drainages, in 8-foot-high piles which have side slopes of 50 percent to 70 percent.
 2. Install siltation fence around the base of the pile to prevent eroding soil from washing into drainages.
 3. Cover any topsoil piles which are to remain for a period of 21 days or more with temporary seed and mulch immediately following stockpiling.
- G. Store Check Dam
1. Place in locations indicated on Drawings or as ordered to provide for temporary control of erosion and sedimentation.
 2. Install as directed by the local Conservation Commission and Engineer.
- H. Hay Bales
1. Place as ordered to provide for temporary control of erosion, and in ditches at 100 foot minimum intervals.
 2. Install as shown on Drawings, and stake with required stakes.
- I. Siltation Control Devices – Silt Sacks
1. Install in accordance with the Drawings and manufacturer's instructions. Install Inlet Protection (Silt Sacks) in catch basins and as required by the Engineer.
 2. Keep silt sacks in place until the placement of the pavement overlay or top course and the graded areas have become permanently stabilized by vegetative growth.
 3. Install prior to commencement of any excavation including but not limited to, cold planning, pavement reclamation, or unclassified excavation.

J. Silt Curtain

1. Install silt curtain filter material in accordance with the Drawings and prior to commencement of any excavation including but not limited to, cold planning, pavement reclamation, or unclassified excavation.
2. Keep silt curtain in place until removal is approved by the Engineer in accordance with water quality monitoring.

3.04 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Site/Field Tests and Inspections
 1. Inspect erosion control practices immediately after each rainfall and at least daily during prolonged rainfall or snowmelt for damage. Make appropriate repairs or replacement at no additional cost to the Owner, until acceptance by Engineer.

3.05 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.
- B. Remove temporary materials and devices when permanent soil stabilization has been achieved. Re-use materials in good condition if approved by the Engineer.
- C. Remove filter fabric from the Site at completion of the Project.
- D. Remove sedimentation barrier including removal of sediment accumulated at the barrier line, stakes and the barrier and the compost fill. Do not remove before a major storm event or as directed by Engineer. Finish final grade below and around the sedimentation barrier to the match the existing grade.
- E. Level and grade to the extent required to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.
- F. Remove unsuitable materials from Site and dispose of in a lawful manner.

3.06 MAINTENANCE

- A. Maintain areas mulched or matted, at no additional cost to the Owner, until Project acceptance.
- B. Maintain detention basins by removing silt that reaches a depth of over 1 foot, at no additional cost to the Owner, until Project acceptance.

- C. Maintain sedimentation barrier and periodically inspect barrier lines during construction. Remove accumulated sediment higher than 1/2 the height of the barrier, or before a major storm event and as directed by the Engineer.
- D. Remove silt from siltation fence when it has reached one-half the fence height, or prior to expected heavy runoff or siltation.
- E. Repair matting if any pine anchors become loosened or raised, or if any matting becomes loose, torn, or undermined, make satisfactory repairs immediately.
- F. Inspect filter tubes after each rainfall and at least daily during prolonged rainfall. Immediately correct deficiencies, including, but not limited, to washout, overtopping, clogging due to sediment, and erosion. Review location of tubes in areas where construction activity causes drainage runoff to ensure that the tubes are properly located for effectiveness. Maintain the functional integrity of filter tubes in sound condition at all times. Where deficiencies exist, such as overtopping or wash-out, install additional staking or compost material as directed by the Engineer. Remove sediment deposits as necessary to maintain the filters in working condition. Repair or replace filter tubes that are decomposing, cut, or otherwise compromised.
- G. Inspect condition of silt sacks after each rainstorm and during major rain events and clean periodically to remove accumulated sediment and debris. Handle and dispose of debris accumulated in silt sacks. Repair or replace damaged silt sacks.
- H. Periodically inspect and empty the silt curtain and as directed. Dispose of removed material off Site. Inspect the condition of silt curtain after each rainstorm and during major rain events. Repair and replace damaged silt curtain at no additional cost to Owner.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section specifies general requirements for products, materials and equipment and applies to all Specifications and Drawings.
 - 1. Provisions of this Section may be supplemented in individual Specification sections.
- B. Section Includes
 - 1.02 SOURCE QUALITY CONTROL
 - General
 - Independent Testing Agency Certification
 - Factory Testing
 - 1.03 PRODUCT REQUIREMENTS
 - General
 - Transportation and Handling
 - Storage and Protection
 - 1.04 WARRANTIES

1.02 SOURCE QUALITY CONTROL

- A. General
 - 1. Subject material and equipment furnished under the Contract Documents to a complete factory testing program as specified.
 - 2. Shop Drawings and submittals: reviewed by Engineer before initiating testing program.
 - 3. Perform checks and tests in accordance with manufacturer's recommendations and referenced standards.
 - 4. Evaluate test results and advise Owner immediately of any discrepancy between test results and test limits or the failure of any device or system under test. Include test limits for acceptability applicable to each test on the certified test records.
 - 5. Record test information, including the evaluation of testing results, on forms approved by Owner and Engineer.

B. Independent Testing Agency Certification

1. If specified, furnish certificates from an independent testing agency.
2. Independent testing agency to certify that material and equipment components have been examined and tested and are in conformance with the requirements specified in the Contract Documents.
3. Take Samples in accordance with the requirements specified in the Contract Documents, as selected by Owner or independent testing agency. Furnish and ship at no additional cost to Owner.

C. Factory Testing

1. Provide 14 days prior written notice of factory inspections and tests to Owner and Engineer.
2. If failure to give proper written notice results in material and equipment being assembled or covered before a factory inspection or test, make material and equipment ready for inspection or test and reassemble or recover at no additional cost to Owner.
3. Owner may inspect any portion of material and equipment furnished at any reasonable time during manufacture and may witness testing of any portion of material and equipment wherever located. Owner and Engineer to witness tests only.
4. Furnish, set up and operate test equipment and facilities.
5. If facilities for conducting required tests are unavailable to the manufacturer, conduct tests elsewhere or have them performed by an independent agency approved by Owner.
6. Protect material and equipment after testing and checking to provide that subsequent testing of other equipment or systems does not disturb, damage or otherwise interfere with functional capability of material and equipment.
7. Assume responsibility for protection of material and equipment and safety of all personnel during factory testing program.
8. Grounds for rejection: failure to withstand tests; failure to meet ratings; failure to meet applicable standards.

9. In the event of failure
 - a. Submit revisions of documents requiring approval for changes required for rectification.
 - b. Obtain Owner's and Engineer's approval before making such changes.
 - c. Provide written details of any changes to be made not requiring approval.
 - d. Notify Owner and Engineer in writing before retesting.
 - e. Furnish new material and equipment which meets requirements of the Specifications if rejected material and equipment cannot be rectified to satisfaction of Owner and Engineer.
 - f. Retest after rectification in presence of Owner or Engineer.
10. Assume responsibility for all costs, including, but not limited to: loss or damage to materials and equipment resulting from testing; retesting; rectification; new material and equipment to replace damaged or non-rectifiable material and equipment; removal, furnishing, transportation, unloading, and installation of replacement material and equipment; and witness of testing by Owner and Engineer including travel, lodging, meals, and payroll.
11. Submit certified test reports which define tests, list results, and are signed by Contractor's representative, and copies of raw data collected during tests. Submission of certified test reports does not relieve Contractor of responsibility for material and equipment meeting requirements of the Contract Documents after installation.

1.03 PRODUCT REQUIREMENTS

A. General

1. Products include new material and equipment incorporated into the Work and may also include existing material and equipment required for reuse. This does not include machinery and equipment used for preparation, fabrication, conveying, installation and erection of the Work.
2. Do not use materials and equipment removed from existing Work Site, except as specifically permitted.
3. Provide complete with accessories, trim, finished, safety guards, and other devices and details need for a complete installation and for the intended use or effect.

4. Provide standard products which have been produced and used successfully on other similar projects for similar applications. Provide products which are likely to be available to Owner in the future for items required for maintenance and repair or replacement Work.
5. Furnish interchangeable components of the same manufacturer, for similar components.

B. Transportation and Handling

1. Transport and handle material and equipment in accordance with manufacturer's instructions.
2. Notify Engineer and Owner in writing upon acceptance of a shipment.
3. Promptly inspect shipments to assure that material and equipment comply with requirements, quantities are correct, and material and equipment are undamaged.
4. Furnish equipment and personnel to handle material and equipment by methods to prevent soiling, disfigurement, or damage.
5. Uncrate equipment and dispose of packing material properly.

C. Storage and Protection

1. Store and protect material and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive material and equipment in weather tight, climate controlled enclosures.
2. For exterior storage of fabricated material and equipment, place on sloped supports, above ground.
3. Provide for bonded off Site storage and protection when Site does not permit on Site storage or protection.
4. Cover material and equipment subject to deterioration with impervious sheet covering. Furnish ventilation to avoid condensation or potential degradation of material and equipment.
5. Store loose granular materials on solid flat surfaces in a well-drained area. Avoid mixing with foreign matter.
6. Furnish equipment and personnel to store material and equipment by methods to prevent soiling, disfigurement, or damage.

7. Arrange storage of material and equipment to permit access for inspection. Periodically inspect to assure material and equipment are undamaged and are maintained in acceptable conditions.
8. After receipt of material and equipment, assume responsibility for loss and damage including but not limited to breakage, corrosion, weather damage, and distortion.

1.04 WARRANTIES

- A. Provide warranties for equipment and material in accordance with Paragraphs 6.19 and 14.03 of the Standard General and Supplementary Conditions, if any.
- B. Provide extended or special warranties as indicated in individual Specification sections.

END OF SECTION

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SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section specifies general execution requirements and startup/commissioning and performance testing for closeout of the Work and applies to all Specifications and Drawings
- B. Section Includes

1.02 OVERALL EXECUTION REQUIREMENTS

- Coordination
- Existing Conditions
- Field Engineering
- Record Documents
- Cutting and Patching
- Electrolytic Corrosion Prevention
- Quality Assurance and Control of Installation
- Manufacturers' Field Services
- Independent Testing

1.03 STARTUP, TESTING, AND COMMISSIONING

- Spare Parts

1.02 OVERALL EXECUTION REQUIREMENTS

A. Coordination

1. Conduct preconstruction and pre-installation meetings before commencing certain Work that requires coordination or has special requirements or approvals.
 - a. Prior to the commencement of any activity on this Site, participate in a Pre-Construction Meeting with the Conservation Agent and/or a member of the Conservation Commission to ensure that the requirements of the Order of Conditions are understood. The staked erosion control line shall be adjusted, if necessary, during the pre-construction meeting. Please contact the Conservation Agent at (978) 619-5685 at least 48 hours prior to construction to arrange for the Pre-Construction Meeting.
 - b. Coordinate Work such that Work is completed with minimum disruption to Salem State University activities.
 - c. Should a direct connection from a catch basin to the sewer system be identified during prosecution of the Work, coordinate with the DPW for redirection.
2. Comply with the required Work sequence and coordination as may be specified in Summary of Work and reflect in the Project scheduling.
3. Coordinate Work such that Work is completed with minimum disruption to residents and businesses.
4. Coordinate space requirements and installation of Work. Utilize spaces efficiently to maximize accessibility for other installations, maintenance, and repairs.
5. Coordinate Work of the various Specifications with interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.
6. Coordinate related Work at the Site in accordance with Article 7 of the Standard General and Supplementary Conditions, if any.
7. Coordinate completion and cleanup of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
8. After Owner occupancy of premises, coordinate access to Site for correction of defective Work and/or incomplete Work to minimize disruption of Owner's activities.

B. Existing Conditions

1. Paragraph 4.01 of the Standard General and Supplementary Conditions, if any, covers Availability of Lands. Information identified as shown on the Drawings.
2. Paragraph 4.02 of the Standard General and Supplementary Conditions, if any, covers Subsurface and Physical Conditions. Information identified is included as an attachment to this Section in Geotechnical Reports for Project Site.
3. Pursuant to Paragraph 4.04 of the Standard General and Supplementary Conditions, if any, existence and location of Underground Facilities and other utilities and construction indicated as existing are not guaranteed. Before beginning Work investigate and verify the existence and location of Underground Facilities and other utilities and construction.
 - a. Contact DIGSAFE (www.digsafe.com) by dialing 811.
 - b. Conduct test pits and other utility research and properly restore utilities interfered with or damaged during construction at no cost to the Owner.
 - c. Engage a professional subsurface utility locator to verify the existence and location of underground utilities prior to starting Work.
4. Paragraph 4.05 of the Standard General and Supplementary Conditions, if any, covers Reference Points. Information is included on the Drawings.
5. Paragraph 4.06 of the Standard General and Supplementary Conditions, if any, covers Hazardous Environmental Conditions at Site. Information is included in the Specifications for the Project.

C. Field Engineering

1. Prior to initiating construction, engage an independent professional land surveyor registered in the state where the Project is located to provide surveys and permanent reference points for all bounds and property markers along the line of the Work that may be disturbed during construction. Submit copies of all ties to the bounds and property markers to the Engineer prior to excavation at the Site(s).
2. Maintain surveyor's log of control and other survey work. Keep log available for reference.
3. Verify layout information shown on the Drawings in relation to existing benchmarks before lay out of the Work. Locate and protect existing

benchmarks and control points. Preserve permanent reference points during construction.

4. Promptly report lost or destroyed reference points, benchmarks, or control points. Promptly report requirements to relocate reference and control points due to changes in grades. Promptly replace lost or destroyed bounds or markers and control points based on the original survey control points utilizing the services of a professional land surveyor registered in the state where the Project is located at no additional cost to Owner.
5. Athletic field related Work
 - a. Establish and be responsible for lines, elevations, and measurements of the Work including without limitation, grading, utilities, and other work. Establish subsequent lines needed to accurately layout and construct the Work.
 - b. Provide and maintain stakes, lines, benchmarks, batter boards, and other temporary working points, lines, and levels. Construct temporary working points to be permanent during construction. Remove working points when they are no longer needed.
 - c. Verify actual field dimensions and locations before ordering materials and fabricated components, and before beginning Work and report discrepancies.
 - d. Adjust work to actual field dimensions and conditions if approved by Engineer, and to ensure complete and proper interface of Work.
 - e. Perform a complete as-constructed survey in accordance with Section 01 15 30 of athletic field Work.

D. Record Documents

1. Provide Record Documents in accordance with Paragraph 6.12 of the Standard General and Supplementary Conditions, if any, and in accordance with Section 01 15 30.
2. Store Record Documents separate from documents used for construction. Record information concurrent with construction progress.
3. Legibly mark each item to record description of actual equipment and material installed and actual construction on approved submittals, including the following.
 - a. Manufacturer's name and equipment and material model and number
 - b. Material and equipment substitutions or alternates utilized
 - c. Approved changes
 - d. Measured depths of foundations
 - e. Measured horizontal and vertical locations of Underground Facilities and appurtenances, referenced to permanent surface improvements
 - f. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work
 - g. Field changes of dimension and detail
 - h. Details not on original Contract Documents or Shop Drawings

E. Cutting and Patching

1. Employ skilled and experienced personnel to perform cutting and patching.
2. Submit written request in advance of cutting or alteration which affects:
 - a. structural integrity of any element of Project;
 - b. integrity of weather exposed or moisture resistant elements;
 - c. efficiency, maintenance, or safety element;
 - d. safety, traffic, or hazard barriers;
 - e. visual qualities of sight exposed elements; and
 - f. work of Owner or separate contractor.

3. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
 - a. fit materials together, to integrate with other work;
 - b. uncover Work to install ill-timed Work;
 - c. remove and replace defective or non-conforming Work;
 - d. remove Samples of installed Work for testing when requested; and
 - e. provide openings in element of Work for penetration of mechanical and electrical work.
4. Execute Work by methods to avoid damage to other work and which will provide appropriate surfaces to receive patching and finishing.
5. Provide adequate temporary support for Work to be cut.
6. Restore Work with new materials in accordance with requirements of Contract Documents. Use materials identical with original materials where recognized that satisfactory results can be produced.
7. Provide protection from elements for areas which may be exposed by uncovering work.
8. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained adjoining Work in a manner, which will eliminate evidence of patching.
9. Identify any Hazardous Waste, Hazardous Environmental Condition, or hazardous substance exposed during the Work to Owner for decision or remedy in accordance with Paragraph 4.06 of the Standard General and Supplementary Conditions, if any.
10. Cut work by methods least likely to damage Work to be retained and work adjoining. Cut Work with sawing and grinding tools, not with hammering, chopping, or burning tools. Cut masonry and concrete materials with masonry saw or core drill. Do not use pneumatic tools without prior approval. Core drill openings through concrete Work. Adhere to mandatory cutback requirements when saw cutting concrete and roadway openings.
11. Do not cut and patch structural Work in a manner resulting in reduction of load-carrying capacity or load/ deflection ratio.

12. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Maintain supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage and seal voids. For interior work at penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire resistant material, to full thickness of the penetrated element.
13. Do not cut and patch operational or safety-related components that reduce capacities to perform in manner intended. Do not cut and patch Work that reduces visual qualities. Remove and replace unsatisfactory cutting patching as directed by Engineer or Owner.

F. Electrolytic Corrosion Prevention

1. Prevent galvanic action, bimetallic corrosion, anodic or cathodic action, and electrolysis at all electrical grounds and for all galvanic scale (electromotive series or table of oxidation potentials). Do not allow contact of dissimilar metals further apart than 0.35 on the galvanic scale (electromotive series or table of oxidation potentials). The electrode potential of common metals is listed below.

	Electrode Potential Volts (Relative to Hydrogen)
Magnesium	+2.37
Aluminum	+1.70
Zinc+	+0.76
Chromium	+0.56
Iron and Steel	+0.44
Cadmium	+0.40
Nickel	+0.25
Tin	+0.14
Lead	+0.13
Copper	-0.34

2. Unless otherwise indicated, provide dielectric insulators between ferrous and nonferrous pipe and equipment.

G. Quality Assurance and Control of Installation

1. Monitor quality control of Subcontractors, Suppliers, manufacturers, material, equipment, services, Site conditions, and workmanship, to produce Work of specified quality. Conduct field quality control and testing specified.
2. Comply fully with manufacturers' installation instructions, including each step in sequence. If manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
3. 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.
4. Perform Work using persons qualified to produce workmanship of specified quality.
5. Install field Samples and mockups at the Site as required in Specifications for review. Acceptable Samples and mockups represent a quality level for the Work. Where field Sample or mockup is specified to be removed, clear area after field Sample or mockup has been accepted by Engineer or after Work is complete when mockup is to serve as a control reference.
6. Protect adjacent construction in accordance with Paragraph 6.11 of the Standard General and Supplementary Conditions, if any.

H. Manufacturers' Field Services

1. If required in the Specifications, arrange and pay for material or equipment Suppliers or manufacturers to provide qualified staff personnel (field representative) to perform the following services and services specified. Submit reports of activities, actions taken and test results to Engineer within 10 days of completion.
 - a. Observe Site conditions, conditions of surfaces and installation, quality of workmanship.
 - b. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
 - c. Assist with field assembly as required.
 - d. Furnish, setup, and operate required test equipment and facilities.
 - e. Perform and record results of manufacturer recommended inspections and tests, and tests specified for material and equipment.

- f. Be responsible for protection of material and equipment and safety of all personnel during testing.
- g. Perform any other services normally provided by field representative's company.
- h. Instruct operating personnel in proper use of material and equipment.
- i. Instruct and supervise field repairs before acceptance by Owner.

I. Independent Testing

- 1. Employ and pay for specified services of an independent firm in accordance with Paragraph 13.03 of the Standard General and Supplementary Conditions to perform inspection and testing as may be specified except where responsibility for a specific inspection or test is expressly allocated to Owner in the Specifications or by Laws and Regulations.
- 2. Reports will be submitted by the independent firm to Owner, in duplicate indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents.
- 3. Inspection, testing, and source quality control may occur on or off the Project Site.
- 4. Cooperate with independent firm. Furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
- 5. Notify Owner and independent firm 24 hours before expected time for operations requiring services.
- 6. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.
- 7. Retesting required because of nonconformance to specified requirements will be performed by the same independent firm if instructed by Owner. Payment for retesting will be charged to Contractor by deducting inspection or testing charges from the Contract Price.
- 8. Testing or inspecting does not relieve Contractor from performing Work in accordance with requirements of the Contract Documents.

1.03 STARTUP, TESTING, AND COMMISSIONING

A. Spare Parts

1. Provide spare parts required for construction, startup, testing and commissioning of the Work prior to achievement of Substantial Completion, including spare parts for flushing and consumable supplies such as bolts, nuts, gaskets, filters, insulating tape, etc., normally consumed in the startup, commissioning and testing.
2. If spare parts are purchased by Owner, Contractor shall have the right to use the spare parts purchased by Owner provided that such spare parts are replaced prior to Substantial Completion at Contractor's expense. Replacement spare parts, replaced by Contractor, shall be new, unused and identical as the original spare part used.

1.04 ATTACHMENTS

A. Geotechnical Reports

1. Canal Street Phase II, Contract A Geotechnical Recommendations Report

B. MassDEP Chapter 91 Waterways Permit Modification

C. Forest River Park Field Investigation Report

END OF SECTION

Final Design Geotechnical Recommendations Report

Woodard and Curran

Canal Street Flood Mitigation Project: Phase II

CONTRACT A

Salem, MA



125 Nagog Park
Acton, MA 01720

Geocomp Project Number: 220721

January, 2017

Submitted to:
Woodard and Curran
40 Shattuck Rd #110
Andover, MA 01810

Submitted by:
Geocomp Consulting, Inc.
125 Nagog Park
Acton, MA 01720

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1.0 INTRODUCTION

1.1 GENERAL

This report summarizes the results of subsurface explorations, geotechnical design recommendations, and construction considerations for proposed modifications to existing gravity storm drain systems, improvements within Forest River Park, and construction of a new storm drain system for the purpose of rehabilitating the existing storm water drainage system located south of Downtown Salem. Our understanding of the project and existing conditions is based on:

- Contract A Bid Drawing set drawing set titled *City of Salem, Massachusetts, Department of Public Works, Contract A Phase II, Canal Street Flood Mitigation Project*, by Woodard and Curran, dated January, 2017
- *Preliminary Design Report: Canal Street Flood Mitigation Project* dated August 2014 and provided by Woodard and Curran
- *Preliminary Geology/Geotechnical Study: Improvements to Canal Street Storm water Infrastructure* by Geocomp dated May 2013
- *Report on Subsurface Investigations and Geotechnical Design Recommendations: Improvements to Canal Street Storm water Infrastructure* by Geocomp dated January 2013
- Technical Memorandum entitled *Salem, MA MBTA Bike Path and Drainage Line* by Geocomp, dated June 15, 2015
- Site visits by Geocomp
- Correspondence and discussions with members of the project team
- The results of subsurface exploration programs performed at the site

Elevations in this report are in feet and refer to the NAVD88 elevation base. Other elevations shown on historical information included in this report for completeness may be referenced to a different elevation datum.

1.2 SITE LOCATION AND EXISTING CONDITIONS

The project site is located in the Canal Street region in Salem, Massachusetts, just south of the downtown area. The Phase 2 project site area is bounded by an MBTA commuter rail to the west, Salem Harbor to the east, St. Paul Street to the north, and the O'Keefe center parking lot to the south. Based on historical maps of Salem, present day Canal Street is situated in the vicinity of a former inland water body called Mill Pond which contained marshy areas on its western and eastern shorelines. The former Castle Neck Hill was located at higher elevations west of the former Mill Pond. To the east of the Pond were located the present day residential developments between Salem Harbor and Mill Pond. As developable land became more scarce and valuable in the area, Mill Pond was gradually filled to raise the area site grades above the pond water level to the present elevation for construction of Canal Street and the adjacent property improvements.

Adjacent to Salem Harbor, the eastern portion of the Phase 2 site area is known as Forest River Park. Forest River Park is a recreational oceanfront park which is bounded by Salem Harbor to the east, north

and south and Forest Park Drive to the west. The park contains a baseball field, picnic areas, playgrounds, and beaches. A living history museum known as Pioneer Village which contains multiple 17th century style houses is located in the park and is fenced off from the recreational areas of the park. Bedrock outcrops exist at a number of locations within Forest River Park. The general location of the site area is shown on Figure 1.

1.3 PROPOSED IMPROVEMENTS

The City of Salem has developed a plan to manage flooding in the low-lying watershed area of Salem in the vicinity of Canal Street for the 100-year precipitation event. The project includes the proposed construction of a) new drainage system to drain the upper portions of the watershed area, b) upgrades to the existing drainage system in the upper portion of the watershed area, c) pump station and subsurface storm water storage system, and d) storm water collection discharge outfalls.

The first phase (Phase 1) of the improvements was completed in 2013 and included the installation of new catch basins, manholes and approximately 2,500 linear feet of varying diameter (18-in. to 60-in.) drainage pipes from the low point in Canal Street (between Laurel Street and St. Paul Street) to Forest Avenue and then east along Forest Avenue to the proposed subsurface storage system.

Phase 2 includes additional improvements that will consist of the installation of a 4 million gallon subgrade storm water storage tank in the parking lot adjacent to Salem State University's O'Keefe Center, the construction of a pump station in the northeast corner of the parking lot, regrading of portions of the parking lot, and a new 30 inch diameter force main running from the parking lot east along Forest Avenue and Clifton Avenue into a proposed grassed channel in Forest River Park. The grassed channel will convey the storm water eastward through the park to an existing retention pond before discharging into Salem Harbor through a proposed 2 foot by 10 foot concrete box culvert.

The original alignment of the force main was planned to extend east along Forest Avenue before turning north along Summit Avenue and then east on Ocean Avenue to a proposed outfall location at the junction of Salem harbor and Ocean Avenue. This alignment was revised.

Forest River Park is a recreational oceanfront park which is bounded by Salem Harbor to the east, north and south and Forest Park Drive to the west. The park contains a baseball field, picnic areas, playgrounds, and beaches. A living history museum known as Pioneer Village which contains multiple 17th century style houses is located in the park and is fenced off from the recreational areas of the park. Clifton Avenue, running from east to west, intersects the west side of Forest River Park. Bedrock outcrops exist at a number of locations within Forest River Park.

As part of the proposed improvements in Forest River Park, we understand that the grades of the existing baseball field and adjacent areas in Forest River Park are proposed to be raised approximately 1 to 4 feet. Beneath the baseball field, an underdrain system is proposed consisting of 1-inch by 12-inch horizontal flat drains spaced 15 feet apart conveying runoff east towards the grassed channel through 12 to 18-inch diameter, solid walled HDPE underdrain pipe.

1.4 FOCUS OF THIS REPORT

This report addresses only those Phase 2 improvements proposed under Contract A, as shown in the Contract A, Phase 2 Bid Drawings, dated January 2017 by Woodard and Curran.

Geotechnical recommendations for the planned Phase 2 improvements within the Salem State University parking lot and other improvements outside of the Contract A scope will be addressed in a future report. Geotechnical recommendations for the planned improvements adjacent to the MBTA commuter rail line and subsurface conditions in that area were discussed in a previous report entitled *Salem, MA MBTA Bike Path and Drainage Line* by Geocomp, dated June 15, 2015.

2.0 SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

2.1 SUBSURFACE EXPLORATIONS

Fifteen test borings (B-203, B-313, B-315 to B-318, and B-401 to B-409) were drilled within the Contract A area by Soil Exploration, Inc. and observed by Geocomp personnel. The test borings were performed to obtain subsurface information for developing geotechnical recommendations for the proposed improvements to be implemented in Phase 2 of the Canal Street Flood Mitigation Project. Of the borings performed within the Contract A site area, one boring (B-203) was drilled on August 21, 2013, five borings (B-313 and B-315 to B-318) were drilled between August 19 and August 22, 2014, and nine borings (B-401 to B-409) were drilled between June 8 and June 10, 2015. The test borings were drilled to depths ranging from 7 to 47 feet below existing grades. In general, the test borings were performed to observe the quality and thickness of fill materials, screen the fill for evidence of volatile organic compounds and observe for the presence of wood ash and/or coal ash, and determine the depth to sound bearing materials at each boring location. In addition to the test borings, one groundwater monitoring well (MW-325) was installed in one of the borings to monitor area water levels.

The borings were drilled with Mobile B-57 and Acker 82 truck mounted drill rigs and a CME-75 tracked drill rig using hollow stem augers and drive casing/wash boring techniques. Generally, standard penetration tests (SPT) were performed and split spoon soil samples were recovered at 5-foot depth intervals. Additionally, to aid in classification of the underlying bedrock, a rock cores was taken at one locations within the Contract A area where rock was encountered at shallow depths. Boring logs for these borings are included in Appendix A. Observations of dry/wet soil conditions were made in each test boring to aid in estimating groundwater levels at the boring locations at the time of the installation of each boring.

The fill soils were screened by Geocomp personnel for evidence of volatile organic compounds (VOCs) and for visible evidence of wood ash or coal ash. Initially, the samples were visually inspected and checked for odors by smell. A photo-ionization detector (PID) with a 10.5 eV lamp was used to screen the entire sample while in the open sampler. Where samples exhibited visible evidence of staining or streaking that did not appear to be geology-related, presented odors inconsistent with the normal soil material, or the PID screening resulted in readings above background levels, a field jar head-space analysis was conducted with the PID in accordance with procedures provided by Woodard & Curran. No soil samples exhibited elevated levels of VOCs or showed evidence of possible contamination (staining, streaking, odors, etc.).

The test boring locations, shown in Figures 2 through 13, were determined by field taping or pacing from existing site features and should be considered approximate. Ground surface elevations at the test boring locations were approximated from available topographic information included on site plans provided by Woodward & Curran.

2.2 LABORATORY TESTING

Soils samples were selected for geotechnical laboratory testing from the test borings listed above to aid in classification of the underlying stratigraphy and to obtain consolidation parameters. The testing was performed by Geotesting Express of Acton, Massachusetts. The laboratory tests performed include the following:

1. Grain Size (ASTM D 422)
2. Atterberg Limits (ASTM D4318)
3. Incremental Consolidation (ASTM D2435)

Sample IDs and depths are presented in the Table below. The data sheets from the laboratory testing are presented in Appendix B.

Boring ID	Sample	Depth (ft)	Grain Size (ASTM D422)	Atterberg Limits (ASTM D4318)	Incremental Consolidation (ASTM D2435)
B-316A	SS-2	5-7	X		
B-401	SS-1	0-2	X		
B-403	SS-3	10-12		X	
B-405	SS-2	5-7	X		
B-407	SS-4	15-17		X	
	ST-1	5-7		X	X
B-408	SS-2	5-7		X	
B-409	SS-3	10-12	X		

3.0 SUBSURFACE CONDITIONS

3.1 GENERAL

In general, the subsurface explorations conducted in the Contract A site area revealed subsurface soil and water conditions that are consistent with our local experience and understanding of the site area geology. Below are descriptions of specific subsurface conditions encountered in the Contract A site area during recent subsurface investigation programs.

3.2 FORCE MAIN AND GRAVITY LINES EXTENDING ALONG FOREST AND CLIFTON AVENUES

A total of eight borings (B-313/313A, B-315 to B-318, and B-401 to B-403) were performed to depths ranging from approximately 11.5 to 17 feet in Forest and Clifton Avenues within the Contract A work area in order to aid in the design of the force main alignment along Forest and Clifton Avenue. One additional boring (B-203) was performed to a depth of 47 feet in the northeast corner of the SSU parking lot near the intersection of Forest Avenue and Lussier Street.

All eight borings performed within Forest and Clifton Avenues revealed an approximately 6 to 8 inch surficial layer of bituminous asphalt underlain by an approximately loose to dense, 5 to 17-foot thick layer of shallow granular sands and gravels with varying amounts of silt. Boring B-313/313A, performed in the western part of Forest Ave between Canal and Lussier Street, encountered a 5-foot thick layer of soft clay (N-value of 2) with little sand under the surficial granular soils. With the exception of B-318, all borings performed east of boring B-313A along final force main alignments revealed a layer of stiff to very stiff clay underlying the bituminous asphalt and sands and gravels, with N-values ranging from 9 to 32. The top of this clay layer varied from El. 4 in Boring B-315 to El. 18 in Boring B-401.

At Boring B-318, performed near the intersection of Clifton Avenue and Summit Avenue, shallow bedrock was encountered at a depth of approximately 6.5' (approximately El. 25.5), above the design invert of the proposed force main and associated drainage structures. Significant ledge was also visible on the south side of Clifton Avenue near this intersection.

Silt or clay was not encountered in Boring B-203, performed in the northeast corner of the SSU parking lot near the intersection of Forest Avenue and Lussier Street.

3.2.1 Bedrock

Salem Gabbro-Diorite is the predominant rock found throughout the project area. It varies from fine to medium grained and is generally dark-gray to green augite-biotite-hornblende diorite and gabbro, locally with varietal quartz. There are dikes of porphyritic microgranite to the south and west of the project area. These deposits contain light colored fine to medium-grained microgranite with microperthite phenocrysts. Some of these dikes also contain glassy quartz phenocrysts.

The depth to bedrock generally decreases moving from Canal Street eastward toward Salem Harbor, with the highest bedrock elevation encountered near the intersection of Clifton Avenue and Summit Avenue, where significant rock ledge was observed. Bedrock, weathered rock, or auger/split spoon refusal was encountered in borings B-401, B-402, and B-403 which were performed near the alignment of the Force Main on the east end of Clifton Avenue. The elevation of the top of bedrock, weathered rock or auger/split

spoon refusal encountered along the alignment ranged from approximately El. 4 to El. 25.5. A 5-foot long rock core run was recovered from borings B-318, with top of rock encountered at approximately El. 25.5 at this boring. The rock sample recovered in boring B-318 consisted of hard, fine to medium grained basalt. It is anticipated that hard to very hard unweathered rock will be encountered during construction along the alignment in the area of Summit Avenue and between Summit Avenue and Cliff Street.

3.3 FOREST RIVER PARK

A total of six borings (B-404 to B-409) were performed to depths ranging from approximately 6.7 to 21.2 feet within Forest River Park and Pioneer Village to obtain subsurface information for developing geotechnical recommendations and construction considerations for the proposed drainage improvements and ball field rehabilitation.

3.3.1 Soil

Subsurface conditions encountered in the vicinity of Forest River Park typically consist of top soil over loose to very dense sand with varying amounts of silt, clay, and gravel underlain by naturally-deposited medium stiff to very stiff silts and clays over bedrock.

Boring B-404 was drilled to 12 feet below existing grade to approximately El. 1 in the area of the proposed plunge pool. This boring revealed a medium to very stiff clay/silt layer with N-values ranging from 7 to 37.

Three borings were drilled in Pioneer Village. Boring B-405 was drilled to a depth of approximately 7.5 feet to auger refusal in the western part of the Village near the mid-point of the proposed grassed channel alignment and immediately north of the existing ball field. Soil conditions at Boring B-405 consisted of very dense silty sand. Borings B-406 and B-408 were drilled in the eastern part of the Village, approximately 25 to 50 feet from the shoreline in the vicinity of the proposed concrete box culvert. Soil conditions in this area consisted of a 5 to 10 foot thick layer of stiff to very stiff clay with N-values ranging from 9 to 18. Beneath the clay layer, a 2 to 5 foot thick layer of sand and gravel was encountered.

Two borings, B-407 and B-409 were drilled in the existing baseball field. Boring B-407, in right field, encountered approximately 3 feet of sand and gravel over organic clay, underlain by approximately 19 feet of stiff to very stiff clay and silt. Boring B-409 encountered 15 feet of overburden consisting of silt/clay. N-values in the silt/clay layer ranged from 11 to 15 in the two borings performed in the existing baseball field, indicating stiff consistency.

3.3.2 Bedrock

Weathered rock, generally consisting of medium grained, dark-gray gabbro-diorite, was encountered in Borings B-404 and B-409. The elevation of the encountered top of weathered rock or auger or split spoon refusal ranged from approximately El. -12.2 (B-407) to El. 3.5 (B-405A) in the borings performed in Forest River Park.

Weathered bedrock or auger refusal was encountered in the borings performed in the vicinity of the proposed plunge pool and grassed channel approximately 7.5 to 12 feet below existing grades (El. -1 to

El. 3.5). Borings B-407 and B-409, performed in the eastern and southern areas of the existing ball field, respectively, encountered the thickest amount of overburden, with weathered rock or split spoon refusal ranging from depths of approximately 15.2 to 21.2 feet below existing grades (El. -5.2 to El. 12.2). Borings performed in the Pioneer Village in the area of the proposed 2-foot by 10-foot box culvert encountered bedrock approximately 6.8 to 15 feet below existing grades (El. -6 to El. 1.2). In addition, numerous bedrock outcrops are present in Forest River Park near the shoreline.

3.4 GROUNDWATER

Groundwater elevations were measured at each boring location at the time of drilling. Of the eight borings performed in Forest and Clifton Avenue along the proposed alignment of the force main, groundwater was encountered in only three of them (B-313A, B-316A, and B-317) and was observed to range from approximately El. 2 to El. 13.

Of the six borings performed in the Forest River Park Area, groundwater was only encountered in Borings B-404, 407, and 409 and was estimated to range from approximately El. 2 to El. 5.

The reported groundwater levels were for the times and conditions when they were measured. Groundwater levels will fluctuate with season, precipitation, snowmelt, nearby construction activities, leakage into and out of utilities, and other factors. Groundwater encountered during construction should be expected to differ from the levels encountered in the test borings.

3.5 LABORATORY TEST RESULTS

The results of the geotechnical laboratory tests are summarized in the table below.

Boring ID	Sample	Depth (ft)	Atterberg Limits			% Gravel	% Sand	% Silt and Clay	Soil Description
			Liquid Limit	Plastic Limit	Plasticity Index				
B-316A	SS-2	5-7	-	-	-	1.7	55.6	42.7	Moist, reddish brown silty sand
B-401	SS-1	0-2	-	-	-	12.6	41.1	46.3	Moist, yellowish brown silty sand
B-403	SS-3	10-12	52	21	31	-	-	-	Moist, light brownish gray clay
B-405	SS-2	5-7	-	-	-	28.9	51.8	19.3	Moist, yellowish brown silty sand with gravel
B-407	SS-4*	15-17	-	-	-	-	-	-	Moist, grayish brown silt
	ST-1	5-7	47	25	22				Moist, grayish brown clay
B-408	SS-2	5-7	27	16	11				Moist, brownish gray clay
B-409	SS-3	10-12				0	30	70	Moist, yellowish brown sandy silt

*sample determined to be non-plastic

4.0 DESIGN CONSIDERATIONS AND RECOMMENDATIONS

4.1 FORCE MAIN AND GRAVITY LINES EXTENDING ALONG FOREST AND CLIFTON AVENUES

4.1.1 General

Forest and Clifton Avenues are two-way paved roadways which run perpendicular to Canal Street. The abutting properties are primarily residential. Based on the civil drawing set dated January 2017 provided by Woodard and Curran, we understand that the force main will be a 30-inch diameter ductile iron (DI) pipe. The force main is proposed to extend eastwards from the proposed pump house in the northeast corner of the O'Keefe Center parking lot to approximately 100 feet west of Summit Avenue, where the force main ends and transitions to a 36-inch gravity drainage line, which empties in Forest River Park located on the oceanfront. A 12-inch diameter PVC gravity line and associated drainage structures are also proposed to be constructed adjacent to the alignment of the force main in Forest Avenue between the pump house and Wisteria Street and extending southwards down Lussier Street. This 12-inch gravity line will convey storm water to the west and will eventually tie into the proposed storage facility to be constructed in the O'Keefe Center parking lot.

Existing grades along the force main alignment range from approximately El. 6 to 32. The force main will bear at elevations ranging from approximately El. -1 to El. 26 and at depths ranging from approximately 6 to 12 feet below existing grades. The adjacent 12-inch diameter PVC gravity line will bear at elevations ranging from approximately El. 6 to 12 and at depths ranging from approximately 4 to 6 feet below existing grades. The 36-inch gravity line which empties in Forest River Park will bear at elevations ranging from approximately El. 13 to 26 and at depths ranging from approximately 7 to 17 feet below existing grades. We understand that no raises in grade are proposed near the alignment of the force main or gravity line in Forest and Clifton Avenue.

4.1.2 Settlements

Based on the subsurface conditions encountered in the performed borings, we anticipate that the force main and the gravity drain lines will bear in the shallow sands and gravels or underlying stiff clays. Due to the stiff nature of the underlying clay, settlements in this area are expected to be less than 1 inch considering that no significant changes in grades are proposed along the alignment. Based on these settlement estimates, we recommend that the gravity drain lines can be designed and constructed as soil-supported PVC pipes and the force main can be designed and constructed as a soil-supported DI pipe. Both the gravity drain lines and force main should bear on a minimum 12-inch thick bed of drainage pipe and structure bedding (crushed stone) in the existing fill or the stiff clay soils, contingent upon confirmation of the final performance characteristics of the selected drainage pipe and structures. We also anticipate that the associated drainage structures could be soil supported following preparation of bearing surfaces as discussed herein and bearing on a minimum 18-inch thick bed of structure bedding (crushed stone).

4.1.3 Engineered Fills

Construction/installation of the soil-supported drainage system would involve excavation to design subgrade elevations, placement and compaction of crushed stone bedding, installation of the drain pipes, and backfilling of the pipe with the excavated on-site granular fill materials.

Bedding should consist of ¾-inch sized crushed stone (M2.01.4) meeting the criteria of the Massachusetts Department of Transportation (MassDOT) and placed beneath the force main, gravity lines and drainage structures. Bedding should be placed to the crown of the pipes and should be separated from the existing soils at the design subgrade with a layer of geotextile filter fabric (i.e. Mirafi 140N). Each lift of drainage pipe and structure bedding should be compacted with a minimum of four systematic passes of a large vibratory plate compactor.

Above the crowns of the drainage pipes, drainage pipe and structure backfill may be used to backfill up to the base of the pavement section. The more granular portions of the existing fill may be used as drainage pipe and structure backfill above the crown of the pipes. The backfill should be free from organic matter, man-made materials, ice, snow or other deleterious material and should have the characteristic that it can be readily placed and compacted. Drainage pipe and structure backfill should contain less than 35 percent finer than a #200 sieve by weight. Drainage pipe and structure backfill should be placed in loose lift thicknesses not exceeding 12 inches and compacted to at least 92 percent of maximum dry density except within 3 feet beneath pavement grade where it should be compacted to 95 percent of maximum dry density. The maximum particle size for drainage pipe and structure backfill should be no greater than 3 inches.

4.2 FOREST RIVER PARK IMPROVEMENTS

4.2.1 General

The proposed drainage improvements in the Forest River Park area as part of Phase II of Salem's Canal Street Flood Mitigation Project are planned to consist of a 25 x 20 x 1-foot plunge pool comprised of 24-inch diameter boulders stones underlain by non-woven geotextile fabric. Storm water will discharge into the plunge pool from the 36-inch PVC gravity drainage line to be constructed in Clifton Avenue. From the plunge pool, storm water will move into the proposed grassed channel conveying the storm water to an existing retention pond, before discharging into Salem Harbor through a 2 x 10-foot concrete box culvert. The proposed box culvert discharging into Salem Harbor is proposed to be reinforced concrete, bearing at approximately El. 3.2. We understand that raises-in-grade along the alignment of the proposed grassed channel are anticipated to be approximately one to two feet locally.

As part of the proposed improvements in Forest River Park, we understand that the grades of the existing baseball field and adjacent areas in Forest River Park are proposed to be raised approximately 1 to 4 feet. Beneath the baseball field, an underdrain system is proposed consisting of 1-inch by 12-inch horizontal flat drains spaced 15 feet apart conveying runoff east towards the grassed channel through 12 to 18-inch diameter, solid walled HDPE underdrain pipe.

4.2.2 Settlements

Plunge Pool/Grassed Channel. The plunge pool is proposed to be constructed in the area of boring B-404 where approximately 12 feet of medium stiff to very stiff silts and clays was encountered from the ground surface to the bottom of the boring (approximately El. 1).

Boring B-405 was performed near the mid-point along the alignment of the grassed channel where raises in grade are expected to be generally less than 1 foot. Overburden at this boring location was found to be

generally granular in nature with auger refusal encountered at a depth of approximately 7.5 feet (El. 3.5). Settlements at the plunge pool and along the alignment of the grass channel are anticipated to be less than one inch.

Baseball Field. The elevation of the baseball field is currently proposed to be raised approximately three to four feet. Settlement calculations were performed for the regrading work proposed at the baseball field using data obtained from field testing and laboratory tests on samples retrieved from the recent subsurface investigation. Up to approximately 2 inches of long-term primary consolidation settlement was estimated to occur after construction of the underdrain system and regrading of the baseball field. Up to one inch of settlement is estimated to occur due to secondary compression of the underlying clay/silt over the design life of the baseball field. These settlement estimates assume that all top soil and organic soils will be removed from the surface of the existing field prior to new fill placement.

Concrete Culvert. Based on findings from the recent subsurface investigation, the box culvert will likely bear on either very dense naturally deposited sand and gravel or very stiff clay. The maximum change in grade proposed in the vicinity of the box culvert is less than 1 foot and is located where very dense sand and gravel was encountered at the proposed bearing depth. The installation of the proposed box culvert is anticipated to produce a net-unloading condition. This, combined with the stiff nature of the underlying soil upon which the box culvert will bear, is expected to limit settlements of this structure to less than one inch.

4.2.3 Engineered Fills

Concrete Culvert. Bedding should consist of a minimum 6-inch thickness of $\frac{3}{4}$ inch crushed stone (M2.01.4) meeting the criteria of the Massachusetts Department of Transportation (MassDOT) and should be placed under the proposed box culvert. The bedding should be separated from the existing soils at the design subgrade with a layer of geotextile filter fabric (i.e. Mirafi 140N). The bedding material should be compacted with a minimum 4 systematic passes of a large vibratory plate compactor.

Baseball Field. Unsuitable materials such as fill, topsoil, and organic matter should be removed prior to raising the grade of the existing baseball field. Exposed subgrade soils should be observed in the field by a geotechnical engineer to confirm the assumed bearing conditions for the rehabilitated ball field. After the removal of any unsuitable material, the exposed subgrade should be compacted with a minimum of four passes with a double-drum vibratory roller compactor such as a Bomag BW-60S or other equipment approved by the Engineer. It is recommended that Mirafi RS 580i woven geosynthetic be placed on the exposed subgrade prior to backfill placement to reduce localized differential settlement of the ball field. Backfill used for raises in grades should be free from organic matter, man-made materials, ice, snow or other deleterious material and should have the characteristic that it can be readily placed and compacted and should contain less than 35 percent finer than a #200 sieve by weight. Backfill for raises-in-grade should be placed in loose lift thicknesses not exceeding 12 in. and compacted to at least 95 percent of maximum dry density. Based on our experience with local soil conditions, the naturally deposited clays underlying the baseball field have relatively low swell potential. Any potential swelling of these soils should not have a significant adverse effect on the performance of the proposed ball field.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 EXCAVATION

5.1.1 Force Main, Drainage Improvements and Box Culvert

Construction of the proposed drainage systems and structures will require excavations to depths of up to approximately 17 feet below existing grades. Construction of these proposed improvements will require excavation through roadway sections consisting of asphalt and possibly other concrete/bituminous materials, granular fills, and silty/clayey soils. The granular fills and silty/clayey soils should be able to be excavated with normal earth moving construction equipment.

Given the relatively shallow nature of the underlying bedrock in some areas of the proposed drainage improvements, it will likely be necessary to excavate through rock, particularly in the area of Summit Avenue where bedrock was encountered above the design bottom of drain pipe and associated drainage structures. Depending on the degree of weathering, strength and fracturing of the underlying bedrock, excavations through rock may be accomplished using normal excavating equipment, hoe rams, or blasting. If blasting is necessary to excavate to design subgrades, a blasting plan should be submitted and approved by the Engineer before proceeding with excavation operations. It may be necessary to limit blasting options to control blasting impacts on existing facilities.

5.1.2 Grassed Channel

Prior to construction of the grassed channel, the top 1 to 2 feet of soil should be removed and the subgrade compacted with four passes with a large plate compactor or small double-drum vibratory roller compactor or other equipment approved by the Engineer.

5.2 SUBGRADE PREPARATION

Exposed subgrade soils should be observed in the field by a geotechnical engineer to confirm the assumed bearing conditions at excavation subgrade. It may be necessary to require over-excavation and replacement of weak, disturbed, or otherwise unacceptable bearing soils at the excavation subgrade. If organic soils are encountered at the proposed subgrade elevation, over excavation and replacement of these soils will be necessary.

Following excavation to bearing level in the clay/silt soils, the exposed subgrade should be observed by the Engineer and then covered with a layer of geotextile filter fabric before placing lifts of drainage pipe and structure bedding material. Excavation to the design subgrade in the clay/silt soils should be conducted carefully so as to minimize disturbance to the subgrade. No compaction is required of the excavated subgrade in the organic clay/silt soils.

If granular soils are encountered at the proposed subgrade elevations, the exposed subgrade should be compacted prior to placing pipe bedding with a minimum four passes with a large plate compactor or small double-drum vibratory roller compactor or other equipment approved by the Engineer. If, in the opinion of the Engineer, compaction of the sandy fill soils will be detrimental to the integrity of the subgrade, the requirement should be waived.

Excavation to the design subgrade in clay/silt soils should be conducted carefully so as to minimize disturbance to the subgrade. If foundation excavation is being conducted during wet weather, the existing soils at the excavation subgrade could be subject to disturbance by equipment and laborer traffic. Such disturbance could be reduced by maintaining excavation subgrades 12 inches above final subgrade elevations until just before final excavation. If these soils are disturbed at final subgrade level, they should be excavated and replaced with bedding material. Soil bearing surfaces below completed excavations must be protected against freezing before and after installation. If construction is performed during freezing weather, drainage pipe and structures on pipe bedding should be backfilled to a sufficient depth (up to 4 feet) as soon as possible after they are installed. Alternatively, insulating blankets or other means may be used for protection against freezing.

5.3 SUPPORT OF EXCAVATION

Considering the proposed depth of the drainage systems and structures, temporary lateral earth support will be required to support the excavation for installation of the force main, gravity lines and drainage structures. The support of excavation system should be designed for soil, water, surcharge, construction and other design loads so as to not impact underground utilities, above-grade utilities and structures that are within the zone of influence of the excavation.

The support of excavation system should be designed by the Contractor based on experience with local conditions.

Drilled-in soldier piles (steel structural sections) and wood lagging would cause the least impacts to nearby underground utilities and the adjacent pavement section, but may be the costlier option. Using this method, the soldier piles would be inserted and grouted into predrilled boreholes to below the excavation subgrade. As the excavation is made in limited steps, wood lagging is installed on the face of the soldier pile and held in place with metal tabs on the face of the soldier pile flanges or installed behind the flanges. The depth of open excavation below installed lagging should be limited to 2 feet. Alternatively, sheet piles or the soldier piles could be installed using an impact or vibratory hammer with the understanding that some impacts to the adjacent utilities and pavement section, namely settlement, may occur as a result of the vibrations caused by the impact driving.

Considering the deepest depth of the excavation, a portion of the support of excavation system would not be able to be cantilevered and would require internal bracing. The bracing level(s) should be spaced to allow efficient installation of the drainage pipe and structures.

5.4 EXCAVATION DEWATERING

Installation of the force main, gravity fed drainage lines and associated structures may require excavations below the groundwater level depending on the conditions at the time of construction. All final excavation work should be conducted in-the-dry. The granular soils, where they contain appreciable amounts of silt, are very susceptible to disturbance by water. Control of surface water run-off and seepage water into the excavations will be necessary to retain the integrity of the bearing soils.

The Contractor should control the flow of surface water into the excavations at all times. Careful dewatering will be necessary to retain the integrity of the bearing soils. Dewatering of excavations during construction can likely be performed using collection trenches and shallow sump wells, and in some cases well points. Water discharge from the excavations should be disposed of in accordance with all applicable

local, State and Federal regulations. Special provisions may be necessary for handling, storing, treating and/or discharging of the collected water.

5.5 RE-USE OF ON-SITE MATERIALS

Granular fill soils encountered during the installation of the drainage structures and the force main may be reused as structure backfill above the crown of the force main after processing to remove unsuitable (silty and clayey soils, any man-made materials) and oversized particles (i.e. cobbles), subject to achieving compaction requirements.

Any organic clayey/silty soils are not suitable as backfill for the force main or gravity drainage lines and structures. Soil moisture content, weather conditions and placement procedures are very important to the successful placement and compaction of the existing fill materials if attempted to be reused as backfill. Moisture conditioning (drying), particularly during periods of wet weather, may be required to permit placement of the existing fill in lifts to the required compaction. Use of the existing fill as pipe backfill may be difficult during the period between late September through mid-June in the Salem area due to difficulties of moisture control and/or freezing temperatures. The Contractor should exercise good surface and groundwater control to protect materials that can be used as backfill from becoming saturated.

5.6 CONSTRUCTION MONITORING

Existing buildings, underground and above-grade utilities, and other existing facilities are located within close proximity to the proposed improvements. The Contractor will be required to design their means and methods (dewatering system, support of excavation, etc.) to protect the existing facilities. Monitoring of the existing utilities and nearby structures should be performed to observe for any impacts during the construction.

Instrumentation is recommended to monitor the performance of the existing utilities and structures during construction. This should include displacement monitoring points on above-grade structures to observe for horizontal and vertical displacements and top of wall monitoring points for the temporary support of excavation systems.

Threshold and Limiting values for each instrument should be developed based on the structure, utility, or surface being monitored, and the adjacent construction. For instruments whose Threshold value has been exceeded, the Contractor should be required to develop a Contingency Plan to address the construction should the Limit value be reached. The Contingency Plan should be submitted to the Engineer for review and approval. For instruments whose Limit value has been reached, the Contractor should be required to implement the approved Contingency Plan. No further work should proceed in the vicinity of the instrument whose Limit value has been reached until the Contingency Plan has been implemented to the satisfaction of the Engineer.

Preconstruction surveys of existing, adjacent structures and utilities, before and following the construction, is recommended to help identify damage resulting from construction.

Additionally, we recommend that a geotechnical engineer or technician qualified by training and experience be present during construction to:

- Monitor that soils used as fill and backfill are in accordance with the contract requirements.

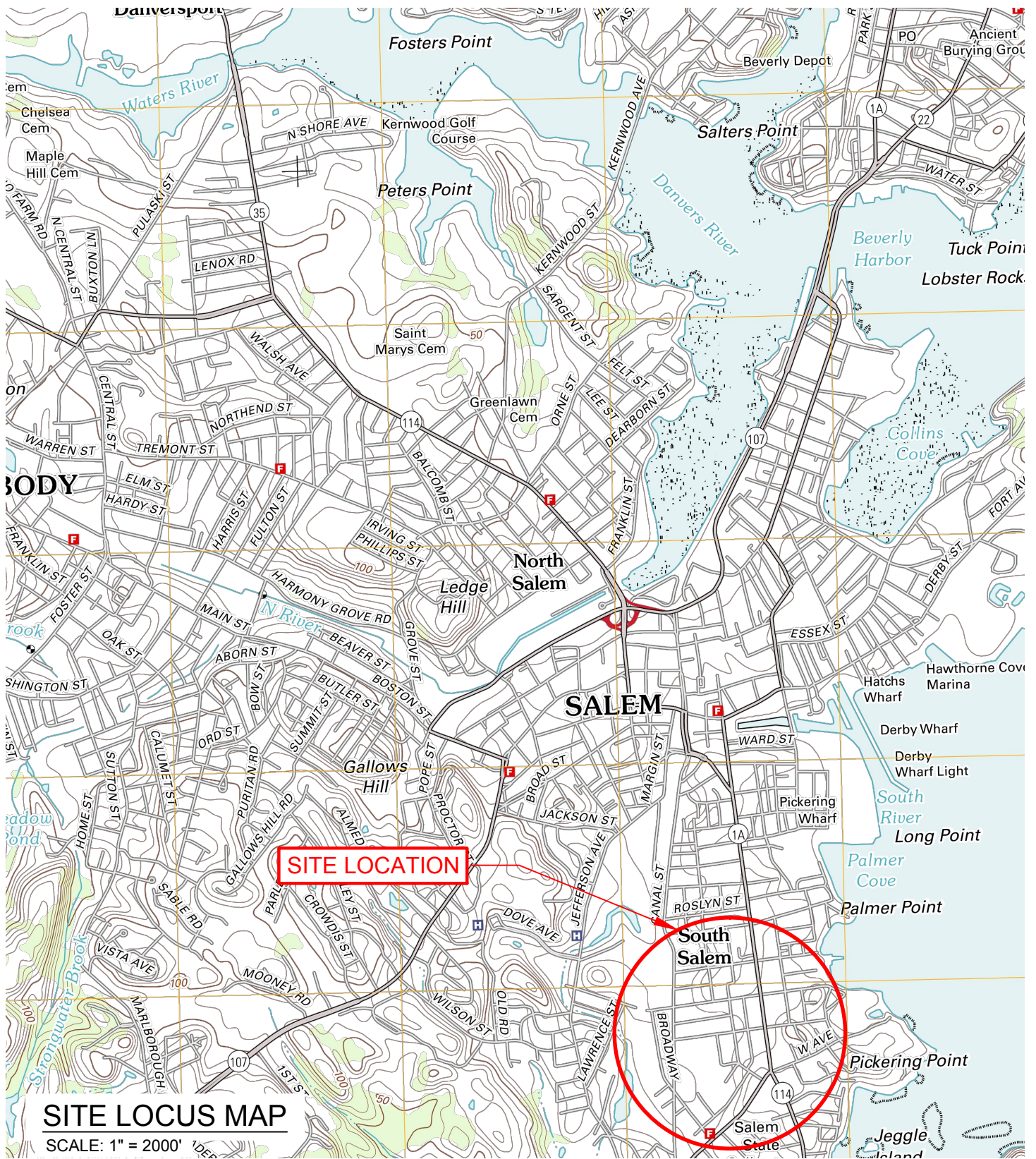
- Observe removal of existing unsuitable foundation materials from drainage system subgrade areas and confirm the character of the material encountered at drainage system bearing levels.
- Observe placement of drainage pipe and structure bedding and pipe/structure backfill and other compacted fills.
- Test compaction of pipe/structure backfill and other compacted fills.
- Observe preparation of drainage pipe and structure bearing surfaces.
- Make judgments on the suitability of excavated fill soils for reuse as pipe and structure backfill.

Given the site conditions and construction requirements, monitoring by experienced personnel will be important to the efficiency and integrity of the geotechnical aspects of the project construction.

6.0 CONCLUDING COMMENTS

This report has been prepared for specific application to the proposed drainage improvements located in the Phase 2, Contract A area in Salem, Massachusetts. In the event that changes in the design are planned, the conclusions and recommendations contained in this report should not be considered valid unless they are reviewed and modified or verified in writing by Geocomp. Our recommendations are based in part upon data obtained from the referenced subsurface exploration program. The nature and extent of variations between explorations will not become evident until construction. If significant variations then appear, it may be necessary to reevaluate the recommendations of this report.

FIGURES



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Technologies to manage risk for infrastructure

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CANAL STREET FLOOD MITIGATION PROJECT - PHASE II

LOCUS MAP

PROJECT #:	220721
DATE:	01-13-2017
FIG. 1	

NOTES:

1. BASE PLAN ADAPTED FROM AUTOCAD FILE "228340-C-401 - C-404 FM" DATED JANUARY 11, 2017 RECEIVED FROM WOODWARD & CURRAN
2. GROUND SURFACE ELEVATIONS WERE ESTIMATED FROM TOPOGRAPHIC INFORMATION OBTAINED FROM THE BASE PLAN PREPARED BY WSP.
3. ELEVATIONS ARE IN FEET AND REFER TO THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM NAD83.
4. LOCATIONS OF THE TEST BORINGS CONDUCTED FOR THE CURRENT STUDY WERE ESTIMATED IN THE FIELD BY TAPING FROM EXISTING SITE FEATURES AND ARE CONSIDERED APPROXIMATE.



NOT FOR CONSTRUCTION

BORING LOCATION PLAN

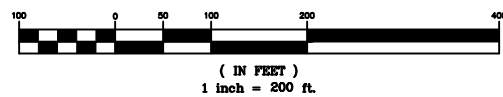
CANAL STREET FLOOD
MITIGATION PROJECT
PHASE II - CONTRACT A

DATE:	01/13/17
DRAWN	RL
DESIGN	DD
CHECKED	MC

LEGEND

- B-101** DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS DRILLED
- B-200 SERIES BORINGS DRILLED IN AUGUST 2013 BY SOIL EXPLORATION CORP.
 - B-300 SERIES BORINGS DRILLED BETWEEN AUGUST AND SEPTEMBER 2014 BY SOIL EXPLORATION CORP.
 - B-400 SERIES BORINGS DRILLED IN JUNE 2015 BY SOIL EXPLORATION CORP.

GRAPHIC SCALE



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FIGURE

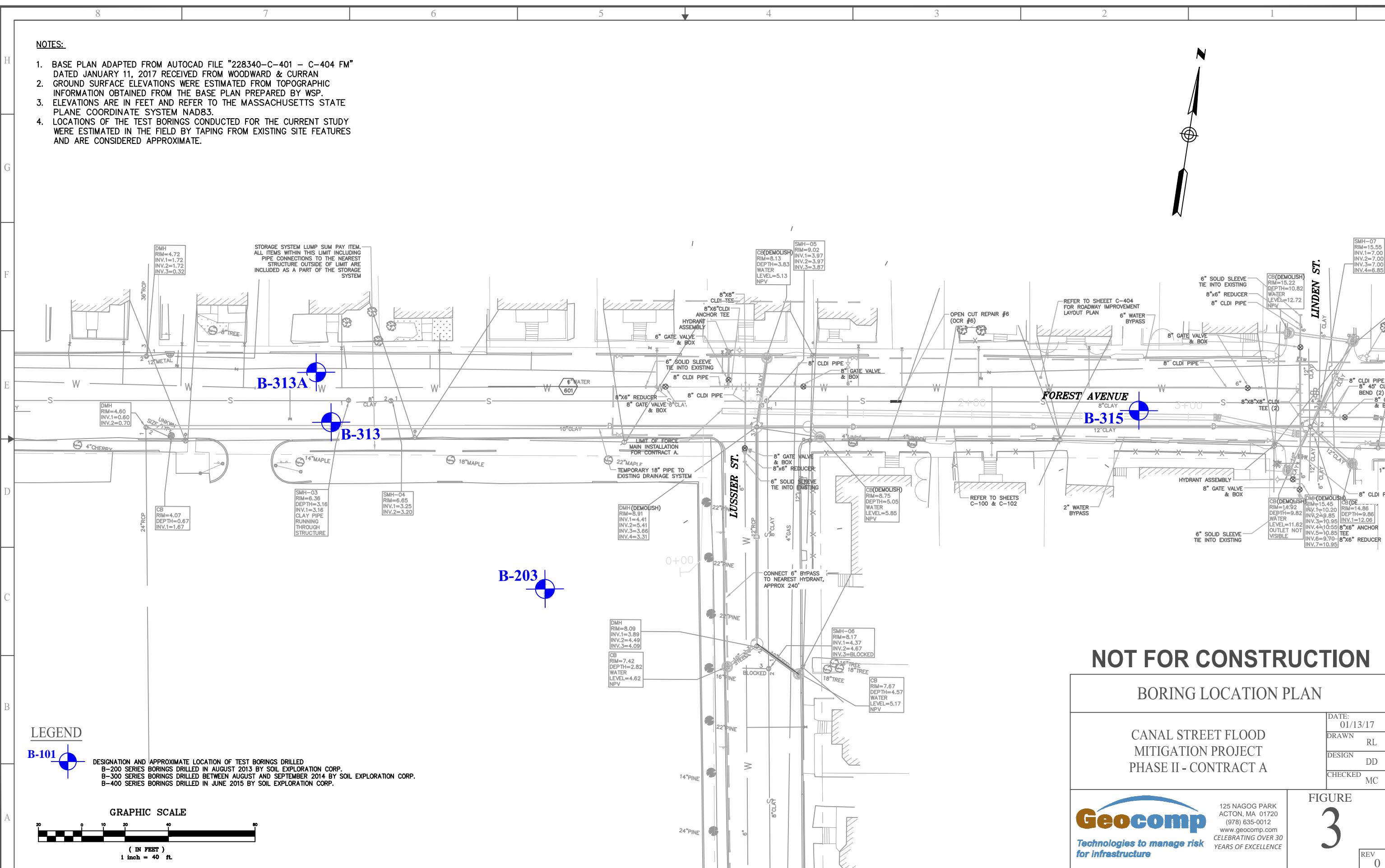
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NOTES:

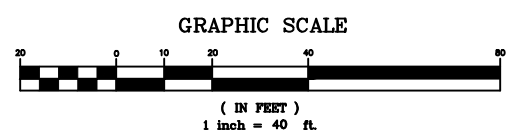
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LEGEND

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BORING LOCATION PLAN

CANAL STREET FLOOD MITIGATION PROJECT
PHASE II - CONTRACT A

DATE:	01/13/17
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DESIGN:	DD
CHECKED:	MC

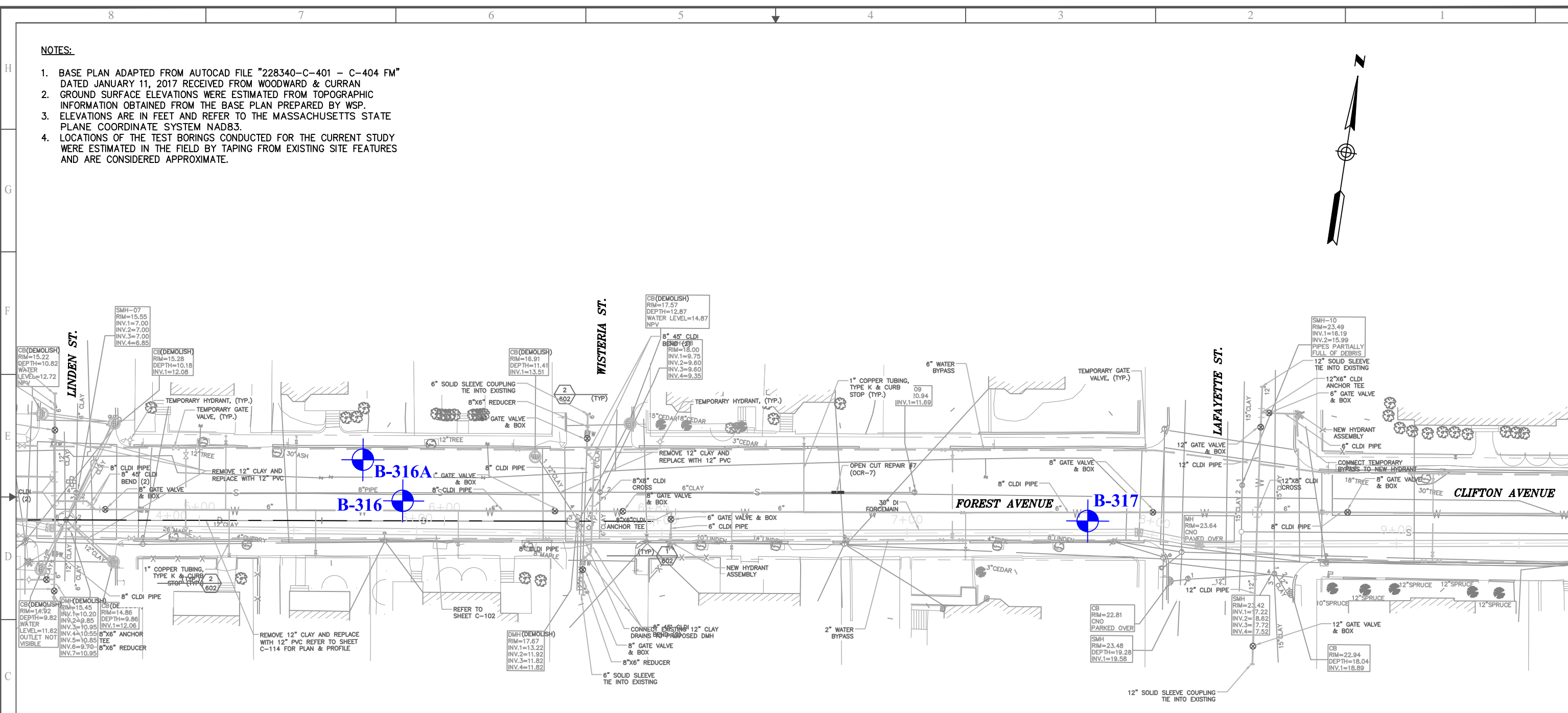
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FIGURE
3
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NOTES:

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BORING LOCATION PLAN

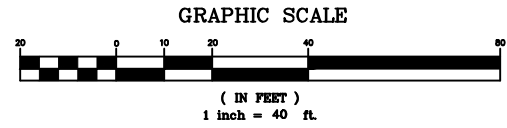
CANAL STREET FLOOD MITIGATION PROJECT
PHASE II - CONTRACT A

DATE:	01/13/17
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DESIGN:	DD
CHECKED:	MC

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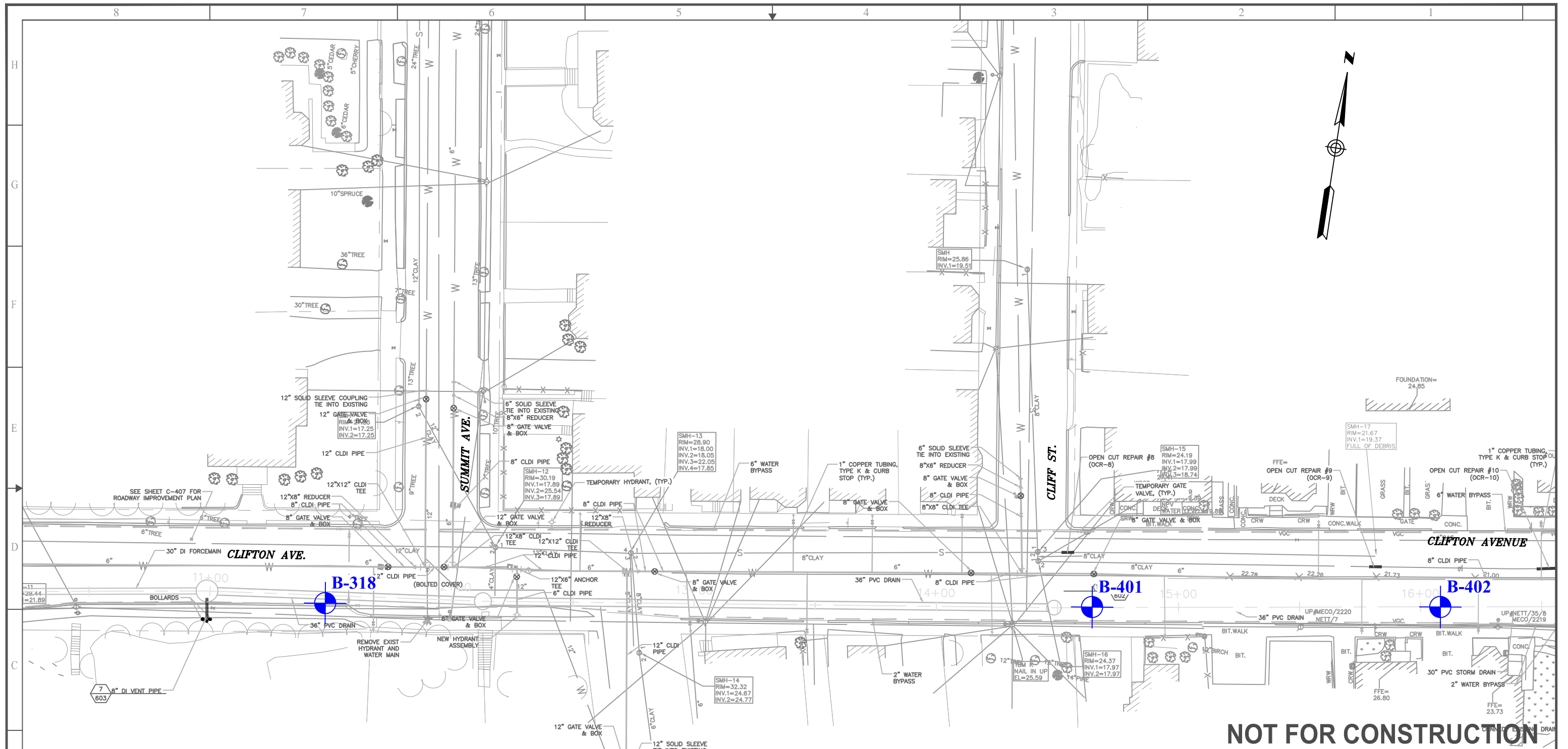
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FIGURE
4
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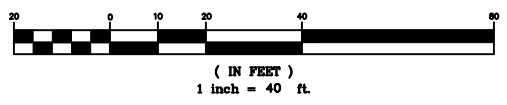


- NOTES:**
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GRAPHIC SCALE



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BORING LOCATION PLAN

CANAL STREET FLOOD
 MITIGATION PROJECT
 PHASE II - CONTRACT A

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FIGURE
5

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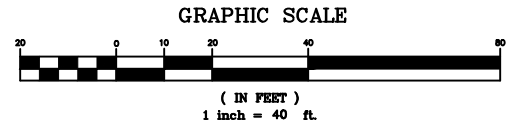
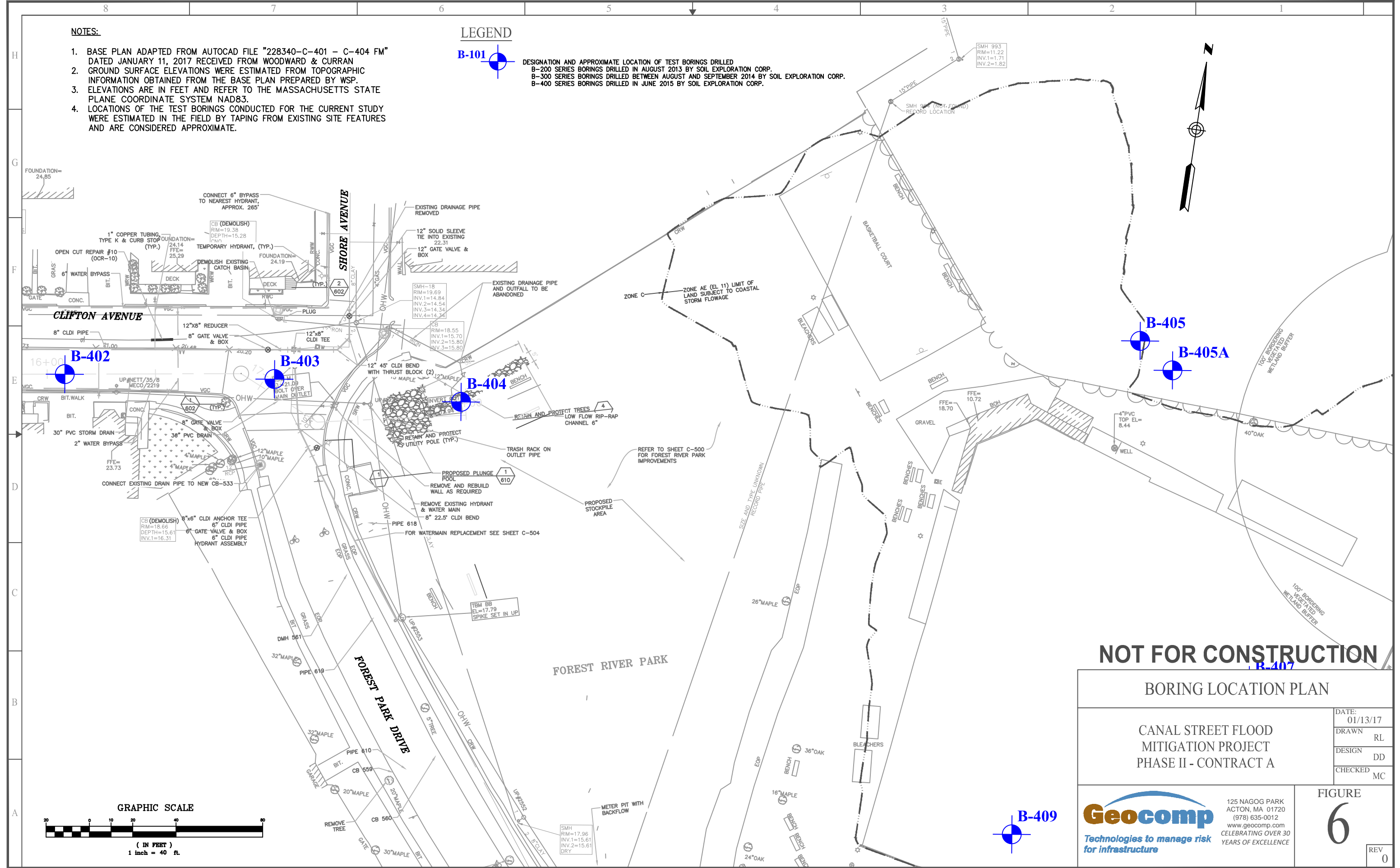
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BORING LOCATION PLAN

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 MITIGATION PROJECT
 PHASE II - CONTRACT A

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FIGURE

6

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NOTES:

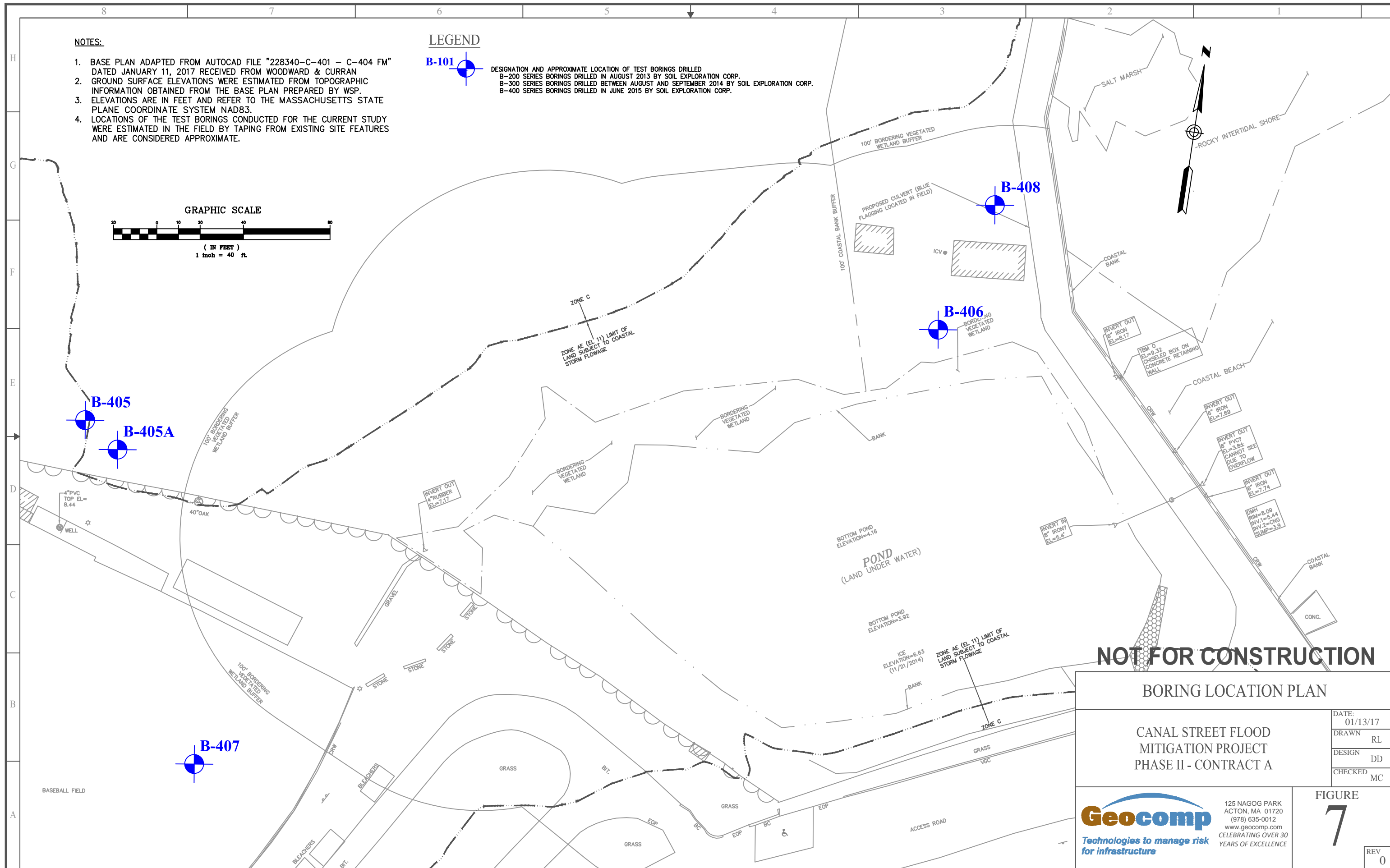
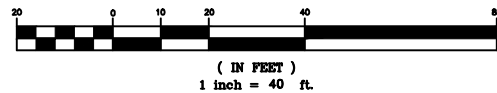
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LEGEND



B-101
 DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS DRILLED
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 B-300 SERIES BORINGS DRILLED BETWEEN AUGUST AND SEPTEMBER 2014 BY SOIL EXPLORATION CORP.
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GRAPHIC SCALE



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BORING LOCATION PLAN

CANAL STREET FLOOD
 MITIGATION PROJECT
 PHASE II - CONTRACT A

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FIGURE

7

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Appendix A
Boring Logs



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BORING NUMBER B-203

PAGE 1 OF 2

CLIENT Woodard & Curran
PROJECT NUMBER 220371
DATE STARTED 8/21/13 **COMPLETED** 8/22/13
DRILLING CONTRACTOR Soil Explorations
DRILLING METHOD Drive and Wash
LOGGED BY Dan Dwyer **CHECKED BY** Scott Bamford
NOTES Ambient PID - 0.0 ppm

PROJECT NAME Canal Street - Stormwater Storage System
PROJECT LOCATION Salem, MA
GROUND ELEVATION 7 ft **HOLE SIZE** 3 inches
GROUND WATER LEVELS:
 ▽ **AT TIME OF DRILLING** 4.00 ft / Elev 3.00 ft
AT END OF DRILLING ---
AFTER DRILLING ---

COPY BH / TP / WELL - GINT STD US LAB.GDT - 9/4/13 09:19 - C:\USERS\BYRNE\DESKTOP\GINT\CANAL ST- STORMWATER STORAGE SYSTEM.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
0					
0.7					0.7 ASPHALT 6.3
1	SS 1	67	5-12-11-6 (23)		Brown and gray, medium to fine SAND, with gravel, and asphalt PID - 0.0 ppm
5					5.0 2.0
5	SS 2	71	1-2-2-3 (4)		Brown and gray, medium to fine SAND, with gravel PID - 0.0 ppm
10					10.0 -3.0
10	SS 3	63	1-1-2-5 (3)		Brown and gray, medium to fine SAND, with gravel PID - 0.0 ppm
15					15.0 -8.0
15	SS 4	50	3-5-8-11 (13)		Brown and gray, medium to fine SAND, with gravel PID - 0.0 ppm
20					20.0 -12.0
20	SS 5	21	10-8-11-8 (19)		Brown, sandy coarse to fine GRAVEL PID - 0.0 ppm
25					25.0 -17.0
25	SS 6	21	6-7-8-6 (15)		Brown, sandy coarse to fine GRAVEL PID - 0.0 ppm
30					30.0 -22.0
30	SS 7	13	11-5-9-15 (14)		Brown, sandy coarse to fine GRAVEL PID - 0.0 ppm
34.0					-27.0

Asphalt USCS Poorly-graded Sand USCS Well-graded Sandy Gravel

Split Spoon

140# Wt x 30" fall on 2" OD SS Sampler	Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft	
10-30	Med Dense	4-8	Firm	
30-50	Dense	8-15	Stiff	
50+	Very Dense	15-30	Very Stiff	
		30+	Hard	

(Continued Next Page)



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BORING NUMBER B-203

PAGE 2 OF 2

CLIENT Woodard & Curran **PROJECT NAME** Canal Street - Stormwater Storage System
PROJECT NUMBER 220371 **PROJECT LOCATION** Salem, MA
DATE STARTED 8/21/13 **COMPLETED** 8/22/13 **GROUND ELEVATION** 7 ft **HOLE SIZE** 3 inches
DRILLING CONTRACTOR Soil Explorations **GROUND WATER LEVELS:**
DRILLING METHOD Drive and Wash **AT TIME OF DRILLING** 4.00 ft / Elev 3.00 ft
LOGGED BY Dan Dwyer **CHECKED BY** Scott Bamford **AT END OF DRILLING** ---
NOTES Ambient PID - 0.0 ppm **AFTER DRILLING** ---

COPY BH / TP / WELL - GINT STD US LAB.GDT - 9/4/13 09:19 - C:\USERS\BYRNE\DESKTOP\GINT\CANAL ST- STORMWATER STORAGE SYSTEM.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
35	SS 8	46	12-10-12-9 (22)		Brown, sandy coarse to fine GRAVEL PID - 0.0 ppm
40	SS 9	50	17-21-17-16 (38)		Brown, sandy coarse to fine GRAVEL PID - 0.0 ppm
45	SS 10	100			Roller bit refusal at 44 feet Brown, sandy coarse to fine GRAVEL

Bottom of borehole at 47.0 feet.

Asphalt

USCS Poorly-graded Sand

USCS Well-graded Sandy Gravel

Split Spoon


140# Wt x 30" fall on 2" OD SS Sampler			
Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	Firm
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	Very Stiff
		30+	Hard



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BORING NUMBER B-313

CLIENT Woodard & Curran **PROJECT NAME** Salem Canal St Phase II Drainage
PROJECT NUMBER 220371 **PROJECT LOCATION** Salem, MA
DATE STARTED 8/19/14 **COMPLETED** 8/19/14 **GROUND ELEVATION** 6 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Soil Exploration Corp **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger 4" **AT TIME OF DRILLING** ---
LOGGED BY Justin Robichaud **CHECKED BY** Matt Chartier **AT END OF DRILLING** ---
NOTES Ambient PID = 0.0 ppm **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
0							
	SS 1	38	8-8-4-4 (12)	Storm drain encountered at 3-4 feet. Boring aborted and moved to other side of street.		0.5 Asphalt 2.0 Medium dense, greyish black, fine to medium SAND, little Gravel 4.0 Bottom of borehole at 4.0 feet.	PID = 0

 Asphalt

 Well-graded Gravelly Sand

 Split Spoon

140# Wt x 30" fall on 2" OD SS Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	Firm
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	Very Stiff
		30+	Hard



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BORING NUMBER B-313A

CLIENT Woodard & Curran **PROJECT NAME** Salem Canal St Phase II Drainage
PROJECT NUMBER 220371 **PROJECT LOCATION** Salem, MA
DATE STARTED 8/19/14 **COMPLETED** 8/19/14 **GROUND ELEVATION** 6 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Soil Exploration Corp **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger 4" **AT TIME OF DRILLING** 4.00 ft / Elev 2.00 ft
LOGGED BY Justin Robichaud **CHECKED BY** Matt Chartier **AT END OF DRILLING** ---
NOTES Ambient PID = 0.0 ppm **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
0						
0.5	SS 1	50	4-5-7-6 (12)		Asphalt	PID = 0
5.0	SS 2	83	0-0-0-1 (0)		Medium dense, blackish brown, fine to coarse SILTY SAND, little gravel	PID = 0
10.0	SS 3	100	0-0-2-2 (2)		Loose, brown to black, fine to coarse, SILTY SAND, trace gravel	PID = 0
15.0	SS 4	75	4-5-8-6 (13)		Soft, bluish grey, CLAY, little fine to medium sand	PID = 0
17.0					Medium dense, SILTY SAND, some gravel	PID = 0
Bottom of borehole at 17.0 feet.						

COPY BH TP WELL - GINT STD US LAB.GDT - 9/29/14 15:26 - C:\USERS\JROBICHAU\DESKTOP\CANAL ST PHASE II.GPJ

Asphalt Silty Sand Low Plasticity Sandy Clay

140# Wt x 30" fall on 2" OD SS Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	Firm
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30 30+	Very Stiff Hard

Split Spoon



Geocomp Corporation
 125 Nagog Park
 Acton, MA
 Telephone: 978-635-0012
 Fax: 978-635-0266

BORING NUMBER B-315

CLIENT Woodard & Curran **PROJECT NAME** Salem Canal St Phase II Drainage
PROJECT NUMBER 220371 **PROJECT LOCATION** Salem, MA
DATE STARTED 8/20/14 **COMPLETED** 8/20/14 **GROUND ELEVATION** 14 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Soil Exploration Corp **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger 4" **AT TIME OF DRILLING** ---
LOGGED BY Justin Robichaud **CHECKED BY** Matt Chartier **AT END OF DRILLING** ---
NOTES Ambient PID = 0.0 ppm **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
0						
0.3	SS 1	17	2-2-2-3 (4)		Asphalt Loose, brown, medium to fine SILTY SAND, trace gravel	PID = 0.2
5.0	SS 2	33	9-10-9-6 (19)		Medium dense, light brown, SILTY SAND, trace gravel	PID = 0
10.0	SS 3	100	6-10-11-16 (21)		Very stiff, light brown, SILTY CLAY, trace sand	PID = 0
15.0	SS 4	100	1-1-2-3 (3)		Loose, brownish grey, SILTY SAND, trace gravel	PID = 0
17.0					Bottom of borehole at 17.0 feet.	

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Asphalt



Silty Sand



Low Plasticity Silty Clay



Split Spoon

140# Wt x 30" fall on 2" OD SS Sampler



Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	Firm
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	Very Stiff
		30+	Hard



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 Acton, MA
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 Fax: 978-635-0266

BORING NUMBER B-316

CLIENT Woodard & Curran **PROJECT NAME** Salem Canal St Phase II Drainage
PROJECT NUMBER 220371 **PROJECT LOCATION** Salem, MA
DATE STARTED 8/20/14 **COMPLETED** 8/20/14 **GROUND ELEVATION** 17 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Soil Exploration Corp **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger 4" **AT TIME OF DRILLING** ---
LOGGED BY Justin Robichaud **CHECKED BY** Matt Chartier **AT END OF DRILLING** ---
NOTES Borehole aborted at 3' after hitting refusal Ambient PID = 0.0 ppm **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
0							
	SS 1	42	11-26-21-18 (47)	Refusal met at 3 feet. Moved to North side of road due to utilities	 0.3  3.0	Asphalt Dense, brown, fine to medium SAND, trace gravel	PID = 0
						Refusal at 3.0 feet. Bottom of borehole at 3.0 feet.	

 Asphalt

 Well-graded Gravelly Sand

 Split Spoon

140# Wt x 30" fall on 2" OD SS Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	Firm
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30 30+	Very Stiff Hard



Geocomp Corporation
 125 Nagog Park
 Acton, MA
 Telephone: 978-635-0012
 Fax: 978-635-0266

BORING NUMBER B-316A

CLIENT Woodard & Curran **PROJECT NAME** Salem Canal St Phase II Drainage
PROJECT NUMBER 220371 **PROJECT LOCATION** Salem, MA
DATE STARTED 8/20/14 **COMPLETED** 8/20/14 **GROUND ELEVATION** 17 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Soil Exploration Corp **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger 4" **AT TIME OF DRILLING** 11.00 ft / Elev 6.00 ft
LOGGED BY Justin Robichaud **CHECKED BY** Matt Chartier **AT END OF DRILLING** ---
NOTES Ambient PID = 0.0 ppm **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
0						
0.3					Asphalt	
16.7	SS 1	50	5-5-3-2 (8)		Loose, brown, SILTY SAND, trace gravel, trace sand	PID = 0
5.0						
12.0	SS 2	75	6-7-12-11 (19)		Medium dense, reddish brown, SILTY SAND, trace gravel	PID = 0
10						
10.0	SS 3	92	4-8-10-9 (18)		Very stiff, greyish brown, SILTY CLAY	PID = 0
15.0						
2.0	SS 4	100	4-4-5-5 (9)		Stiff, greenish grey, CLAY, trace silt	PID = 0
17.0						

Bottom of borehole at 17.0 feet.



Asphalt



Low Plasticity Silty Clay



Silty Sand

140# Wt x 30" fall on 2" OD SS Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	Firm
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	Very Stiff
		30+	Hard



Split Spoon



Geocomp Corporation
 125 Nagog Park
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BORING NUMBER B-317

PAGE 1 OF 1

CLIENT Woodard & Curran **PROJECT NAME** Salem Canal St Phase II Drainage
PROJECT NUMBER 220371 **PROJECT LOCATION** Salem, MA
DATE STARTED 8/20/14 **COMPLETED** 8/20/14 **GROUND ELEVATION** 23 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Soil Exploration Corp **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger 4" **AT TIME OF DRILLING** 10.00 ft / Elev 13.00 ft
LOGGED BY Justin Robichaud **CHECKED BY** Matt Chartier **AT END OF DRILLING** ---
NOTES Ambient PID = 0.0 ppm **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
0						
0.3					Asphalt	
22.7	SS 1	42	4-5-5-3 (10)		Medium dense, dark brown, SILTY SAND, trace gravel	PID = 0
5.0	SS 2	75	3-4-8-8 (12)		Stiff, brown, SILTY CLAY, trace gravel	PID = 0
10.0	SS 3	92	5-8-11-12 (19)		Very stiff, reddish brown, SILTY CLAY	PID = 0
15.0	SS 4	67	10-12-8-12 (20)		Medium dense, reddish brown, SILTY SAND, trace clay	PID = 0
17.0					Bottom of borehole at 17.0 feet.	

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Asphalt



Silty Sand



Low Plasticity Silty Clay



Split Spoon

140# Wt x 30" fall on 2" OD SS Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	Firm
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	Very Stiff
		30+	Hard



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BORING NUMBER B-318

PAGE 1 OF 1

CLIENT Woodard & Curran **PROJECT NAME** Salem Canal St Phase II Drainage
PROJECT NUMBER 220371 **PROJECT LOCATION** Salem, MA
DATE STARTED 8/22/14 **COMPLETED** 8/22/14 **GROUND ELEVATION** 32 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR Soil Exploration Corp **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger 4" **AT TIME OF DRILLING** ---
LOGGED BY Justin Robichaud **CHECKED BY** Matt Chartier **AT END OF DRILLING** ---
NOTES Ambient PID = 0.0 ppm **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	ENVIRONMENTAL DATA
0						
0.3	SS 1	38	9-14-17-21 (31)		Asphalt	PID = 0
31.8					Dense, reddish brown, medium to fine SAND, trace gravel	
5.0						
6.5	SS 2	50	19-40-49 (89)		Very dense, brown, SILTY SAND, little gravel	PID = 0
27.0						
25.5					Layer RQD = 50% Hard, fine to medium grained, BASALT; primary joint set horizontal very close to wide, rough, planar, discolored, open	
10						
11.5						
20.5						

Refusal at 6.5 feet.
 Bottom of borehole at 11.5 feet.

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Asphalt

Well-graded Gravelly Sand

Silty Sand

Bedrock

Split Spoon

140# Wt x 30" fall on 2" OD SS Sampler

Cohesionless	Density	Cohesive	Consistency
0-10	Loose	0-4	Soft
10-30	Med Dense	4-8	Firm
30-50	Dense	8-15	Stiff
50+	Very Dense	15-30	Very Stiff
		30+	Hard



TEST BORING REPORT

HOLE ID
B-401
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
23 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES			RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	CME 75	6/10/15 07:20 AM
CASING ID (in) N/A	SAMPLER ID (in) 2	DRILL MUD N/A	BIT TYPE Auger	FINISH DATE 6/10/15 08:15 AM
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130	DRILLING METHOD Hollow Stem Auger	DRILLER Pat Gooddal and Nick Hume	GEOCOMP REP Mir Karim
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30	HOIST/HAMMER Automatic	CHECKED BY D. Dwyer	

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0						0.5	Asphalt	22.5
	SS 1	6-7-5-3 (12)	58			5.0	Yellowish brown, medium dense, moist, SILTY SAND	
5	SS 2	5-5-7-11 (12)	92			10.0	Yellowish brown and gray, mottled, moist, stiff CLAY	18.0
10	SS 3	5-7-10-15 (17)	100			15.3	Brown, moist, stiff SILTY CLAY	13.0
15	SS 4	100/4"	0			15.3	Gray, dry, weathered ROCK	7.7

Refusal Bottom of borehole at 15.3 feet.

REMARKS
Groundwater not encountered
Refusal at 15.3' depth

SUMMARY
Overburden (ft): **15.3**
Rock Cored (ft): **0.0**
Samples: **SS=4**

WATER LEVEL DATA			
Depth (ft) to:			
Date/Time	Bot. of Casing	Bot. of Hole	Depth to Water

Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of ground water may occur due to other factors than those present at the time measurements were made. The ASTM 2488 classification symbol and name presented on the boring logs are based on visual-manual procedures

HOLE ID
B-401

GEOCOMP BOREHOLE LOG - GCCGINTEST.GDT - 9/15/15 10:39 - I\HAL1\GCC\CONSULTING\ACTIVE PROJECTS\220597 - SALEM FOREST RIVER PARK\SURFACE INVESTIGATION\BORING LOGS\FORREST RIVER PARK BORING LOGS.GPJ



TEST BORING REPORT

HOLE ID
B-402
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
22 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES			RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	CME 75	6/10/15 09:00 AM
CASING ID (in) N/A	SAMPLER ID (in) 2	BIT TYPE Auger	DRILL MUD N/A	FINISH DATE 6/10/15 09:50 AM
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130	DRILLING METHOD Hollow Stem Auger	GEOCOMP REP Mir Karim	DRILLER Pat Gooddal and Nick Hume
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30	HOIST/HAMMER Automatic	CHECKED BY D. Dwyer	

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0						0.5	Asphalt	21.5
	SS 1	10-10-7-5 (17)	33			5.0	Dark gray and reddish brown, medium dense, moist SILTY SAND	
5	SS 2	5-6-9-10 (15)	100			10.0	Brownish gray, stiff, moist, SILTY CLAY	17.0
10	SS 3	7-9-15-14 (24)	100			13.0	Gray, very stiff, moist, CLAY	12.0
							Bottom of borehole at 13.0 feet.	9.0

Auger Refusal

REMARKS Groundwater not encountered Auger refusal at 13' depth	SUMMARY Overburden (ft): 13 Rock Cored (ft): 0.0 Samples: SS=3		
	WATER LEVEL DATA Depth (ft) to:		
	Date/Time	Bot. of Casing	Bot. of Hole
			Depth to Water

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HOLE ID
B-402

GEOCOMP BOREHOLE LOG - GCCGINTEST.GDT - 9/15/15 10:39 - I\HAL1\GCC\CONSULTING\ACTIVE PROJECTS\220597 - SALEM FOREST RIVER PARK\SURFACE INVESTIGATION\BORING LOGS\FORREST RIVER PARK BORING LOGS.GPJ



TEST BORING REPORT

HOLE ID
B-403
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
20 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES			RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	CME 75	6/10/15 10:10 AM
CASING ID (in) N/A	SAMPLER ID (in) 2	BIT TYPE Auger	DRILL MUD N/A	FINISH DATE 6/10/15 11:30 AM
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130	DRILLING METHOD Hollow Stem Auger	GEOCOMP REP Mir Karim	DRILLER Pat Gooddal and Nick Hume
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30	HOIST/HAMMER Automatic	CHECKED BY D. Dwyer	

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0						0.5	Asphalt	19.5
	SS 1	4-5-8-11 (13)	50			5.0	Dark gray and reddish brown, medium dense, moist, coarse SAND and GRAVEL	
5	SS 2	3-3-6-9 (9)	100			15.0	Yellowish brown, stiff, moist, SILTY CLAY	15.0
10	SS 3	8-10-13-15 (23)	100			15.0	Light brownish gray, very stiff, moist CLAY	
15	SS 4	17-23-36-100/2"	90			16.7	Top 12" - Brownish gray, very stiff, moist CLAY Bottom 6" - Dark gray, very dense, moist SILTY SAND	5.0
						16.7	Bottom of borehole at 16.7 feet.	3.3

Refusal

Weathered bedrock in tip of spoon

REMARKS Groundwater not encountered Refusal at 16.7' depth	SUMMARY Overburden (ft): 16.7 Rock Cored (ft): 0.0 Samples: SS=4		
	WATER LEVEL DATA Depth (ft) to:		
	Date/Time	Bot. of Casing	Bot. of Hole
			Depth to Water

GEOCOMP BOREHOLE LOG - GCCGINTEST.GDT - 9/15/15 10:39 - I\HAL1\GCC\CONSULTING\ACTIVE PROJECTS\220597 - SALEM FOREST RIVER PARK\SURFACE INVESTIGATION\BORING LOGS\FORREST RIVER PARK BORING LOGS.GPJ

GEOCOMP BOREHOLE LOG - GCCGINVT1.GDT - 1/3/17 13:20 - I\HAL1\GCCCONSULTING\PROPOSALS\990464 - SALEM STORAGE TANK CONSTRUCTION PHASE\BORING INFORMATION\400 SERIES - JUNE 2015 (FOREST RIVER PARK)\FOREST RIVER PARK BORING



TEST BORING REPORT

HOLE ID
B-404
PAGE 1 OF 1

PROJECT NAME: **Canal Street Drainage Phase 2 - Forest River**
 CLIENT: **Woodard and Curran**
 DRILLING CONTRACTOR: **Soil Exploration Corp.**
 PROJECT NUMBER: **220597**
 PROJECT LOCATION: **Salem, MA**
 SURFACE EL.: **13 ft**
 BORING LOC.:

DRILLING EQUIPMENT & PROCEDURES

CASING TYPE: N/A	SAMPLER TYPE: SPT	BARREL TYPE:	RIG MAKE & MODEL: CME 75	START DATE: 6/8/15 07:40 AM
CASING ID (in): N/A	SAMPLER ID (in): 2	BARREL ID (in):	BIT TYPE: Auger	FINISH DATE: 6/8/15 08:40 AM
CASING HAMMER WT. (lb): 140	SAMPLER HAMMER WT. (lb): 130		DRILL MUD: N/A	DRILLER: Pat Gooddal and Nick Hume
CASING HAMMER FALL (in): N/A	SAMPLER HAMMER FALL (in): 30		DRILLING METHOD: Hollow Stem Auger	GEOCOMP REP: Mir Karim
			HOIST/HAMMER: Automatic	CHECKED BY: D. Dwyer

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0								
5	SS 1	2-3-4-5 (7)	100				Yellowish brown and gray, medium stiff, moist CLAYEY SILT	
7.0	SS 2	4-7-9-13 (16)	100			7.0	Yellowish brown, stiff, moist, SILTY CLAY	6.0
10							▽	
12.0	SS 3	18-16-21-31 (37)	50			12.0	Top 9" - Yellowish brown, very stiff, moist to wet, CLAY Bottom 3" - Gray, dry, weathered rock	1.0
Bottom of borehole at 12.0 feet.								

REMARKS: Refusal at 12' depth

SUMMARY: Overburden (ft): **12**
 Rock Cored (ft): **0.0**
 Samples: **SS=3**

WATER LEVEL DATA			
Date/Time	Bot. of Casing	Bot. of Hole	Depth to Water
6/8/2015 8:10:00 AM			8

HOLE ID: **B-404**

Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of ground water may occur due to other factors than those present at the time measurements were made. The ASTM 2488 classification symbol and name presented on the boring logs are based on visual-manual procedures.



TEST BORING REPORT

HOLE ID
B-405
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
11 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES			RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	CME 75	6/9/15 07:50 AM
CASING ID (in) N/A	SAMPLER ID (in) 2	BIT TYPE Auger	DRILL MUD N/A	FINISH DATE 6/9/15 08:00 AM
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130	DRILLING METHOD Hollow Stem Auger	DRILLER Pat Gooddal and Nick Hume	GEOCOMP REP Mir Karim
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30	HOIST/HAMMER Automatic	CHECKED BY D. Dwyer	

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0								
	SS 1	4-6-100/4"	44			1.3	Brown, very dense, moist, coarse SAND and GRAVEL	9.7

Bottom of borehole at 1.3 feet.

REMARKS
Groundwater not encountered
Hit obstruction at 1.3 depth and boring was relocated

SUMMARY
Overburden (ft): **1.3**
Rock Cored (ft): **0.0**
Samples: **SS=1**

WATER LEVEL DATA			
Depth (ft) to:			
Date/Time	Bot. of Casing	Bot. of Hole	Depth to Water

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HOLE ID
B-405

GEOCOMP BOREHOLE LOG - GCCGINTEST.GDT - 9/15/15 10:39 - I\HAL1\GCC\CONSULTING\ACTIVE PROJECTS\220597 - SALEM FOREST RIVER PARK\SURFACE INVESTIGATION\BORING LOGS\FORREST RIVER PARK BORING LOGS.GPJ



TEST BORING REPORT

HOLE ID
B-405a
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
11 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES			RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	CME 75	6/9/15 08:10 AM
CASING ID (in) N/A	SAMPLER ID (in) 2	BARREL ID (in)	BIT TYPE Auger	FINISH DATE 6/9/15 08:45 AM
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130		DRILL MUD N/A	DRILLER Pat Gooddal and Nick Hume
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30		DRILLING METHOD Hollow Stem Auger	GEOCOMP REP Mir Karim
			HOIST/HAMMER Automatic	CHECKED BY D. Dwyer

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0								
5	SS 1	25-19-20-24 (39)	71			7.5	Yellowish brown, very dense, moist, coarse SILTY SAND with gravel	3.5

Bottom of borehole at 7.5 feet.

Auger refusal

REMARKS

Groundwater not encountered

Auger refusal at 7.5' depth

SUMMARY			
Overburden (ft):		7.5	
Rock Cored (ft):		0.0	
Samples:		SS=1	
WATER LEVEL DATA		Depth (ft) to:	
Date/Time	Bot. of Casing	Bot. of Hole	Depth to Water

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HOLE ID
B-405a

GEOCOMP BOREHOLE LOG - GCCGINTEST.GDT - 9/15/15 10:39 - I\HAL1\GCC\CONSULTING\ACTIVE PROJECTS\220597 - SALEM FOREST RIVER PARK\SURFACE INVESTIGATION\BORING LOGS\FORREST RIVER PARK BORING LOGS.GPJ



TEST BORING REPORT

HOLE ID
B-406
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
8 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES				RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	BIT TYPE CME 75	FINISH DATE 6/9/15 10:30 AM	
CASING ID (in) N/A	SAMPLER ID (in) 2	BARREL ID (in)	DRILL MUD N/A	DRILLER Pat Gooddal and Nick Hume	
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130		DRILLING METHOD Hollow Stem Auger	GEOCOMP REP Mir Karim	
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30		HOIST/HAMMER Automatic	CHECKED BY D. Dwyer	

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0								
	SS 1	9-5-4-4 (9)	58			5.0	Top 6" - Black, loose, moist, SAND and GRAVEL Bottom 8" - Reddish brown, stiff, moist, CLAY	3.0
5	SS 2	5-5-6-100/3"	19			6.8	Grayish brown, very dense, moist, coarse SAND and GRAVEL	1.2

Bottom of borehole at 6.8 feet.

Refusal

REMARKS Groundwater not encountered Refusal at 6.8' depth	SUMMARY Overburden (ft): 6.8 Rock Cored (ft): 0.0 Samples: SS=2			
	WATER LEVEL DATA Depth (ft) to:			
	Date/Time	Bot. of Casing	Bot. of Hole	Depth to Water

Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of ground water may occur due to other factors than those present at the time measurements were made. The ASTM 2488 classification symbol and name presented on the boring logs are based on visual-manual procedures

HOLE ID
B-406

GEOCOMP BOREHOLE LOG - GCCGINTEST.GDT - 9/15/15 10:39 - I\HAL1\GCC\CONSULTING\ACTIVE PROJECTS\220597 - SALEM FOREST RIVER PARK\SURFACE INVESTIGATION\BORING LOGS\FORREST RIVER PARK BORING LOGS.GPJ



TEST BORING REPORT

HOLE ID
B-407
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
9 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES			RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	CME 75	6/8/15 12:30 PM
CASING ID (in) N/A	SAMPLER ID (in) 2	BIT TYPE Auger	DRILL MUD N/A	FINISH DATE 6/8/15 02:15 PM
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130	DRILLING METHOD Hollow Stem Auger	DRILLER Pat Gooddal and Nick Hume	GEOCOMP REP Mir Karim
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30	HOIST/HAMMER Automatic	CHECKED BY D. Dwyer	

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0						0.5	Topsoil	8.5
	SS 1	3-7-4-2 (11)	75			1.5	Brown and black, moist, coarse SAND with gravel	7.5
						3.0	Dark gray, ORGANIC CLAY	6.0
5	ST 1		100				Grayish brown, moist, CLAY	
	SS 2	5-6-9-11 (15)	100				Yellowish brown, stiff, moist, SILTY CLAY	
10	SS 3	4-6-9-16 (15)	92			10.0	Brownish gray, very stiff, moist, CLAY with silt	-1.0
15	SS 4	5-6-6-9 (12)	92			15.0	Grayish brown, stiff, moist SILT	-6.0
20	SS 5	5-7-100/2"	100			20.0	Top 7" - Brownish gray, medium dense, moist to wey, SILTY SAND Bottom 7" - Brownish gray, stiff, moist, CLAY	-11.0

Refusal
Bottom of borehole at 21.2 feet.

REMARKS Refusal at 21.2' depth	SUMMARY Overburden (ft): 21.2 Rock Cored (ft): 0.0 Samples: SS=5		
WATER LEVEL DATA			
Depth (ft) to:			
Date/Time	Bot. of Casing	Bot. of Hole	Depth to Water
6/8/2015 1:00:00 PM			7

GEOCOMP BOREHOLE LOG - GCCGINTEST.GDT - 9/15/15 10:39 - I\HAL1\GCCCONSULTING\ACTIVE PROJECTS\220597 - SALEM FOREST RIVER PARK\SURFACE INVESTIGATION\BORING LOGS\FORREST RIVER PARK BORING LOGS.GPJ



TEST BORING REPORT

HOLE ID
B-408
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
9 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES			RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	CME 75	6/9/15 10:50 AM
CASING ID (in) N/A	SAMPLER ID (in) 2	BIT TYPE Auger	FINISH DATE 6/9/15 01:35 PM	
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130	DRILL MUD N/A	DRILLER Pat Gooddal and Nick Hume	
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30	DRILLING METHOD Hollow Stem Auger	GEOCOMP REP Mir Karim	
		HOIST/HAMMER Automatic	CHECKED BY D. Dwyer	

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0								
	SS 1	3-5-7-9 (12)	67			5.0	Yellowish brown and gray, stiff, moist, CLAYEY SILT	4.0
5								
	SS 2	19-10-8-13 (18)	83			10.0	Brownish gray, very stiff, moist, CLAY	-1.0
10								
	SS 3	15-23-18-31 (41)	96			15.0	Grayish brown, dense, moist SAND and GRAVEL	-6.0
15								

Refusal

Bottom of borehole at 15.0 feet.

REMARKS

Groundwater not encountered

Refusal at 15' depth

SUMMARY			
Overburden (ft):		15	
Rock Cored (ft):		0.0	
Samples:		SS=3	
WATER LEVEL DATA		Depth (ft) to:	
Date/Time	Bot. of Casing	Bot. of Hole	Depth to Water

GEOCOMP BOREHOLE LOG - GCCGINTEST.GDT - 9/15/15 10:39 - I\HAL1\GCC\CONSULTING\ACTIVE PROJECTS\220597 - SALEM FOREST RIVER PARK\SURFACE INVESTIGATION\BORING LOGS\FORREST RIVER PARK BORING LOGS.GPJ



TEST BORING REPORT

HOLE ID
B-409
PAGE 1 OF 1

PROJECT NAME
Canal Street Drainage Phase 2 - Forest River

CLIENT
Woodard and Curran

DRILLING CONTRACTOR
Soil Exploration Corp.

PROJECT NAME
220597

PROJECT LOCATION
Salem, MA

SURFACE EL.
10 ft

BORING LOC.

DRILLING EQUIPMENT & PROCEDURES			RIG MAKE & MODEL	START DATE
CASING TYPE N/A	SAMPLER TYPE SPT	BARREL TYPE	CME 75	6/8/15 10:00 AM
CASING ID (in) N/A	SAMPLER ID (in) 2	BIT TYPE Auger	DRILL MUD N/A	FINISH DATE 6/8/15 12:00 PM
CASING HAMMER WT. (lb) 140	SAMPLER HAMMER WT. (lb) 130	DRILLING METHOD Hollow Stem Auger	DRILLER Pat Gooddal and Nick Hume	GEOCOMP REP Mir Karim
CASING HAMMER FALL (in) N/A	SAMPLER HAMMER FALL (in) 30	HOIST/HAMMER Automatic	CHECKED BY D. Dwyer	

Depth (ft)	Sample # Type	Blow Counts (N Value)	Recovery %	Casing (b/ft) Coring (min/ft)	Graphic Log	Depth (ft)	Material Description	Elevation (ft)
0								
	SS 1	4-5-8-11 (13)	100				Yellowish brown and brownish gray, stiff, moist, CLAY	
5						5.0		5.0
	SS 2	4-5-7-8 (12)	100				Grayish brown, stiff, moist, SILTY CLAY	
10						10.0		0.0
	SS 3	4-4-7-8 (11)	100				Yellowish brown, medium dense, moist SANDY SILT	
15						13.5		-3.5
	SS 4	100/2"	100			15.2	Yellowish brown, CLAY	-5.2
							Bottom of borehole at 15.2 feet.	
							Refusal	
							Rock fragments at tip of spoon	

REMARKS Refusal at 15.2' depth	SUMMARY Overburden (ft): 15.2 Rock Cored (ft): 0.0 Samples: SS=4
WATER LEVEL DATA	
Depth (ft) to:	
Date/Time	Bot. of Casing Bot. of Hole Depth to Water
6/8/2015 11:00:00 AM	7.5
Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of ground water may occur due to other factors than those present at the time measurements were made. The ASTM 2488 classification symbol and name presented on the boring logs are based on visual-manual procedures	
HOLE ID B-409	

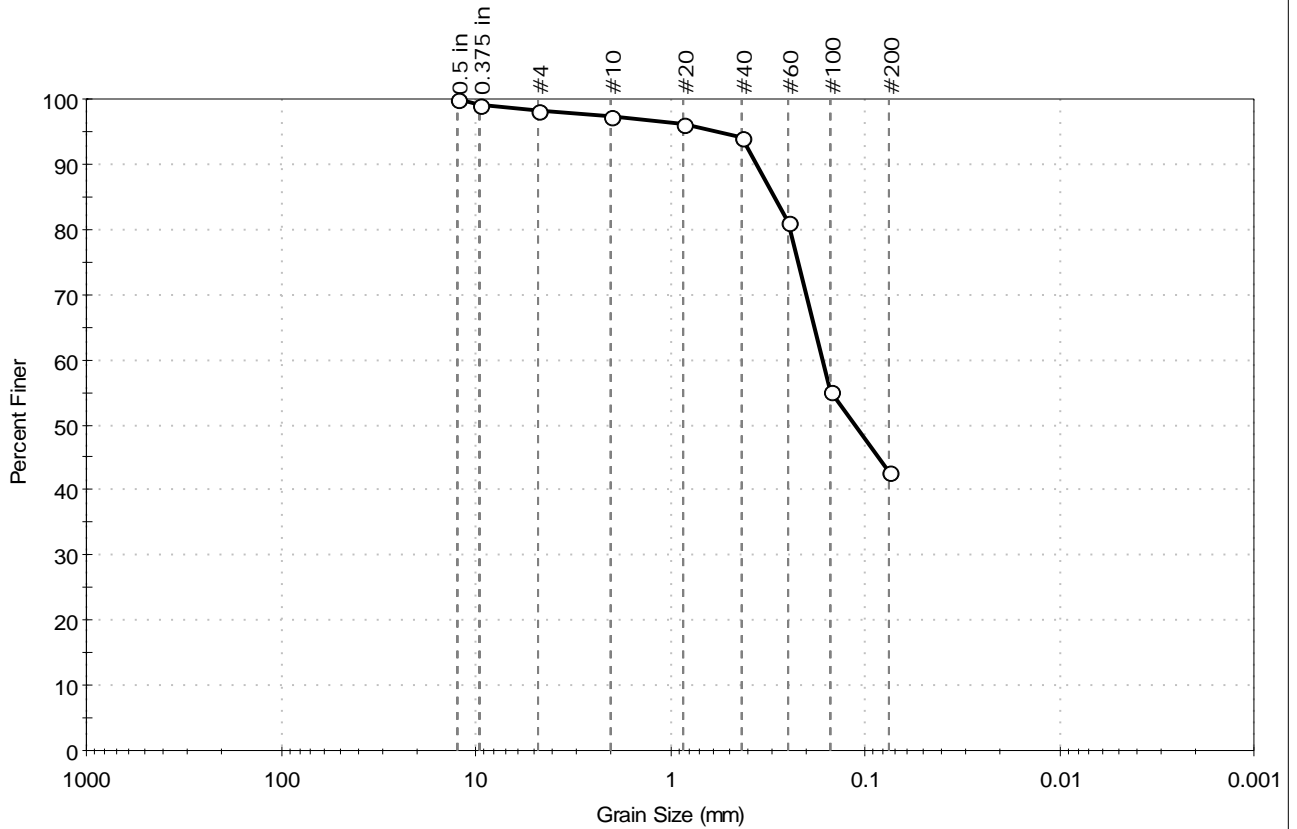
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Appendix B
Lab Test Results



Client: Geocomp Consulting	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No: GTX-302361
Boring ID: B-316A	Sample Type: jar	Tested By: jbr	Checked By: jdt
Sample ID: SS-2	Test Date: 09/30/14	Test Id: 309202	
Depth: 5-7 ft			
Test Comment: ---	Sample Description: Moist, reddish brown silty sand		
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.7	55.6	42.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	98		
#10	2.00	97		
#20	0.85	96		
#40	0.42	94		
#60	0.25	81		
#100	0.15	55		
#200	0.075	43		

Coefficients	
D ₈₅ = 0.2933 mm	D ₃₀ = N/A
D ₆₀ = 0.1649 mm	D ₁₅ = N/A
D ₅₀ = 0.1123 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

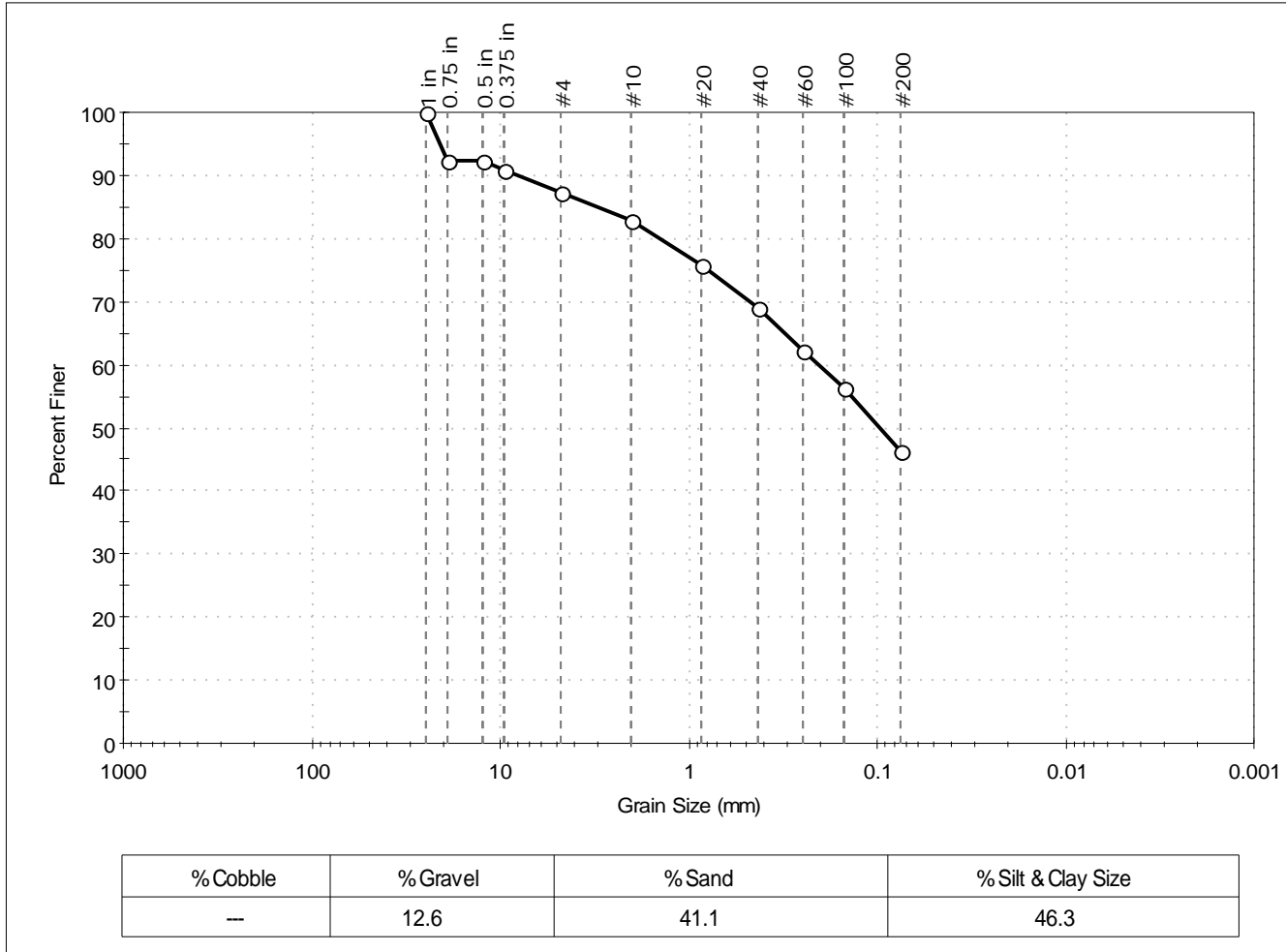
Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0))

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---



Client: Geocomp	Project: Canal Street - Salem Phase 2	Project No: GTX-302361
Location: Salem, MA	Boring ID: B-401	Sample Type: jar
Sample ID: SS-1	Test Date: 06/26/15	Tested By: jbr
Depth: 0-2 ft	Test Id: 336015	Checked By: emm
Test Comment: ---	Sample Description: Moist, yellowish brown silty sand	Sample Comment: ---

Particle Size Analysis - ASTM D422



Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	92		
0.5 in	12.50	92		
0.375 in	9.50	91		
#4	4.75	87		
#10	2.00	83		
#20	0.85	76		
#40	0.42	69		
#60	0.25	62		
#100	0.15	56		
#200	0.075	46		

<u>Coefficients</u>	
D ₈₅ = 2.9742 mm	D ₃₀ = N/A
D ₆₀ = 0.2056 mm	D ₁₅ = N/A
D ₅₀ = 0.0972 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

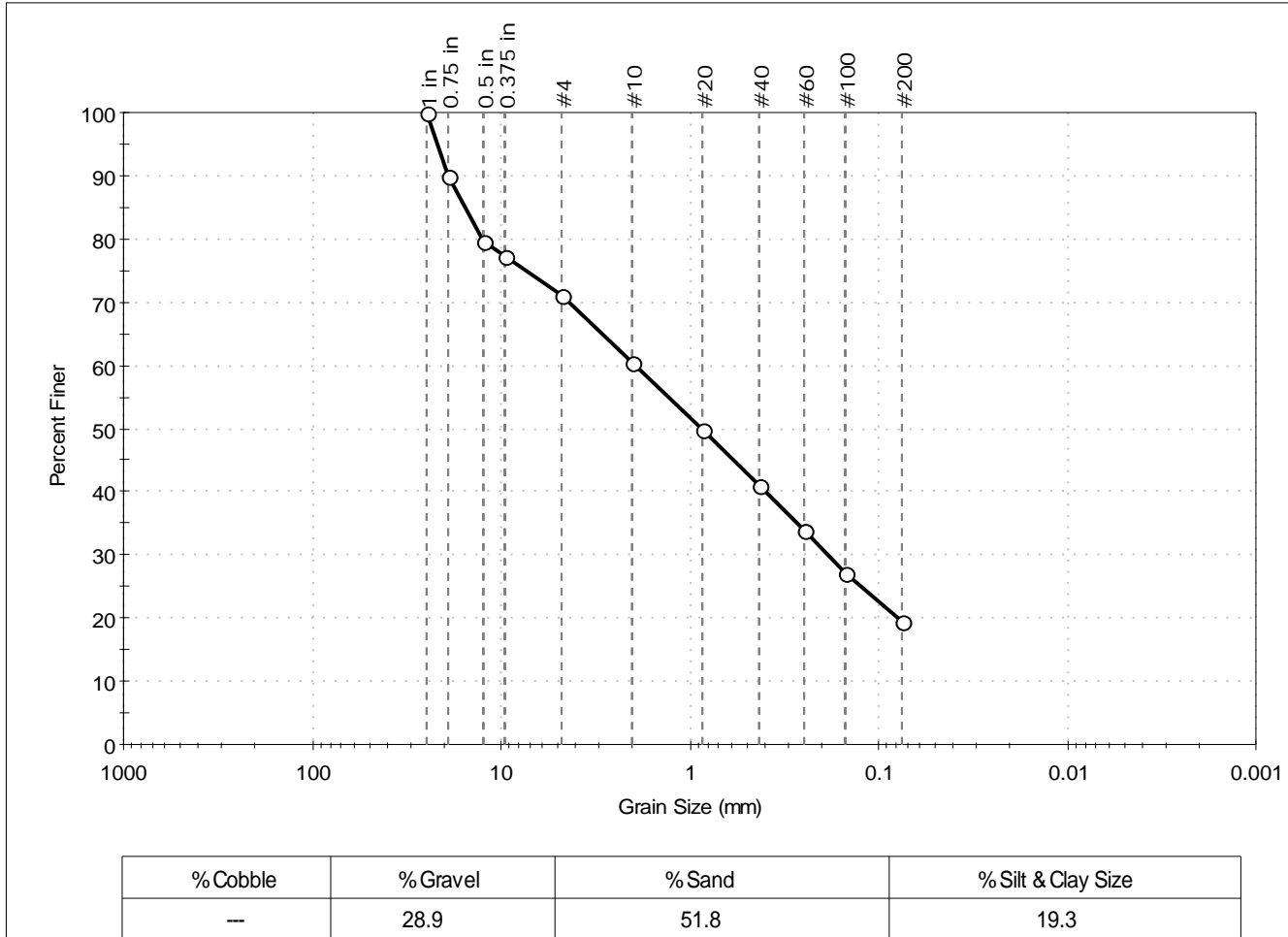
<u>Classification</u>	
<u>ASTM</u>	N/A
<u>AASHTO</u>	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape : ROUNDED	
Sand/Gravel Hardness : HARD	



Client: Geocomp	Project: Canal Street - Salem Phase 2	Project No: GTX-302361
Location: Salem, MA	Boring ID: B-405	Sample Type: jar
Sample ID: SS-2	Test Date: 06/26/15	Tested By: jbr
Depth: 5-7 ft	Test Id: 336016	Checked By: emm
Test Comment: ---	Sample Description: Moist, yellowish brown silty sand with gravel	Sample Comment: ---

Particle Size Analysis - ASTM D422



Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	90		
0.5 in	12.50	80		
0.375 in	9.50	77		
#4	4.75	71		
#10	2.00	60		
#20	0.85	50		
#40	0.42	41		
#60	0.25	34		
#100	0.15	27		
#200	0.075	19		

<u>Coefficients</u>	
D ₈₅ = 15.5241 mm	D ₃₀ = 0.1857 mm
D ₆₀ = 1.9333 mm	D ₁₅ = N/A
D ₅₀ = 0.8519 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

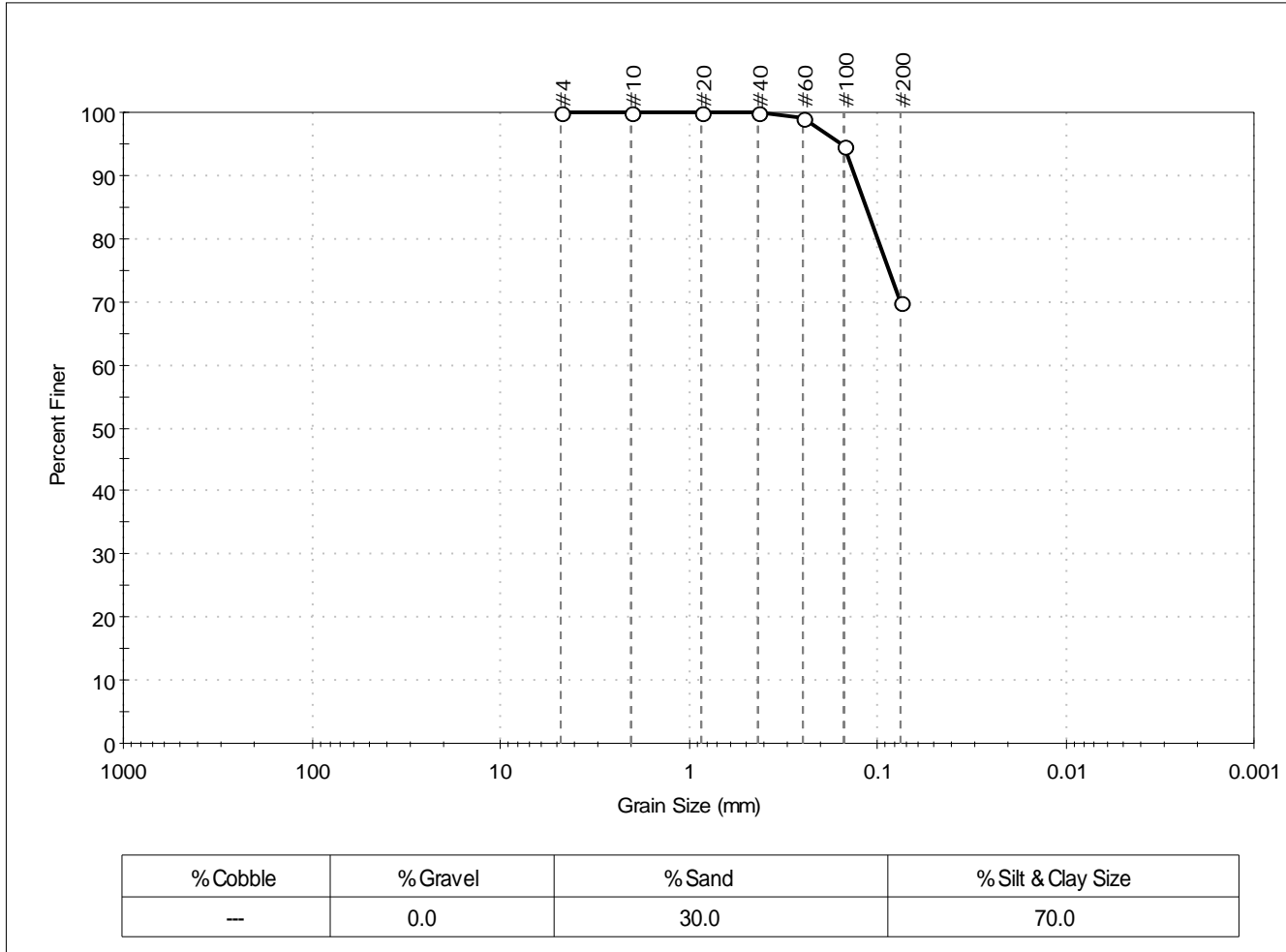
<u>Classification</u>	
<u>ASTM</u>	N/A
<u>AASHTO</u>	Stone Fragments, Gravel and Sand (A-1-b (0))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape : ANGULAR	
Sand/Gravel Hardness : HARD	



Client: Geocomp	Project: Canal Street - Salem Phase 2	Project No: GTX-302361
Location: Salem, MA	Boring ID: B-409	Sample Type: jar
Sample ID: SS-3	Test Date: 06/26/15	Tested By: jbr
Depth: 10-12 ft	Test Id: 336017	Checked By: emm
Test Comment: ---	Sample Description: Moist, yellowish brown sandy silt	Sample Comment: ---

Particle Size Analysis - ASTM D422



Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	95		
#200	0.075	70		

<u>Coefficients</u>	
D ₈₅ = 0.1141 mm	D ₃₀ = N/A
D ₆₀ = N/A	D ₁₅ = N/A
D ₅₀ = N/A	D ₁₀ = N/A
C _u = N/A	C _c = N/A

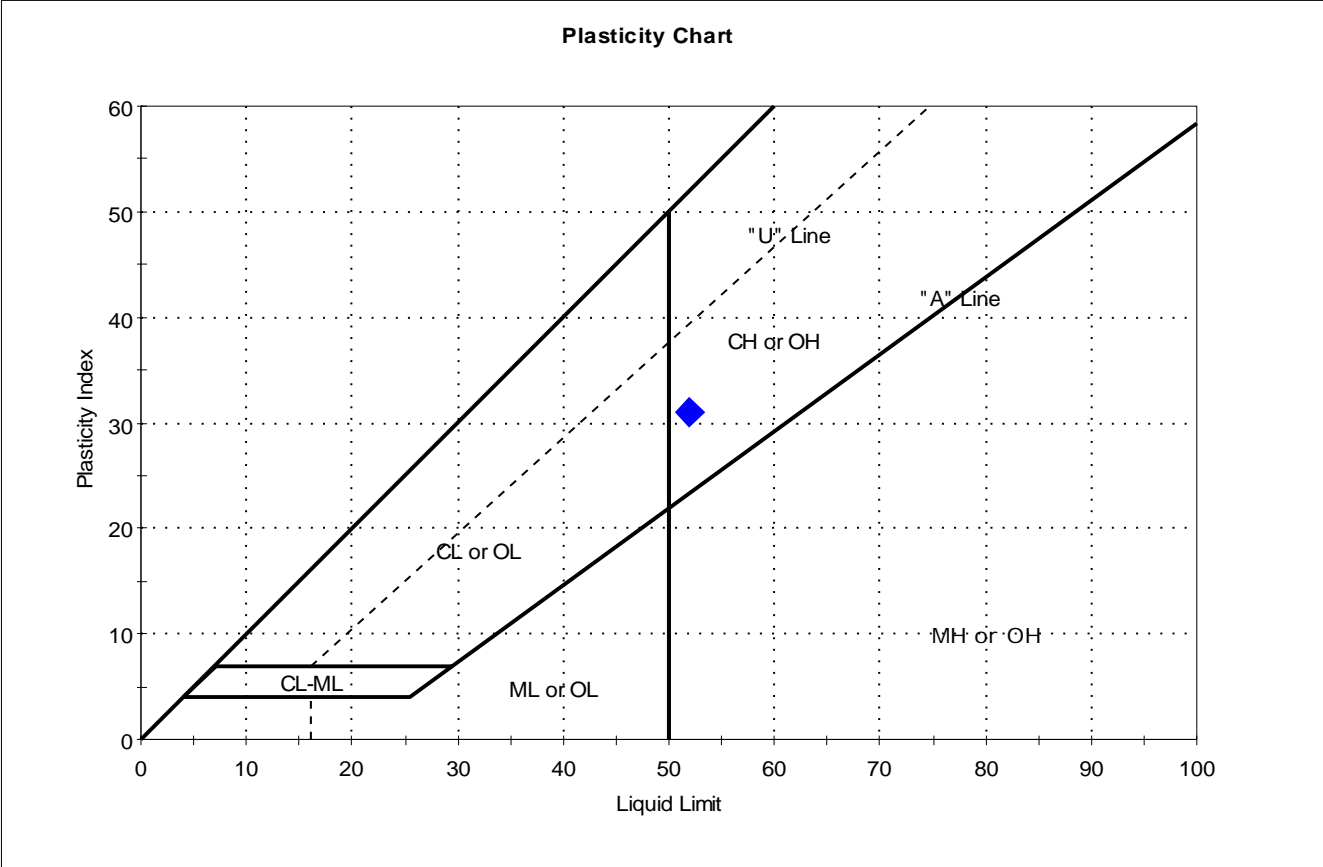
<u>Classification</u>	
<u>ASTM</u>	N/A
<u>AASHTO</u>	Silty Soils (A-4 (0))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape :	---
Sand/Gravel Hardness :	---



Client: Geocomp	Project: Canal Street - Salem Phase 2	Project No: GTX-302361
Location: Salem, MA	Boring ID: B-403	Sample Type: jar
Sample ID: SS-3	Test Date: 06/25/15	Tested By: cam
Depth: 10-12 ft	Test Id: 336011	Checked By: emm
Test Comment: ---	Sample Description: Moist, light brownish gray clay	Sample Comment: ---

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-3	B-403	10-12 ft	30	52	21	31	0.3	

Sample Prepared using the WET method

Dry Strength: HIGH
 Dilatancy: SLOW
 Toughness: LOW



Client:	Geocomp		
Project:	Canal Street - Salem Phase 2		
Location:	Salem, MA	Project No:	GTX-302361
Boring ID:	B-407	Sample Type:	jar
Sample ID:	SS-4	Test Date:	06/25/15
Depth :	15-17 ft	Checked By:	emm
		Test Id:	336012
Test Comment:	---		
Sample Description:	Moist, grayish brown silt		
Sample Comment:	---		

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

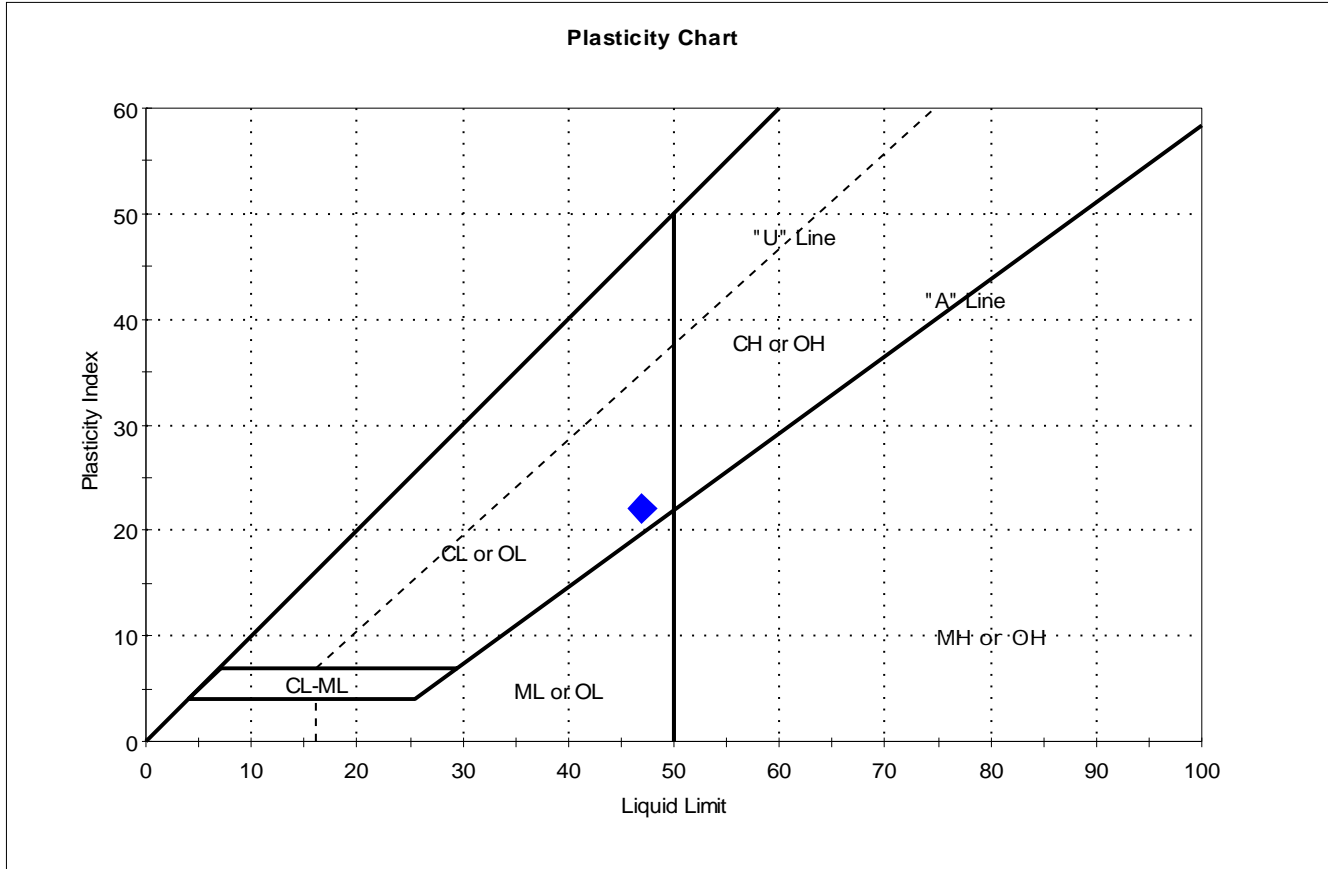
Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-4	B-407	15-17 ft	28	n/a	n/a	n/a	n/a	

Dry Strength: MEDIUM
 Dilatancy: RAPID
 Toughness: n/a
 The sample was determined to be Non-Plastic



Client: Geocomp	Project: Canal Street - Salem Phase 2		Project No: GTX-302361
Location: Salem, MA	Boring ID: B-407	Sample Type: tube	Tested By: cam
Sample ID: ST-1	Depth: 5-7 ft	Test Date: 06/25/15	Checked By: emm
Test Comment: ---	Sample Description: Moist, grayish brown clay	Test Id: 336013	
Sample Comment: ---			

Atterberg Limits - ASTM D4318



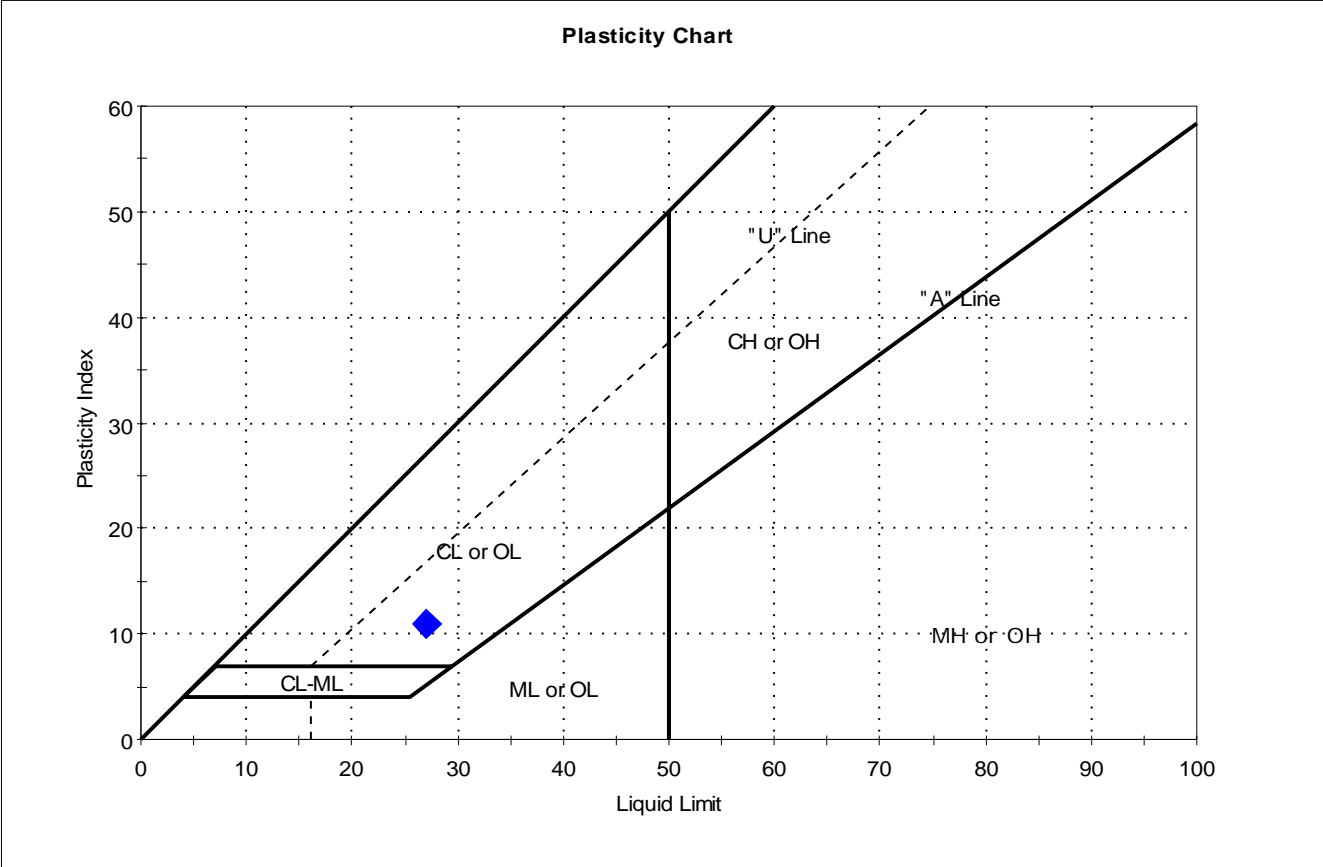
Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	ST-1	B-407	5-7 ft	31	47	25	22	0.3	

Sample Prepared using the WET method

Dry Strength: HIGH
 Dilatancy: SLOW
 Toughness: LOW

Client: Geocomp	Project: Canal Street - Salem Phase 2		Project No: GTX-302361
Location: Salem, MA	Boring ID: B-408	Sample Type: jar	Tested By: cam
Sample ID: SS-2	Depth: 5-7 ft	Test Date: 06/25/15	Checked By: emm
Test Comment: ---	Sample Description: Moist, brownish gray clay	Test Id: 336014	
Sample Comment: ---			

Atterberg Limits - ASTM D4318



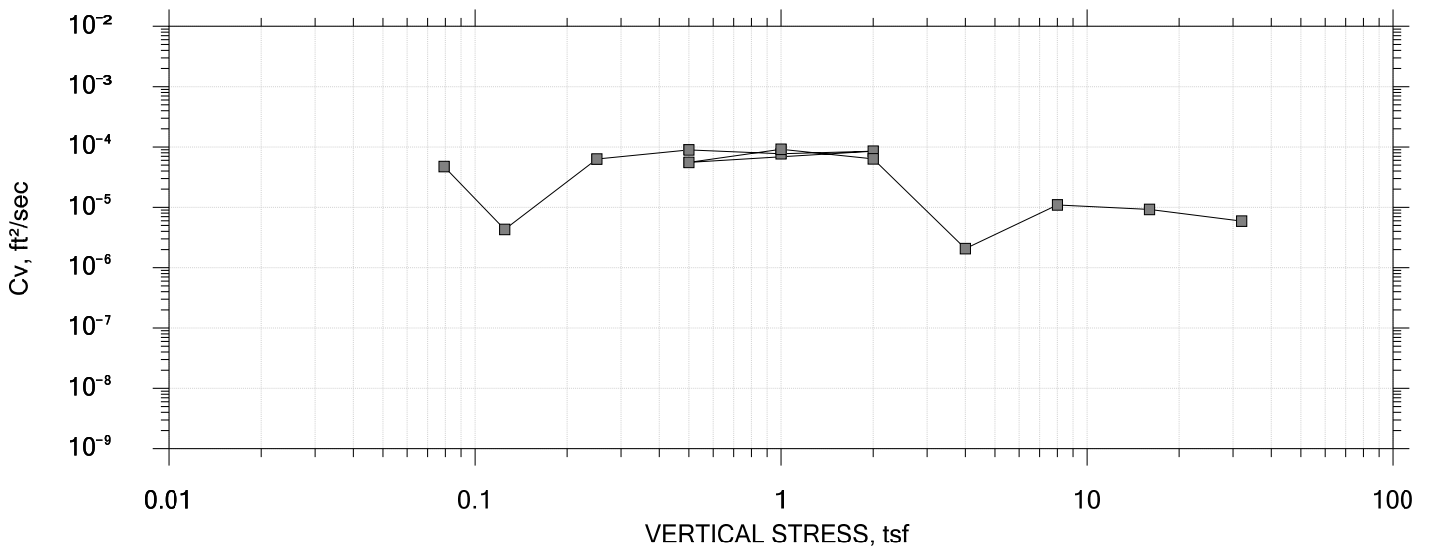
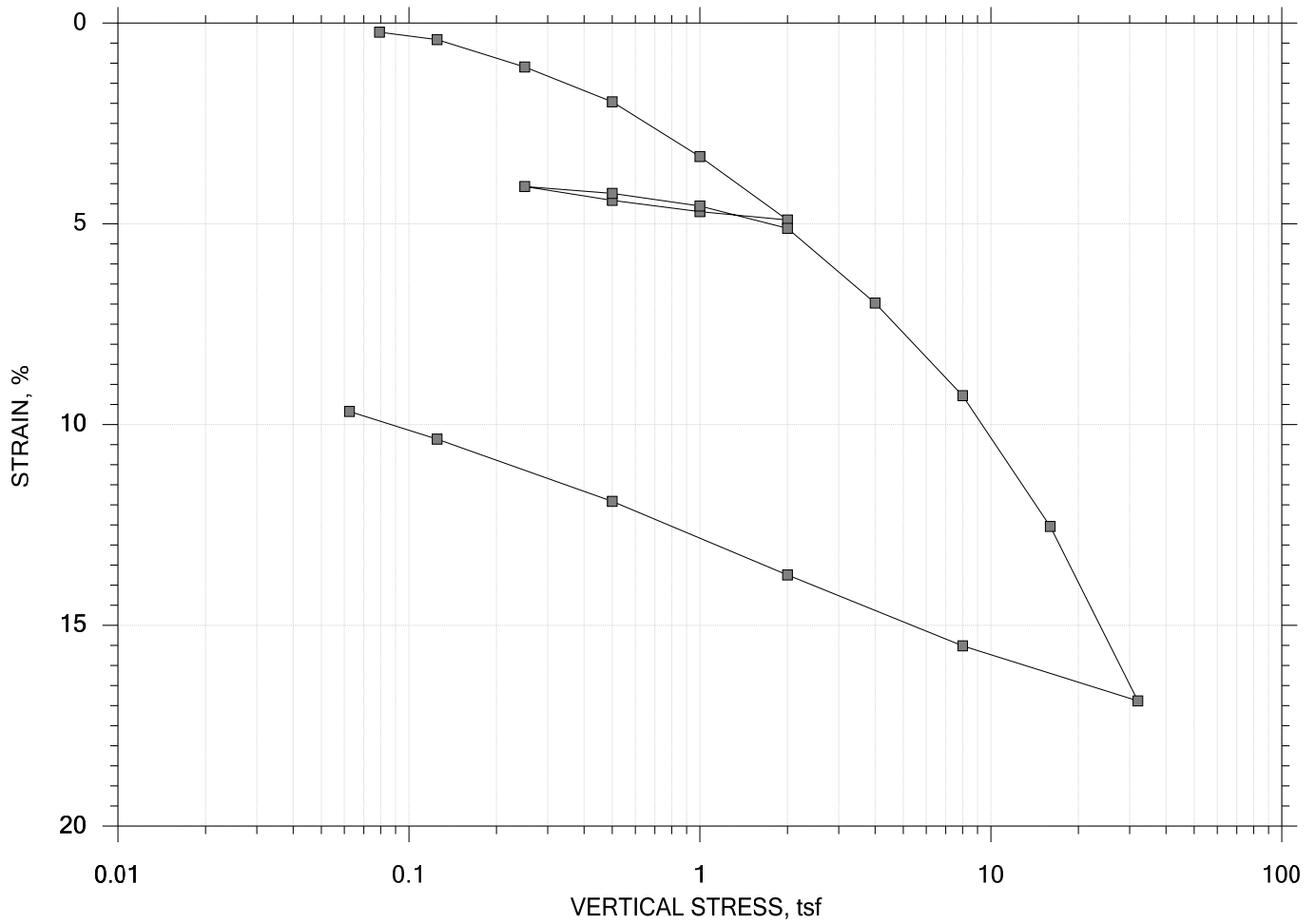
Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS-2	B-408	5-7 ft	10	27	16	11	-0.5	


Sample Prepared using the WET method

Dry Strength: VERY HIGH
 Dilatancy: SLOW
 Toughness: LOW

One-Dimensional Consolidation by ASTM D2435 - Method B

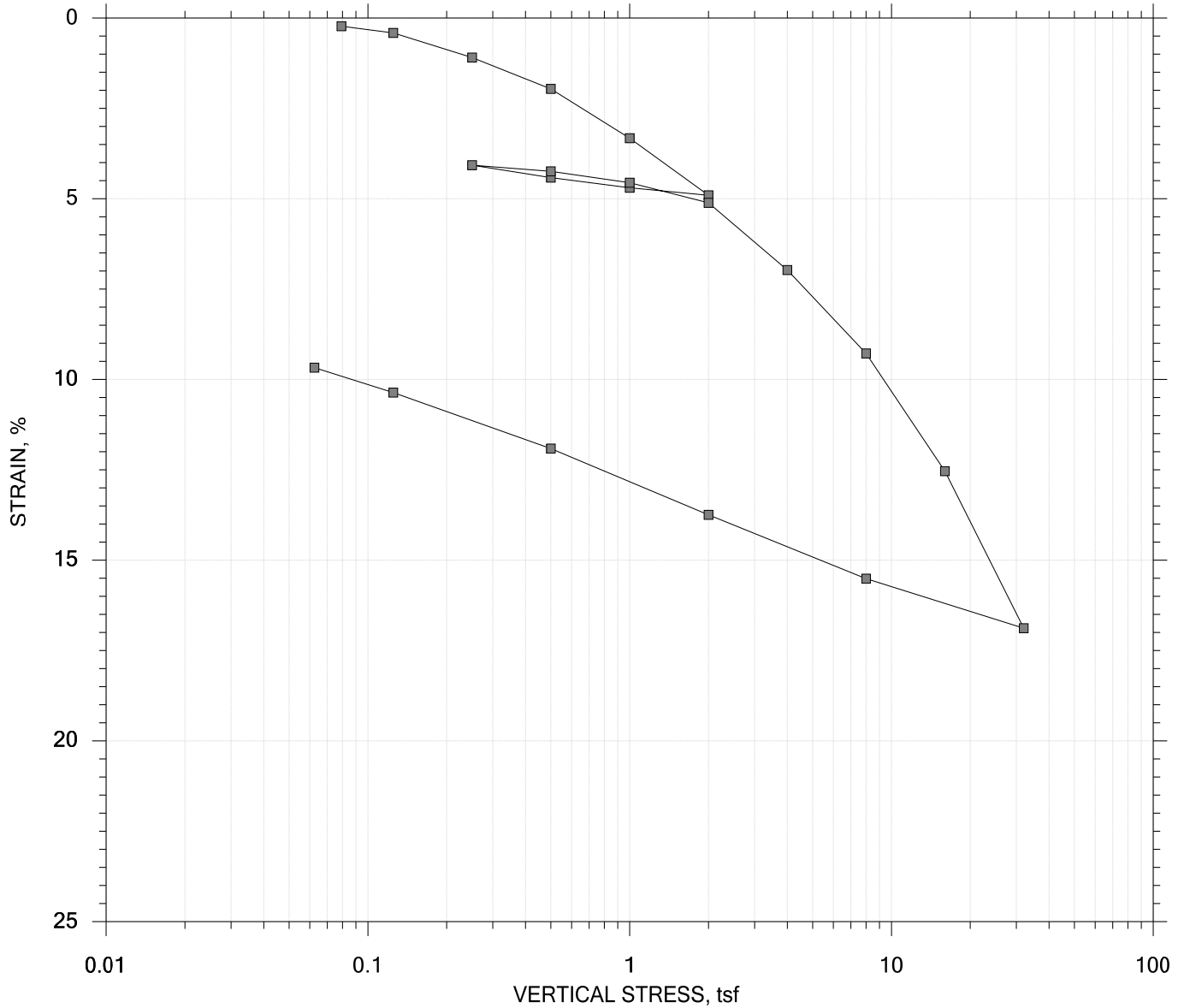
SUMMARY REPORT




	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



				Before Test	After Test	
Current Vertical Effective Stress: ---				Water Content, %	31.25	27.74
Preconsolidation Stress: ---				Dry Unit Weight, pcf	87.767	97.519
Compression Ratio: ---				Saturation, %	89.66	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	0.96	0.76
LL: 47	PL: 25	PI: 22	GS: 2.76			

	Project: Canal Street - Salem Phase 2		Location: Salem, MA		Project No.: GTX-302361	
	Boring No.: B-407		Tested By: md		Checked By: njh	
	Sample No.: ST-1		Test Date: 06/23/2015		Test No.: IP-1	
	Depth: 5-7 ft		Sample Type: intact		Elevation: ---	
	Description: Moist, grayish brown clay					
	Remarks: System X, Swell Pressure = 0.0792 tsf					
	Displacement at End of Increment					

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Canal Street - Salem Phase 2
 Boring No.: B-407
 Sample No.: ST-1
 Test No.: IP-1

Location: Salem, MA
 Tested By: md
 Test Date: 06/23/2015
 Sample Type: intact

Project No.: GTX-302361
 Checked By: njh
 Depth: 5-7 ft
 Elevation: ---

Soil Description: Moist, grayish brown clay
 Remarks: System X, Swell Pressure = 0.0792 tsf

Estimated Specific Gravity: 2.76
 Initial Void Ratio: 0.961
 Final Void Ratio: 0.765

Liquid Limit: 47
 Plastic Limit: 25
 Plasticity Index: 22

Specimen Diameter: 2.50 in
 Initial Height: 1.00 in
 Final Height: 0.90 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	A556	RING		16864
Wt. Container + Wet Soil, gm	93.510	259.96	255.99	153.33
Wt. Container + Dry Soil, gm	74.200	224.62	224.62	121.84
Wt. Container, gm	8.8800	111.53	111.53	8.3200
Wt. Dry Soil, gm	65.320	113.09	113.09	113.52
Water Content, %	29.56	31.25	27.74	27.74
Void Ratio	---	0.961	0.765	---
Degree of Saturation, %	---	89.66	100.00	---
Dry Unit Weight, pcf	---	87.767	97.519	---

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: Canal Street - Salem Phase 2
 Boring No.: B-407
 Sample No.: ST-1
 Test No.: IP-1

Location: Salem, MA
 Tested By: md
 Test Date: 06/23/2015
 Sample Type: intact

Project No.: GTX-302361
 Checked By: njh
 Depth: 5-7 ft
 Elevation: ---

Soil Description: Moist, grayish brown clay
 Remarks: System X, Swell Pressure = 0.0792 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft ² /sec	Mv 1/tsf	k ft/day
1	0.0792	0.002244	0.956	0.224	0.492	4.98e-005	2.83e-002	3.81e-003
2	0.125	0.004098	0.953	0.410	4.621	5.28e-006	4.05e-002	5.76e-004
3	0.250	0.01094	0.939	1.09	0.897	2.69e-005	5.47e-002	3.98e-003
4	0.500	0.01958	0.922	1.96	0.414	5.75e-005	3.46e-002	5.36e-003
5	1.00	0.03325	0.896	3.32	0.420	5.54e-005	2.73e-002	4.08e-003
6	2.00	0.04903	0.865	4.90	0.400	5.64e-005	1.58e-002	2.40e-003
7	1.00	0.04694	0.869	4.69	0.431	5.16e-005	2.10e-003	2.91e-004
8	0.500	0.04415	0.874	4.41	1.763	1.27e-005	5.58e-003	1.91e-004
9	0.250	0.04070	0.881	4.07	1.211	1.86e-005	1.38e-002	6.90e-004
10	0.500	0.04240	0.878	4.24	0.475	4.75e-005	6.80e-003	8.70e-004
11	1.00	0.04554	0.871	4.55	0.387	5.80e-005	6.28e-003	9.81e-004
12	2.00	0.05113	0.860	5.11	0.537	4.14e-005	5.59e-003	6.24e-004
13	4.00	0.06970	0.824	6.97	108.153	2.00e-007	9.29e-003	5.02e-006
14	8.00	0.09280	0.779	9.28	1.998	1.04e-005	5.77e-003	1.61e-004
15	16.0	0.1253	0.715	12.5	2.616	7.45e-006	4.07e-003	8.17e-005
16	32.0	0.1688	0.630	16.9	2.955	6.04e-006	2.72e-003	4.42e-005
17	8.00	0.1551	0.657	15.5	4.228	4.08e-006	5.70e-004	6.27e-006
18	2.00	0.1375	0.691	13.7	7.366	2.43e-006	2.94e-003	1.93e-005
19	0.500	0.1191	0.727	11.9	16.236	1.15e-006	1.22e-002	3.79e-005
20	0.125	0.1036	0.758	10.4	60.865	3.18e-007	4.13e-002	3.55e-005
21	0.0625	0.09672	0.771	9.67	131.341	1.51e-007	1.10e-001	4.50e-005

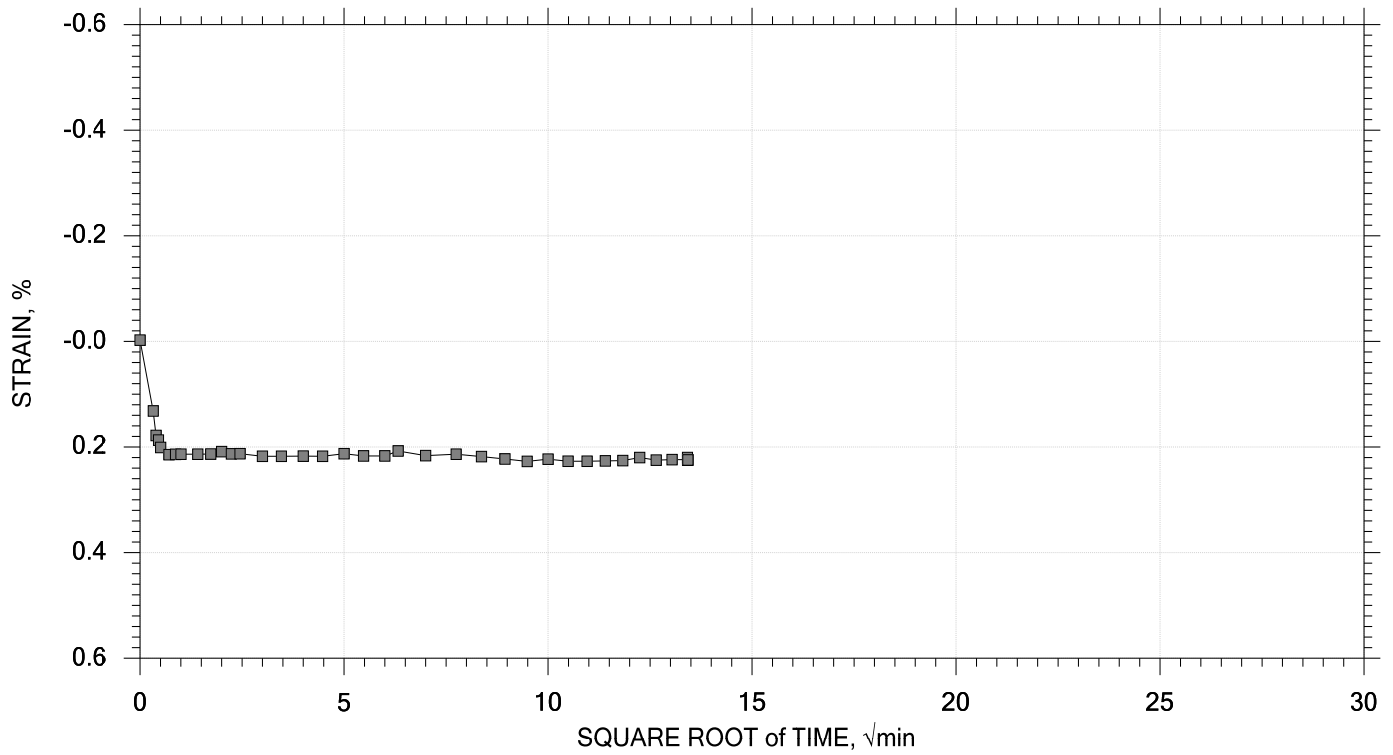
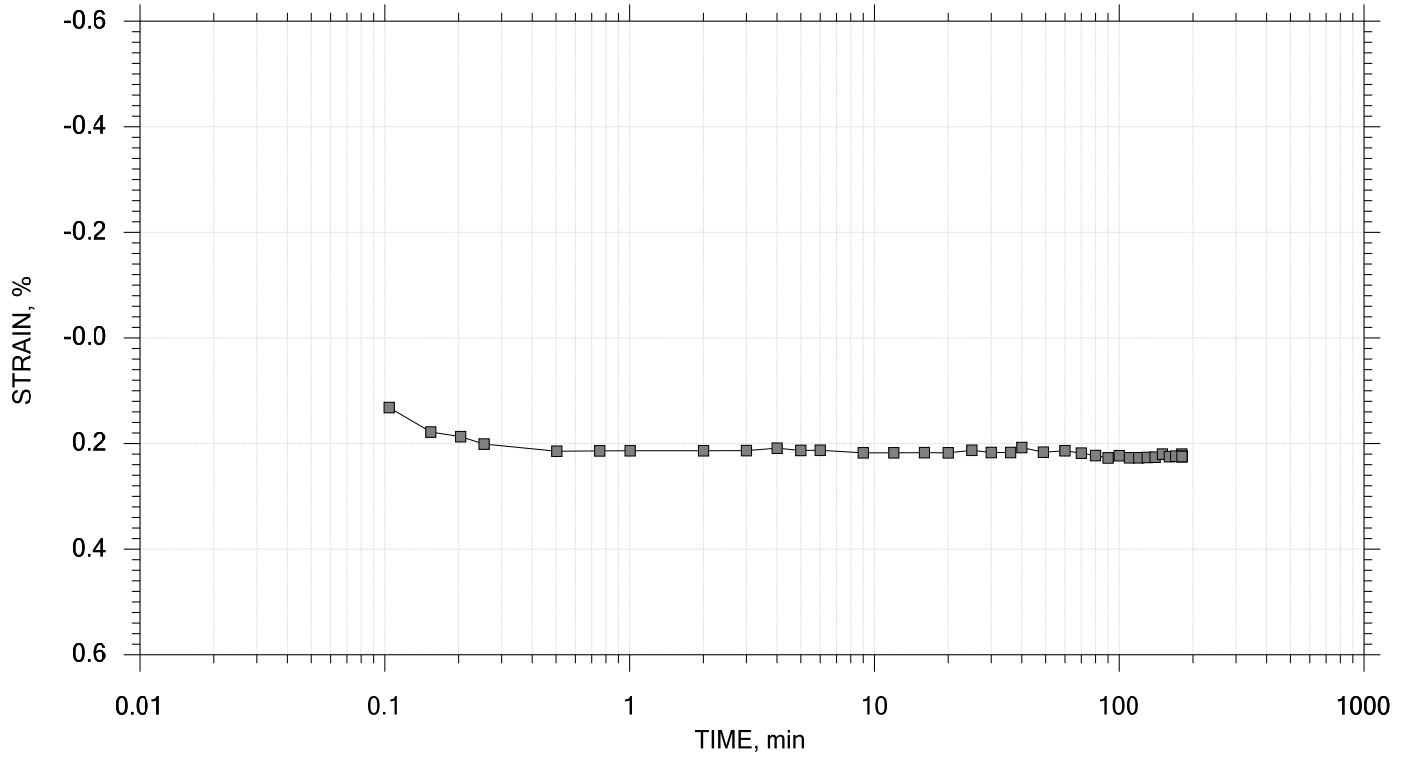
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft ² /sec	Mv 1/tsf	k ft/day	Ca %
1	0.0792	0.002244	0.956	0.224	0.000	0.00e+000	2.83e-002	0.00e+000	0.00e+000
2	0.125	0.004098	0.953	0.410	0.000	0.00e+000	4.05e-002	0.00e+000	0.00e+000
3	0.250	0.01094	0.939	1.09	0.019	2.96e-004	5.47e-002	4.37e-002	0.00e+000
4	0.500	0.01958	0.922	1.96	0.000	0.00e+000	3.46e-002	0.00e+000	0.00e+000
5	1.00	0.03325	0.896	3.32	0.000	0.00e+000	2.73e-002	0.00e+000	0.00e+000
6	2.00	0.04903	0.865	4.90	0.000	0.00e+000	1.58e-002	0.00e+000	0.00e+000
7	1.00	0.04694	0.869	4.69	0.000	0.00e+000	2.10e-003	0.00e+000	0.00e+000
8	0.500	0.04415	0.874	4.41	0.000	0.00e+000	5.58e-003	0.00e+000	0.00e+000
9	0.250	0.04070	0.881	4.07	0.312	1.68e-005	1.38e-002	6.22e-004	0.00e+000
10	0.500	0.04240	0.878	4.24	0.000	0.00e+000	6.80e-003	0.00e+000	0.00e+000
11	1.00	0.04554	0.871	4.55	0.000	0.00e+000	6.28e-003	0.00e+000	0.00e+000
12	2.00	0.05113	0.860	5.11	0.000	0.00e+000	5.59e-003	0.00e+000	0.00e+000
13	4.00	0.06970	0.824	6.97	0.000	0.00e+000	9.29e-003	0.00e+000	0.00e+000
14	8.00	0.09280	0.779	9.28	0.000	0.00e+000	5.77e-003	0.00e+000	0.00e+000
15	16.0	0.1253	0.715	12.5	0.401	1.13e-005	4.07e-003	1.24e-004	0.00e+000
16	32.0	0.1688	0.630	16.9	0.000	0.00e+000	2.72e-003	0.00e+000	0.00e+000
17	8.00	0.1551	0.657	15.5	0.000	0.00e+000	5.70e-004	0.00e+000	0.00e+000
18	2.00	0.1375	0.691	13.7	2.198	1.89e-006	2.94e-003	1.50e-005	0.00e+000
19	0.500	0.1191	0.727	11.9	4.492	9.64e-007	1.22e-002	3.18e-005	0.00e+000
20	0.125	0.1036	0.758	10.4	0.000	0.00e+000	4.13e-002	0.00e+000	0.00e+000
21	0.0625	0.09672	0.771	9.67	0.000	0.00e+000	1.10e-001	0.00e+000	0.00e+000


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.079181 tsf



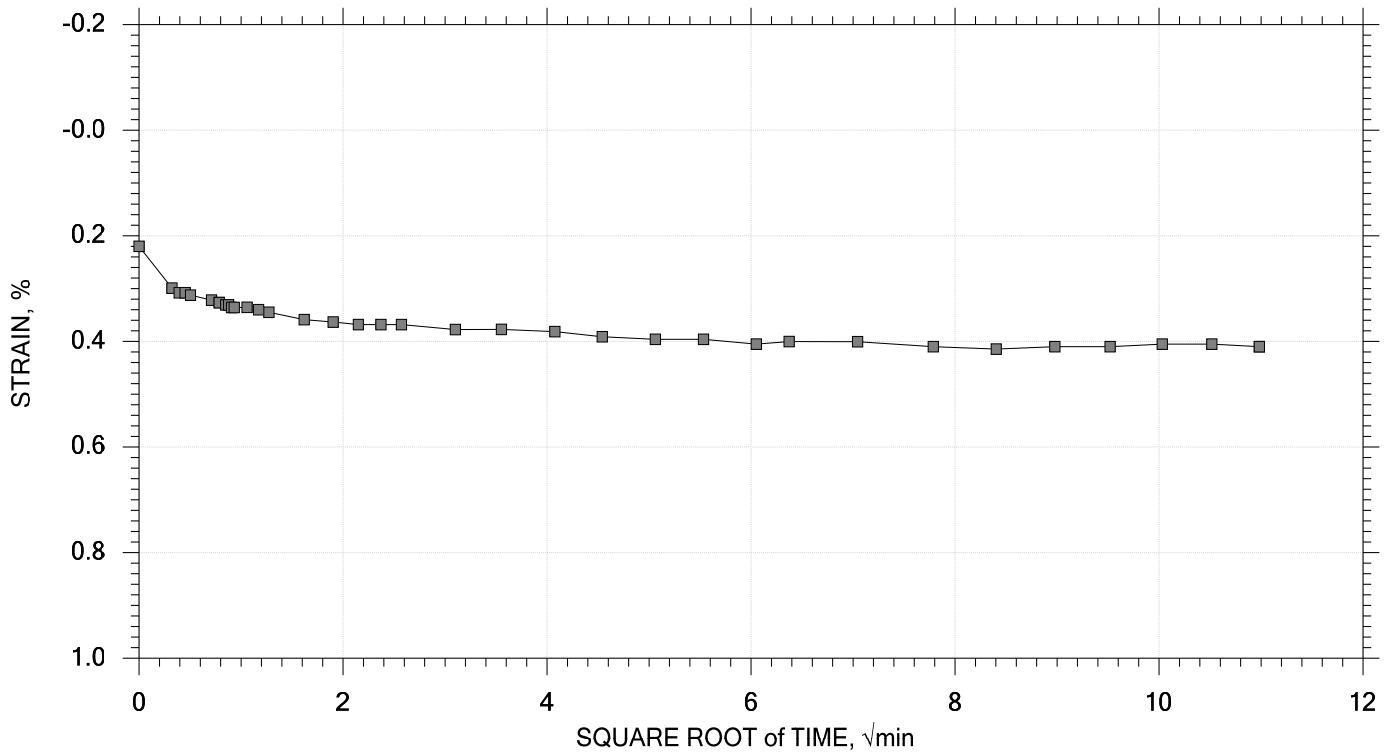
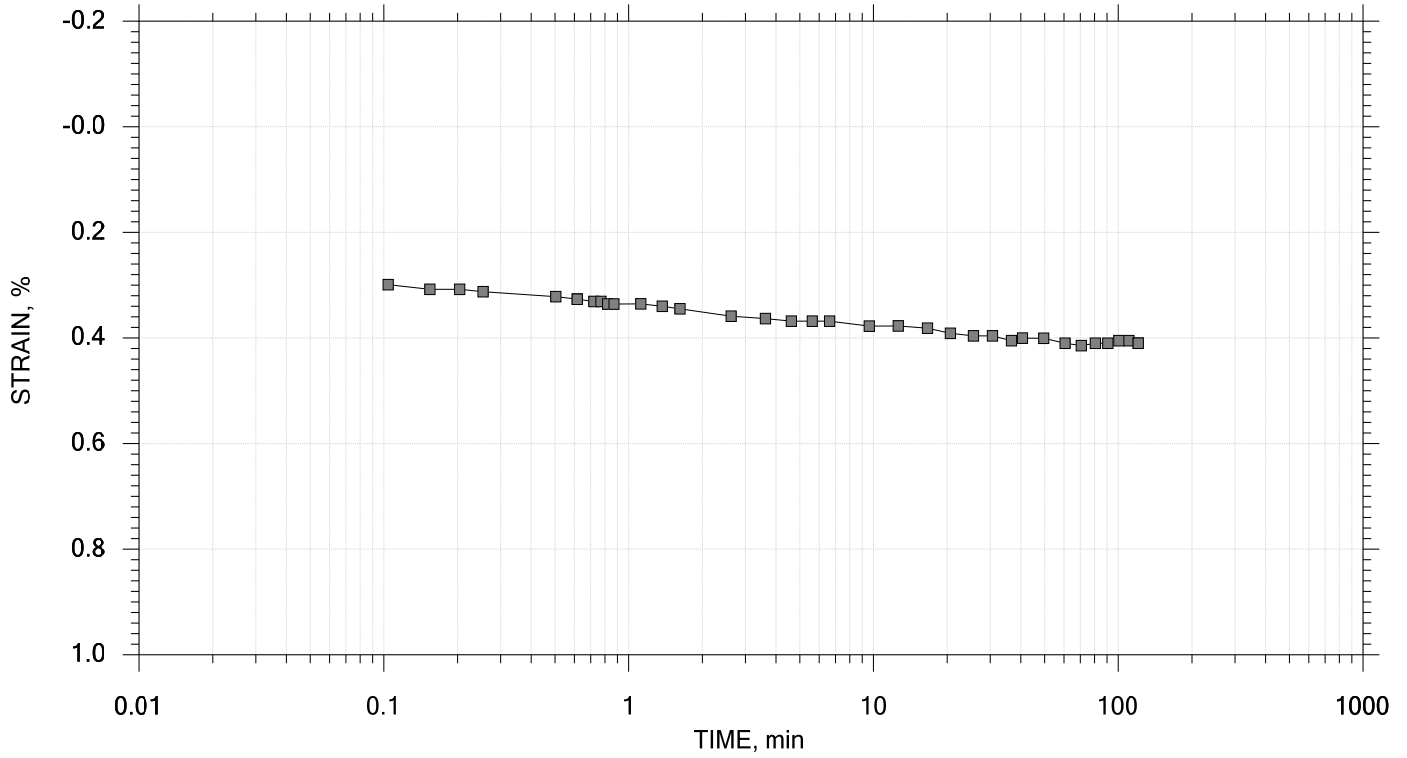
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf



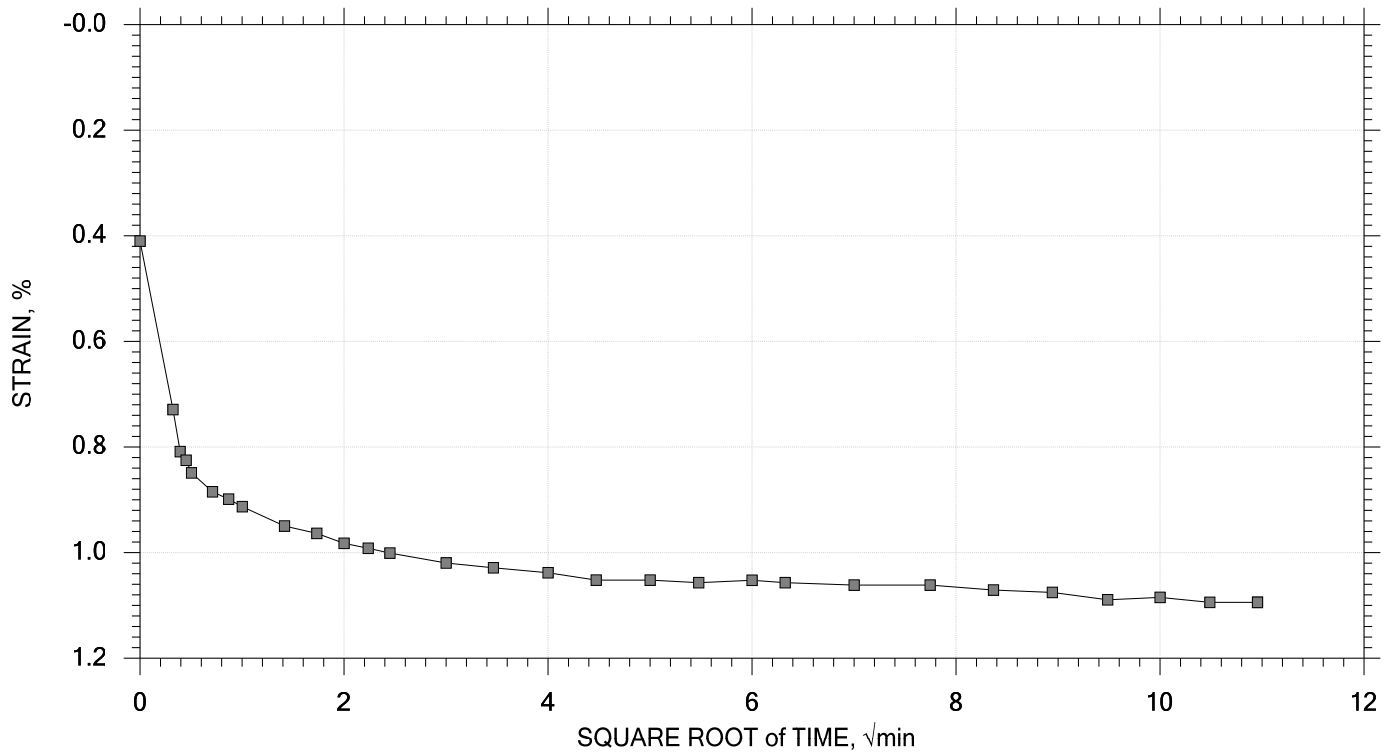
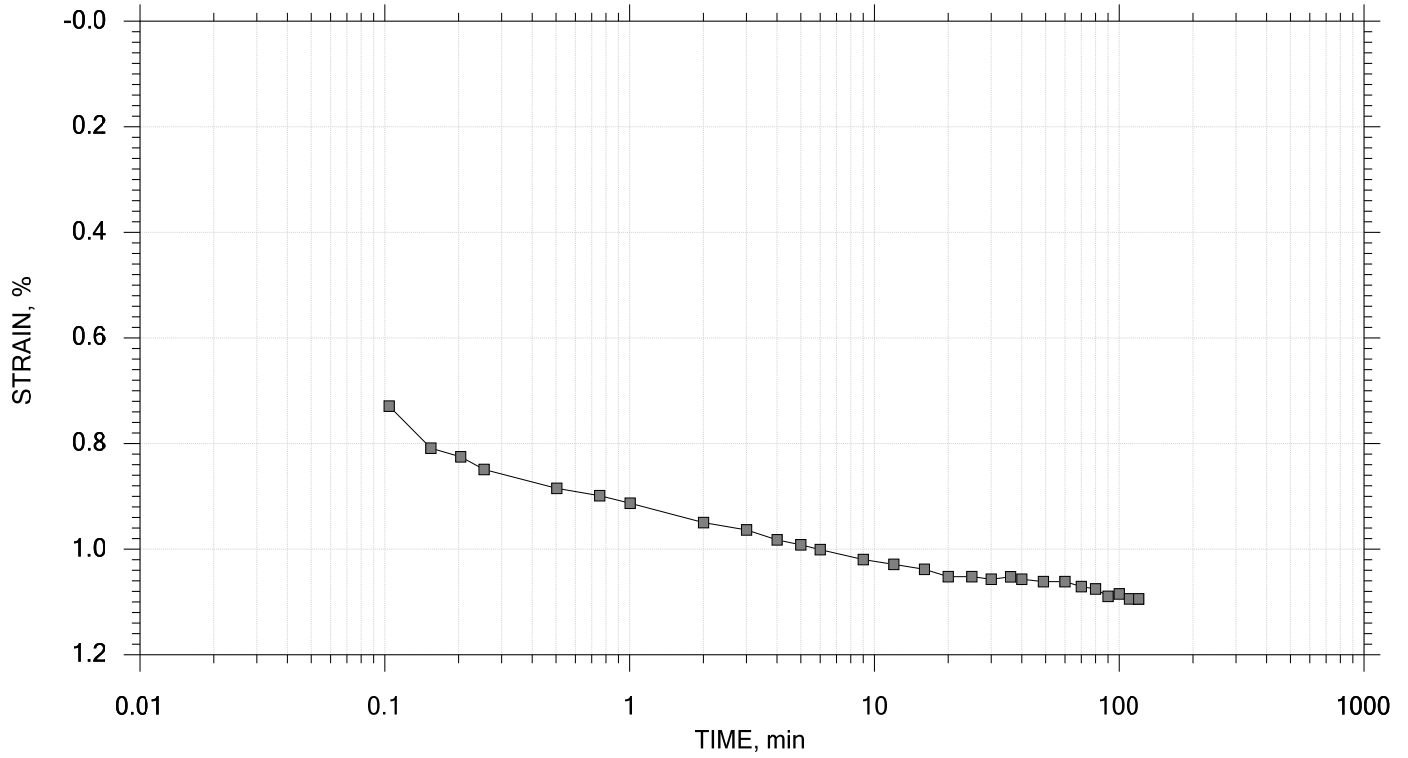
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf



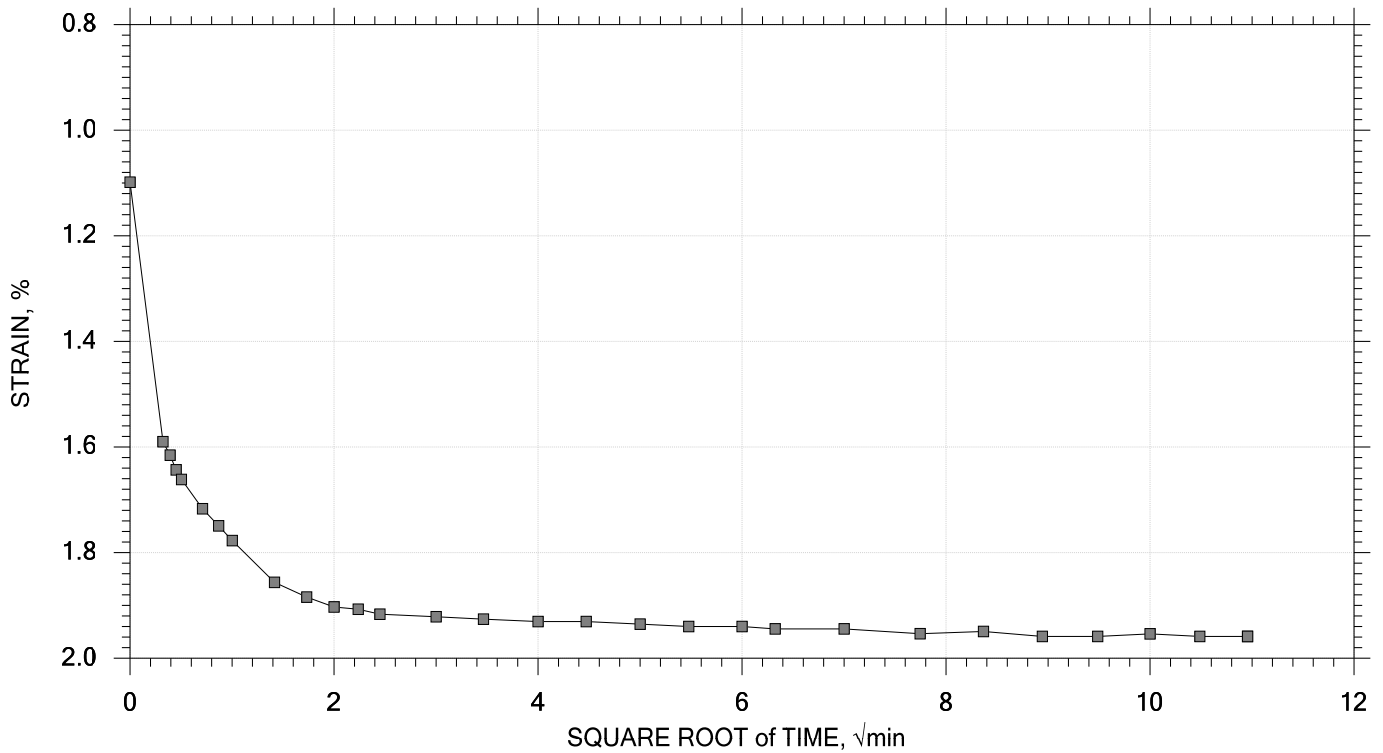
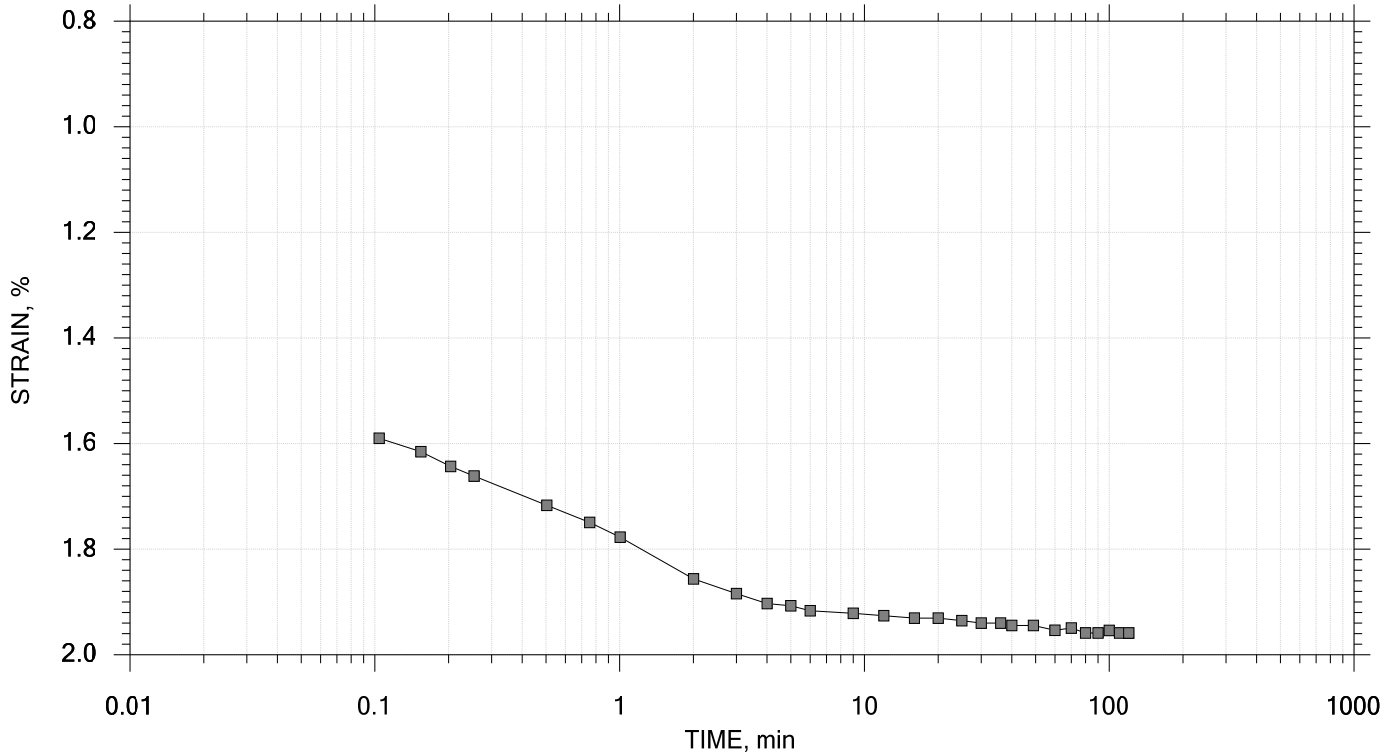
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf



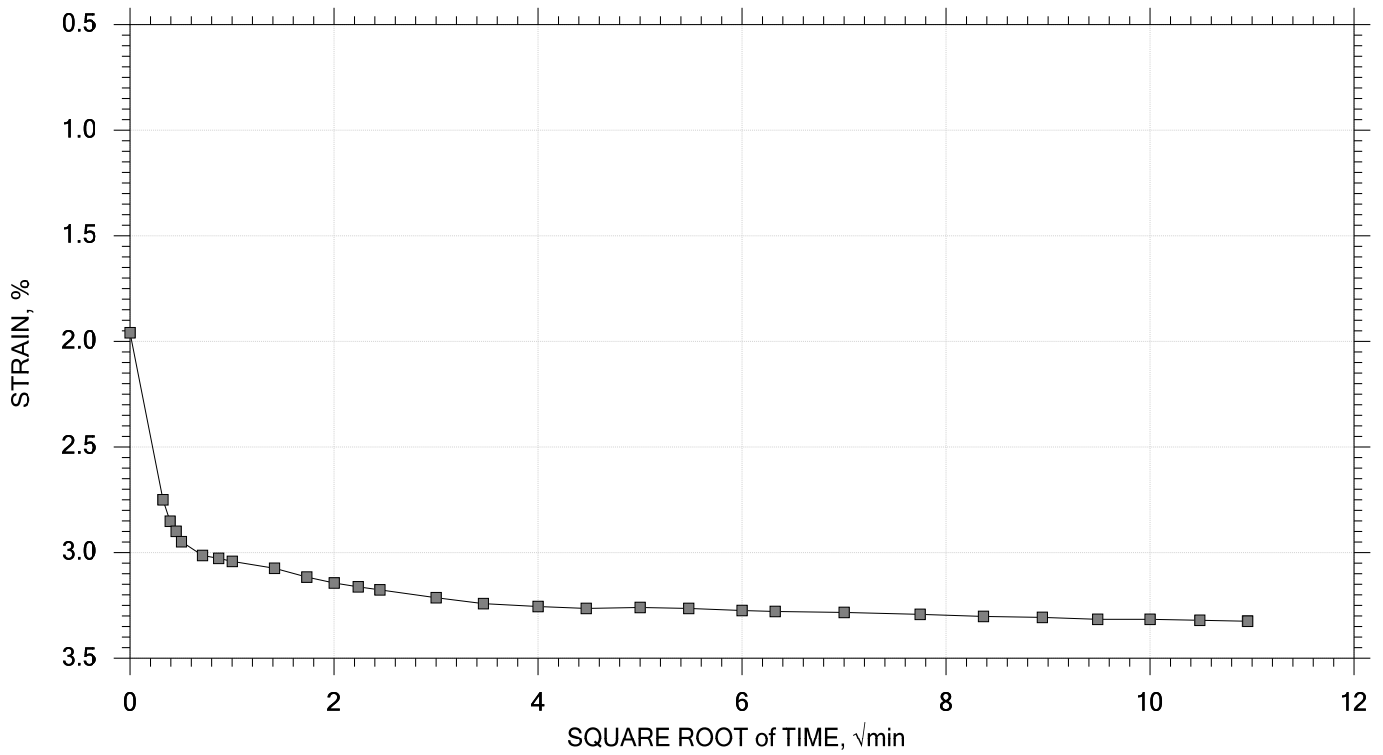
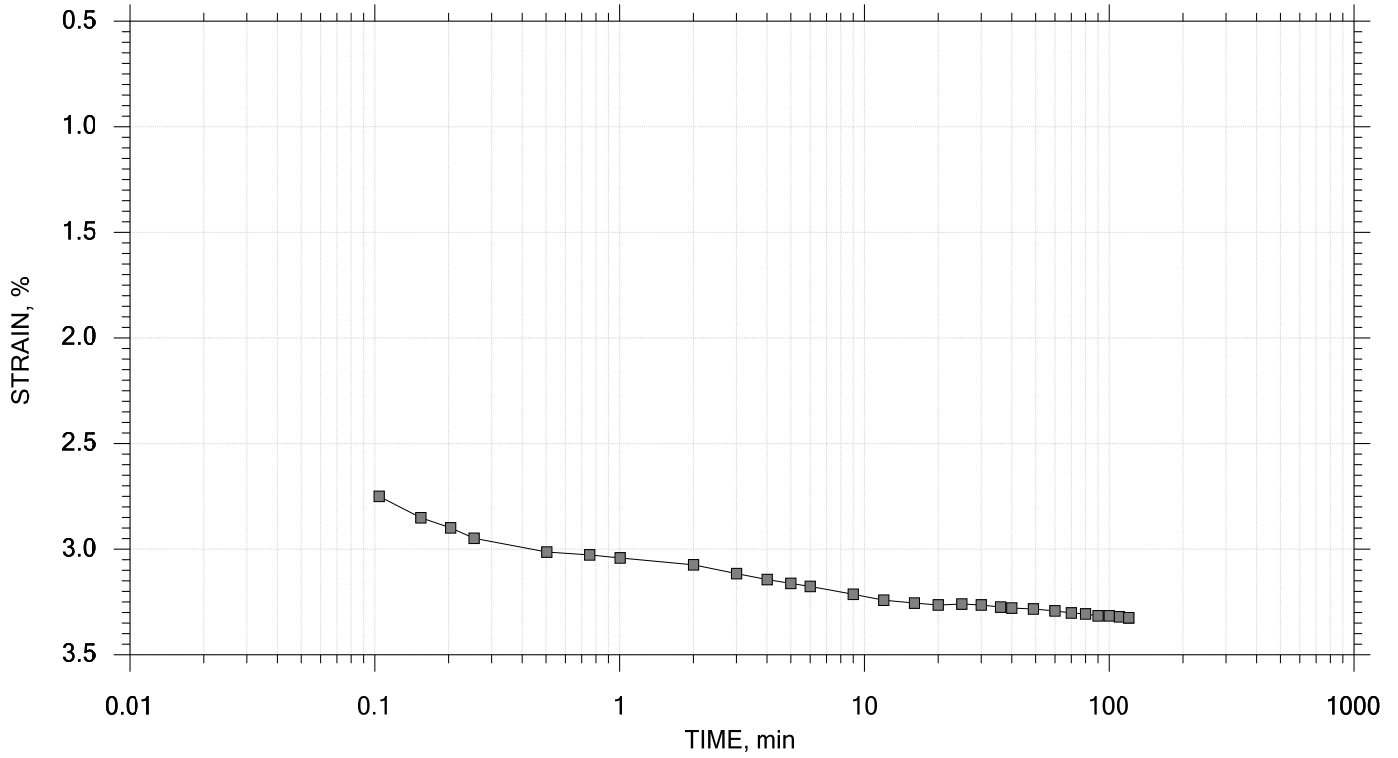
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf



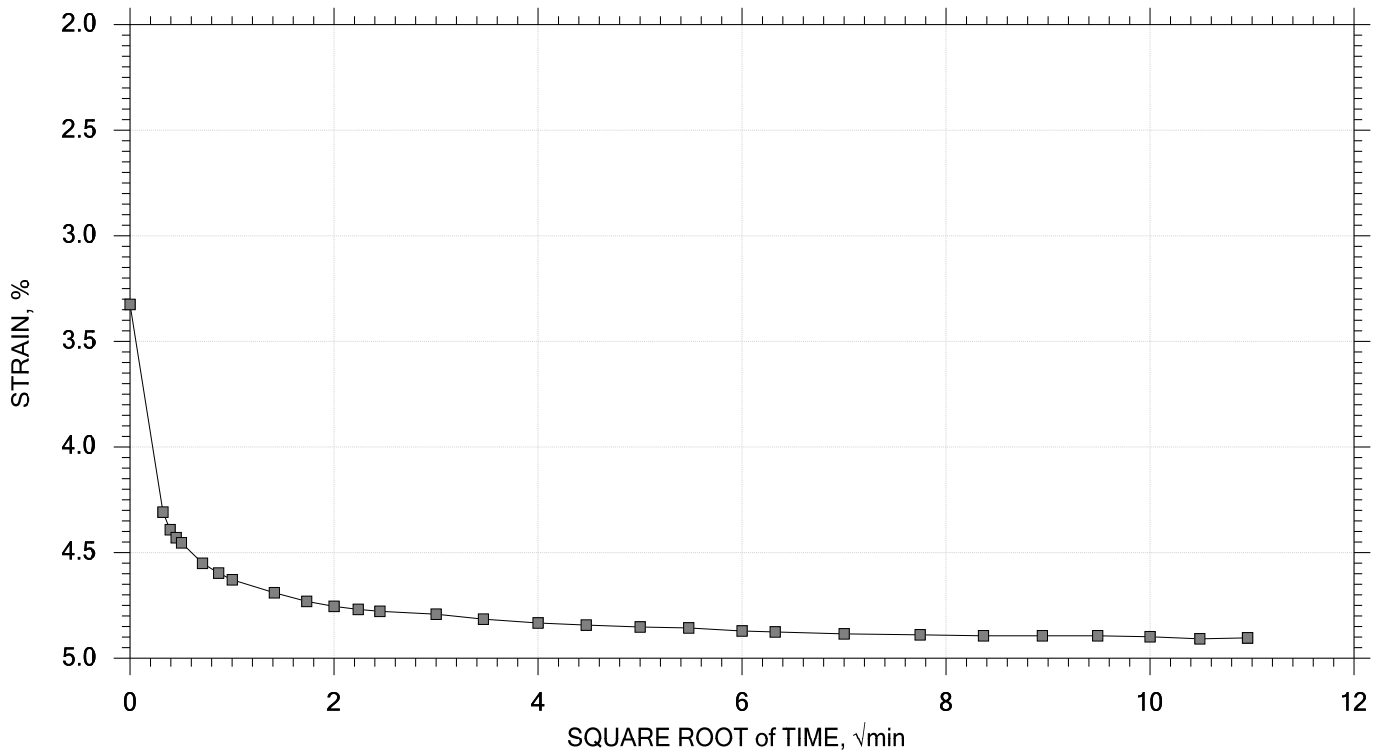
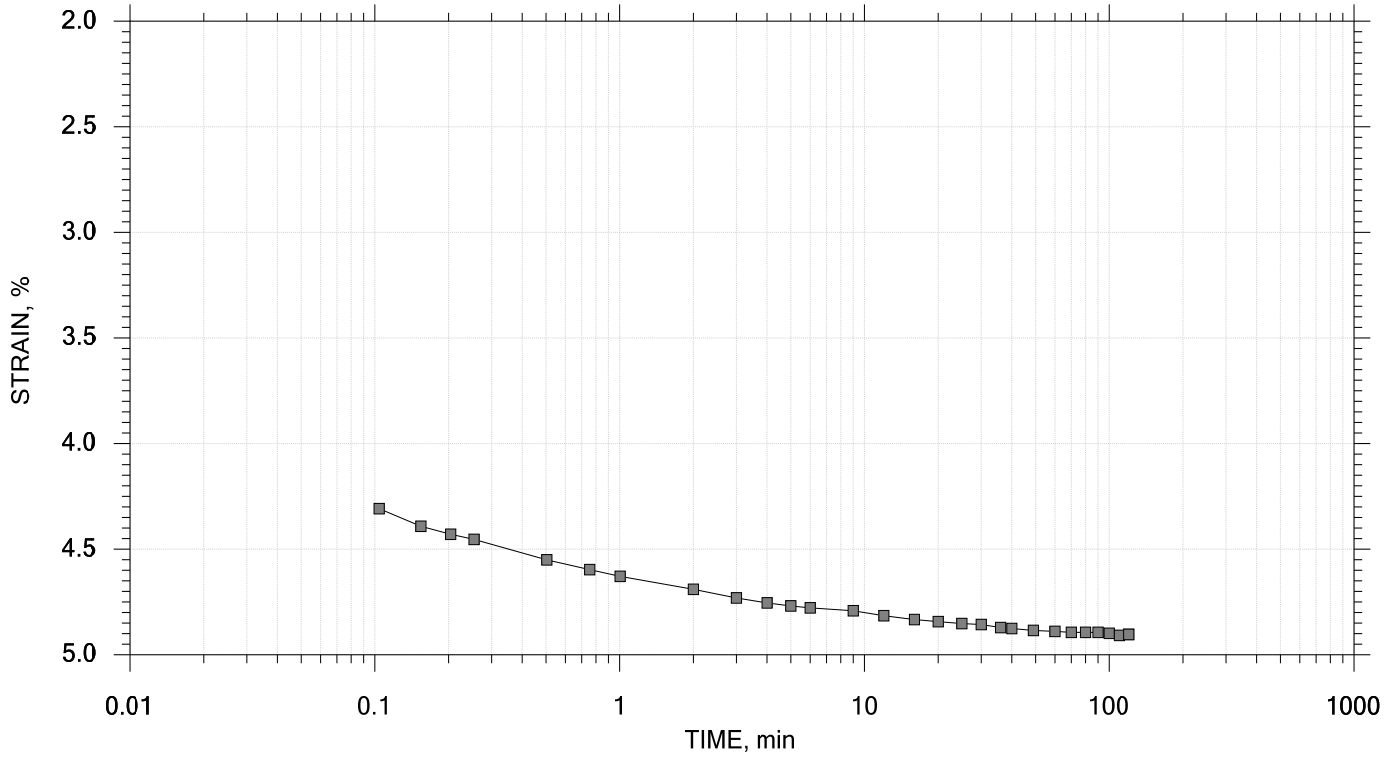
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf



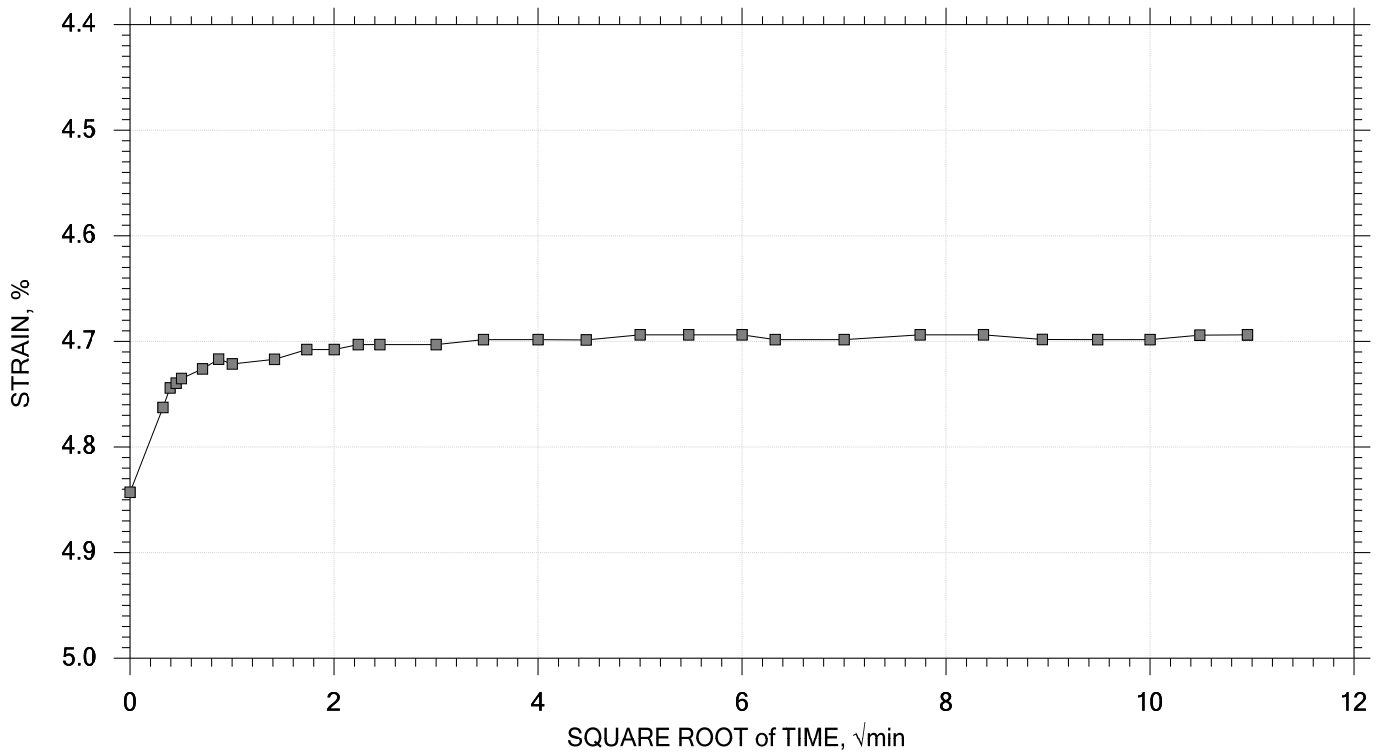
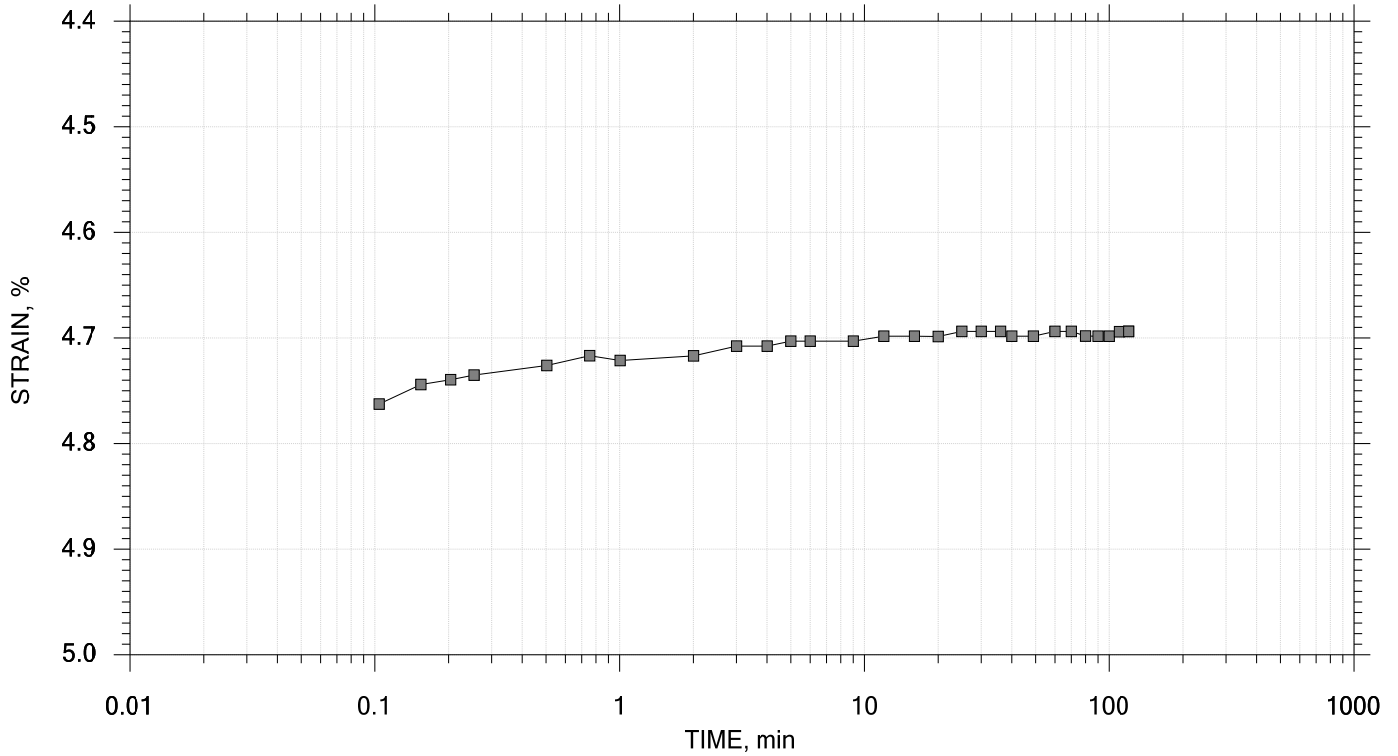
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 1 tsf



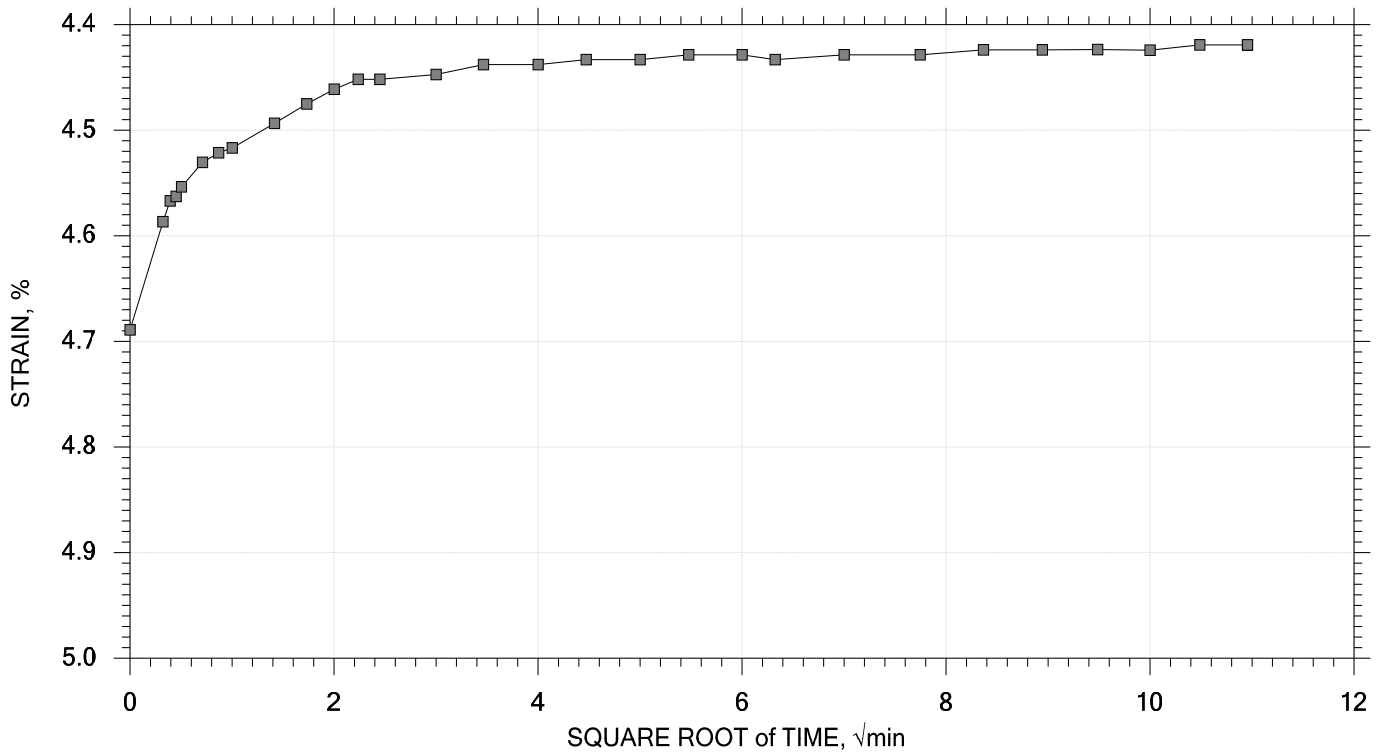
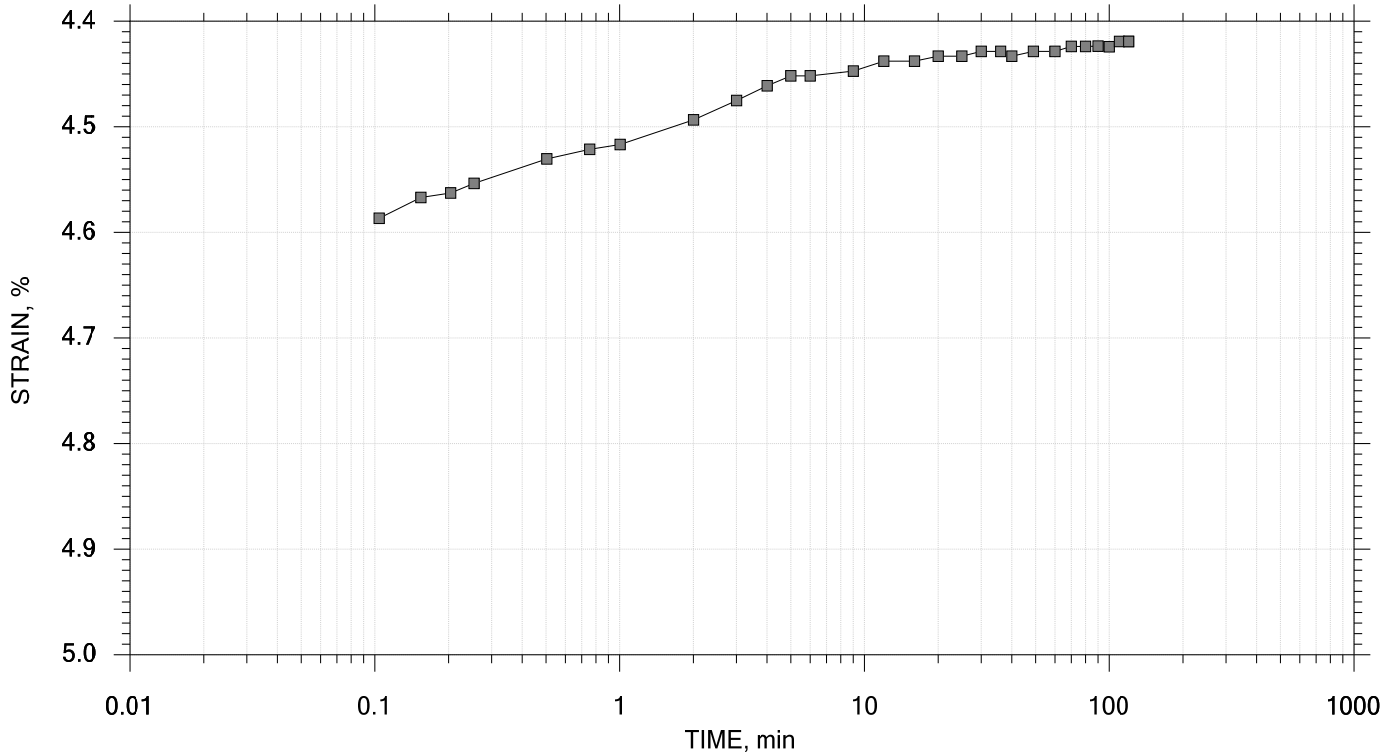
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 0.5 tsf



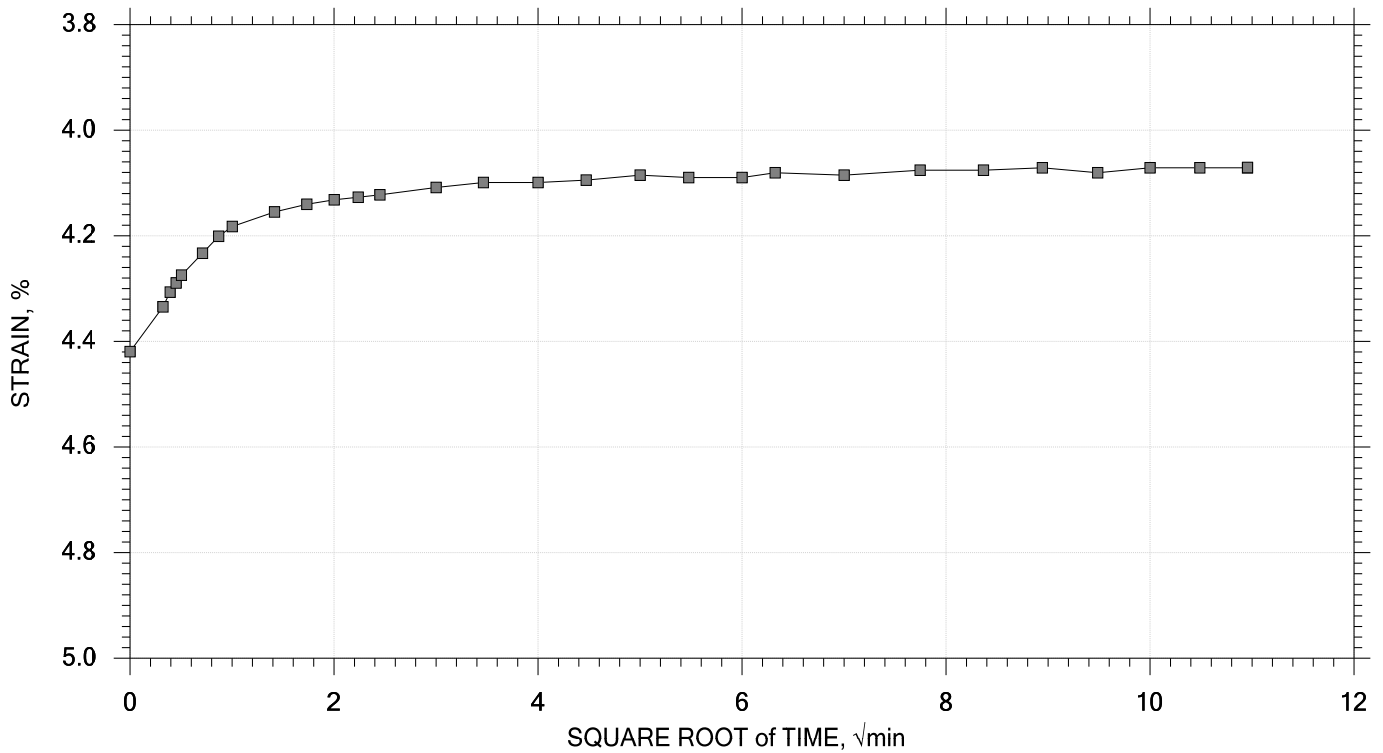
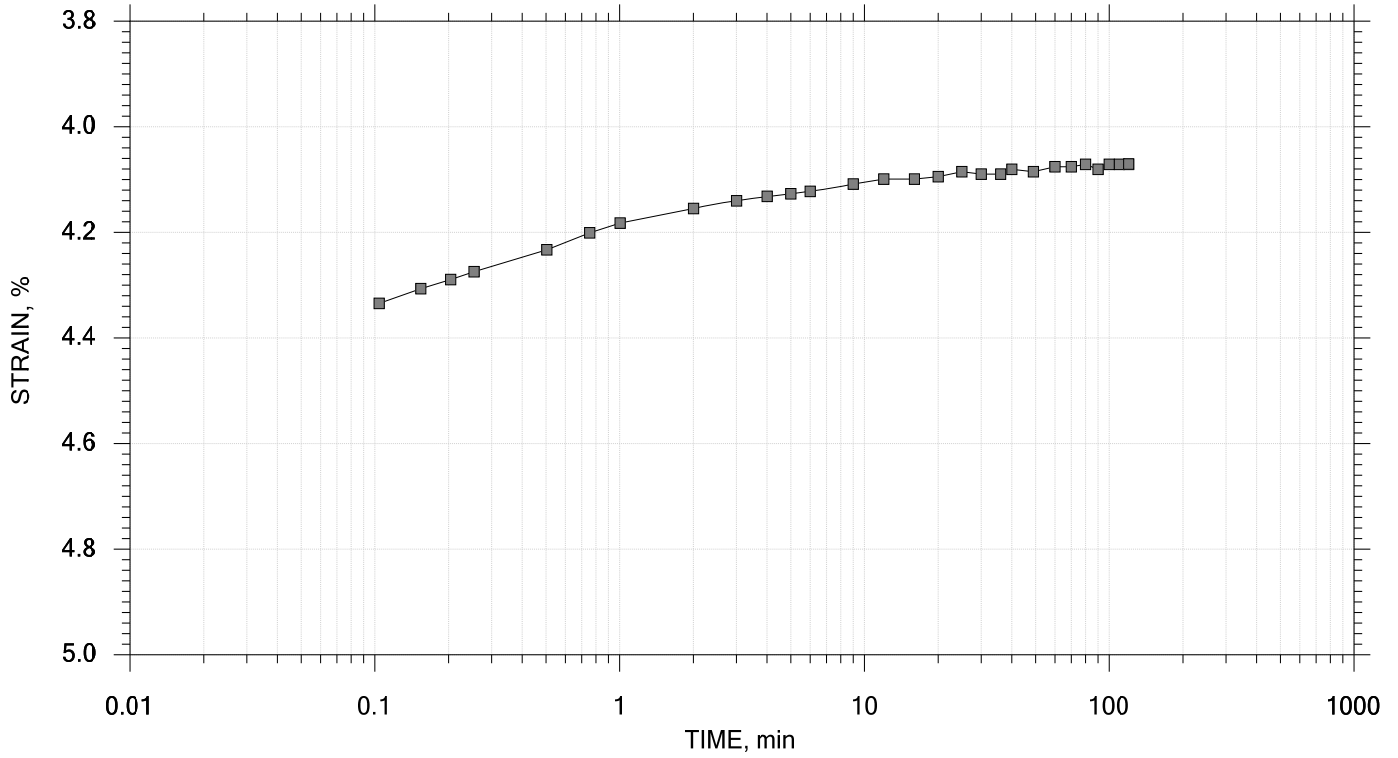
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 0.25 tsf



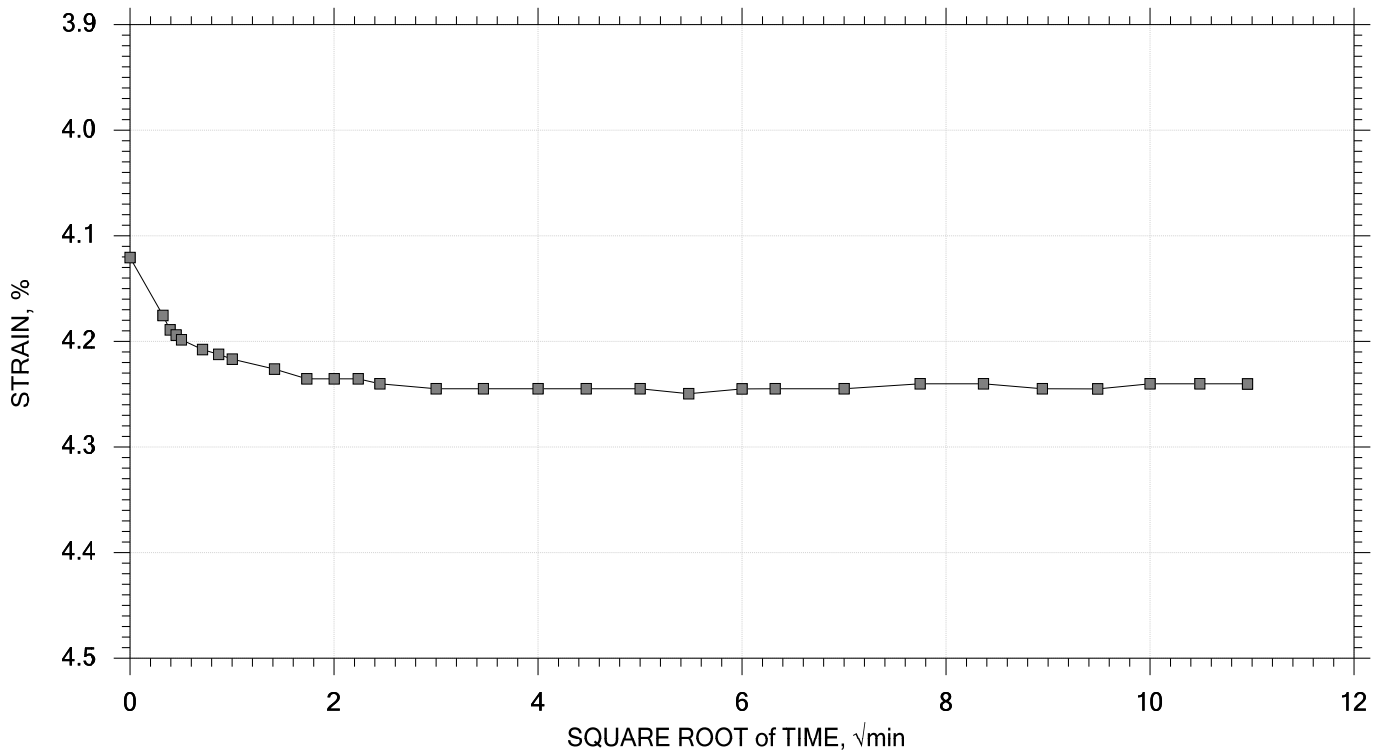
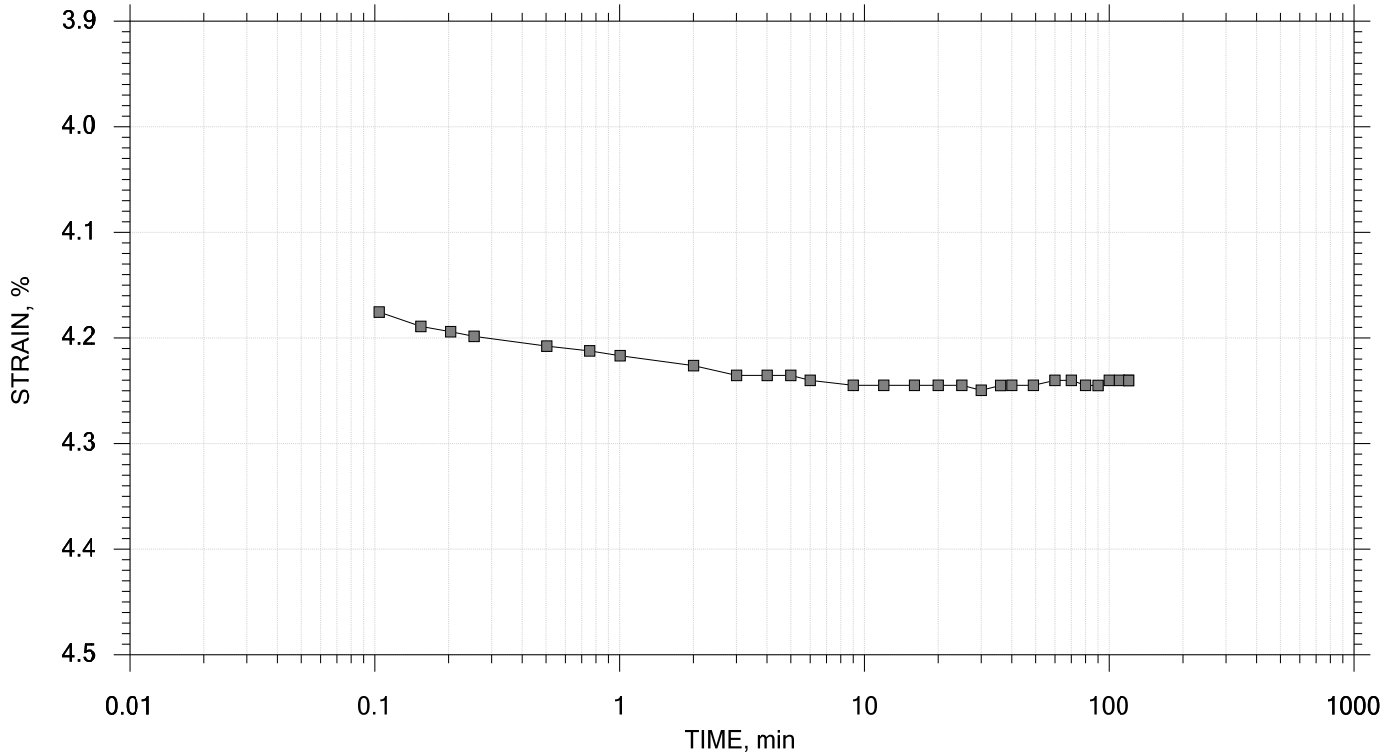
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 0.5 tsf



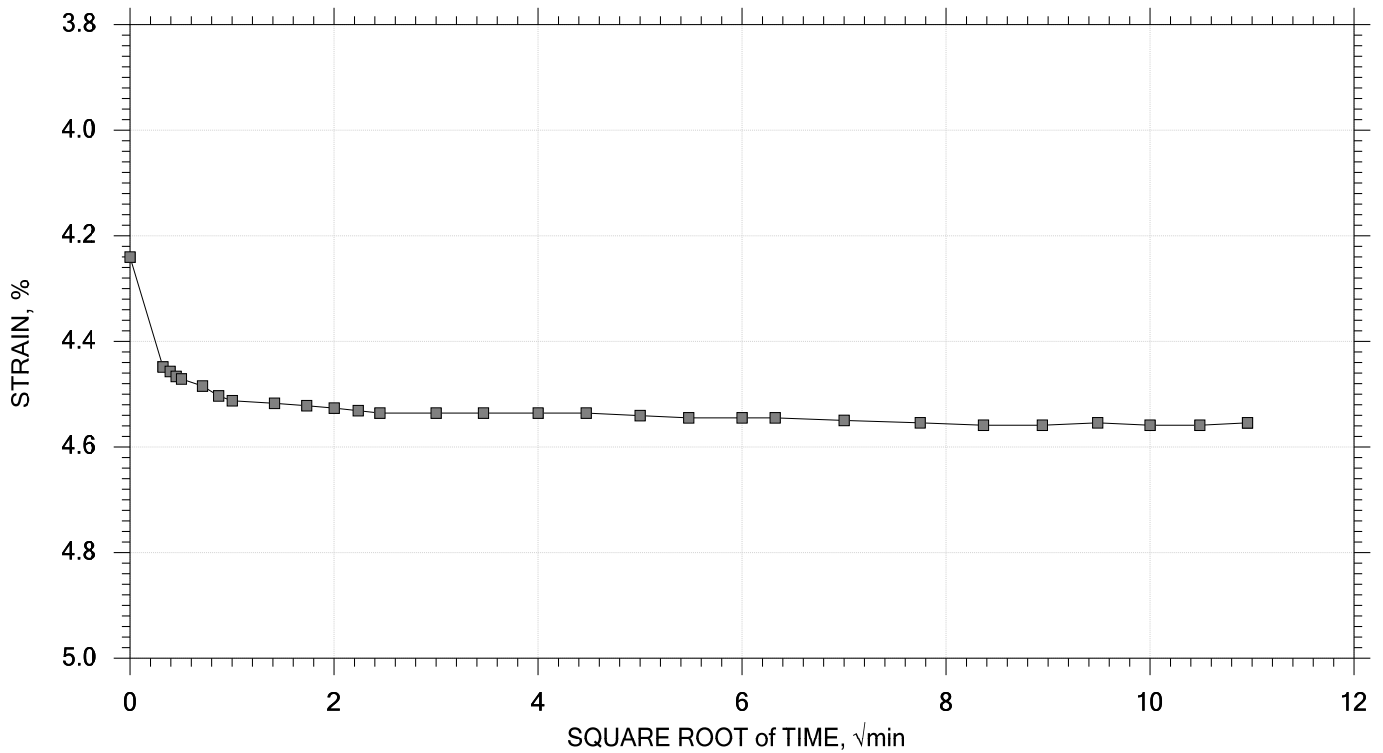
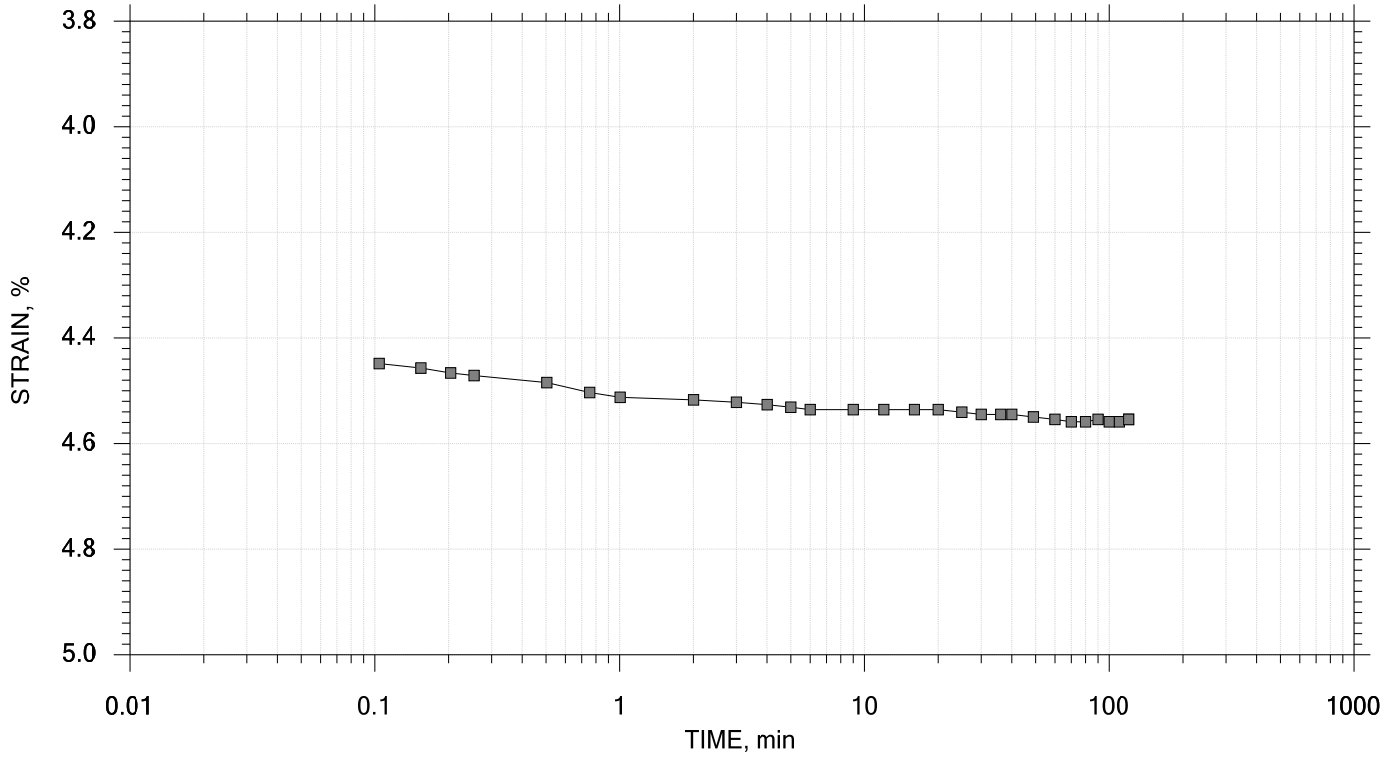
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf



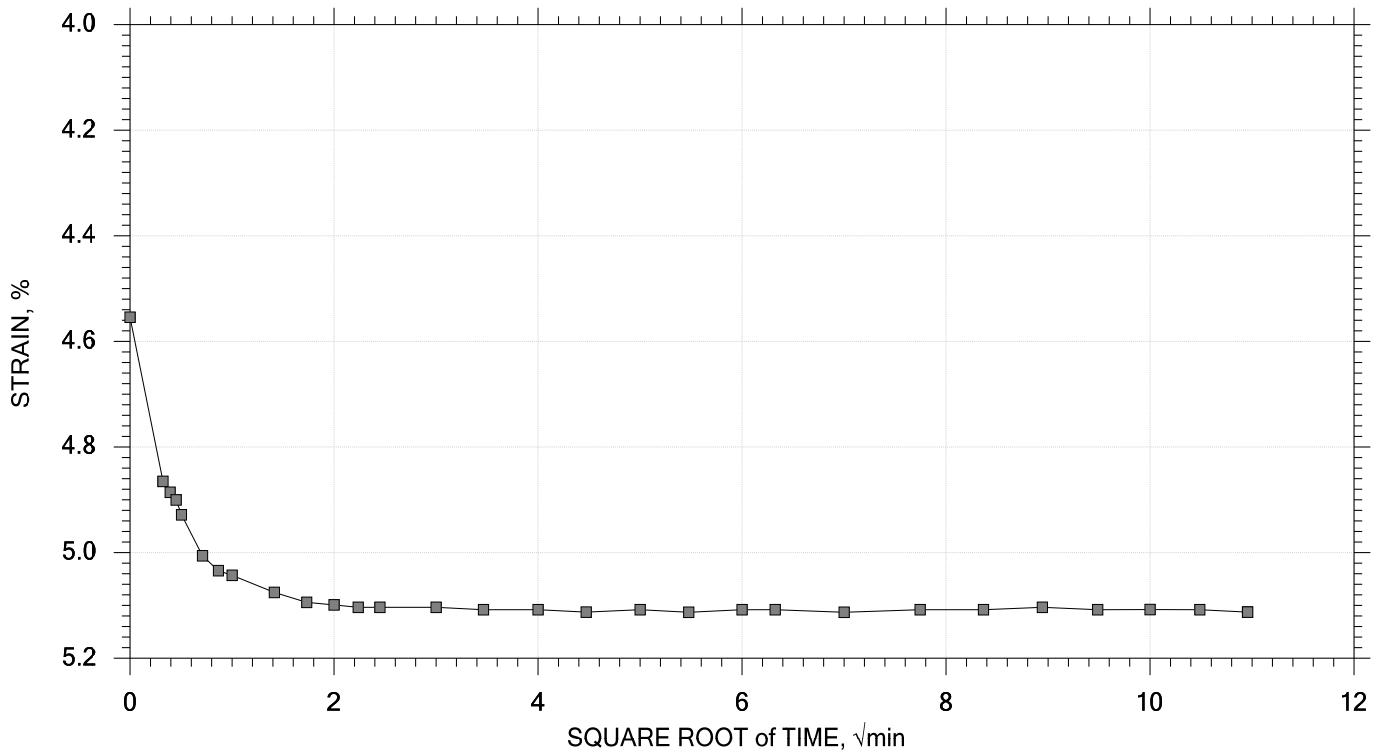
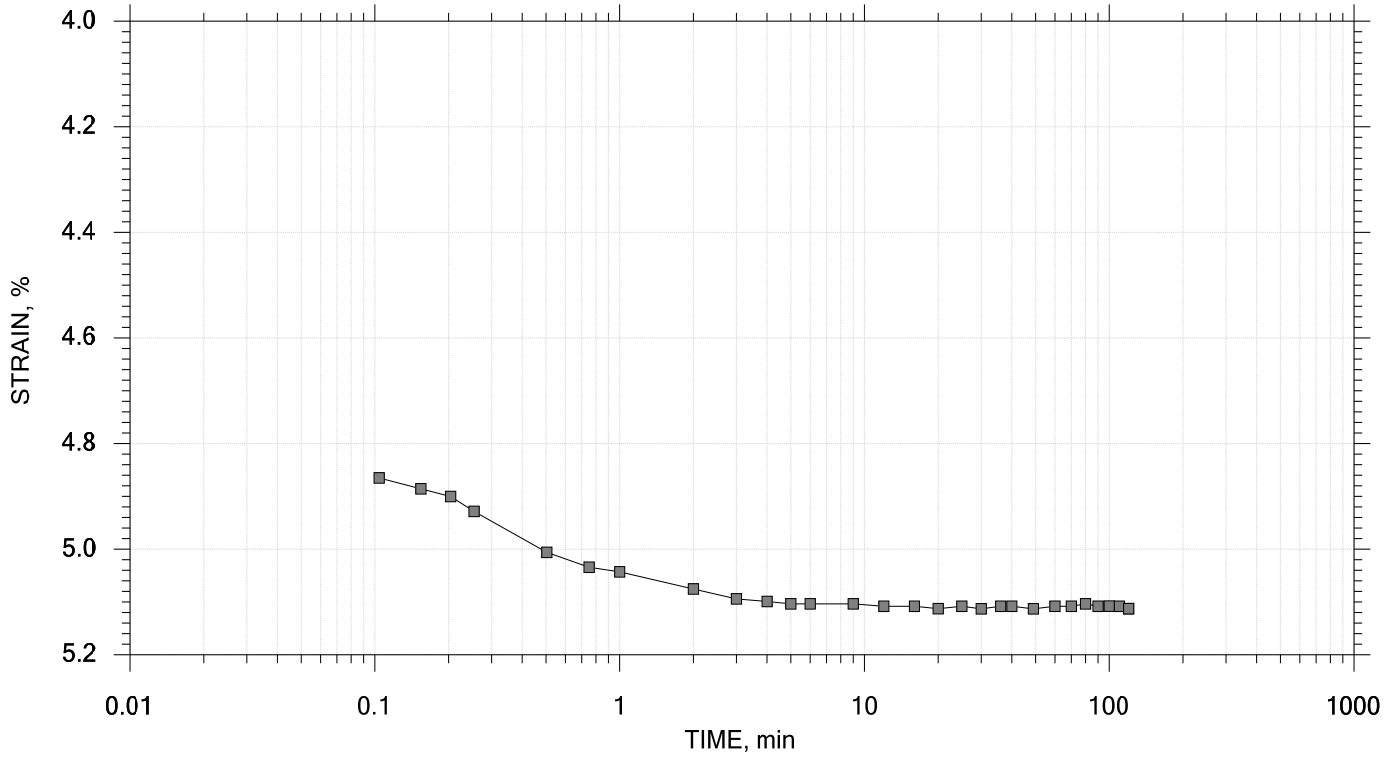
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 2 tsf



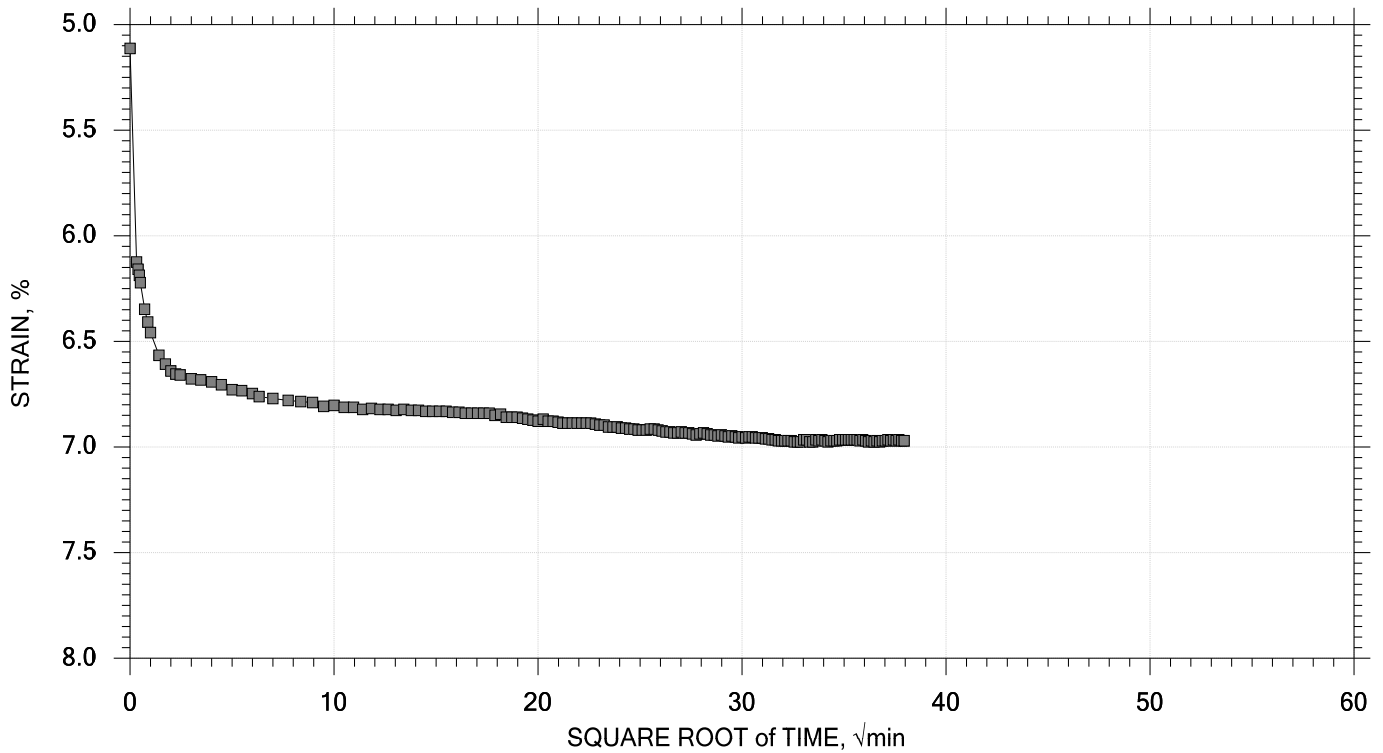
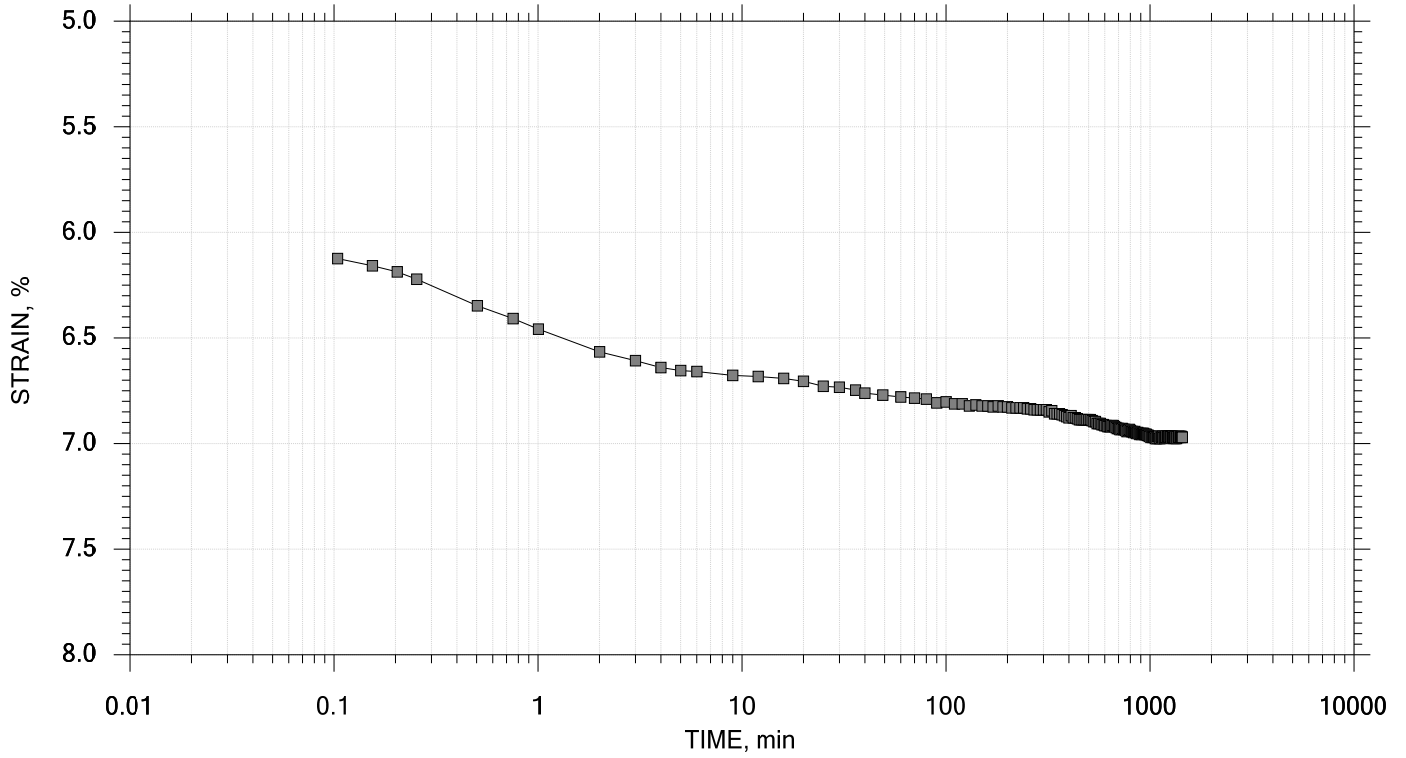
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 4 tsf



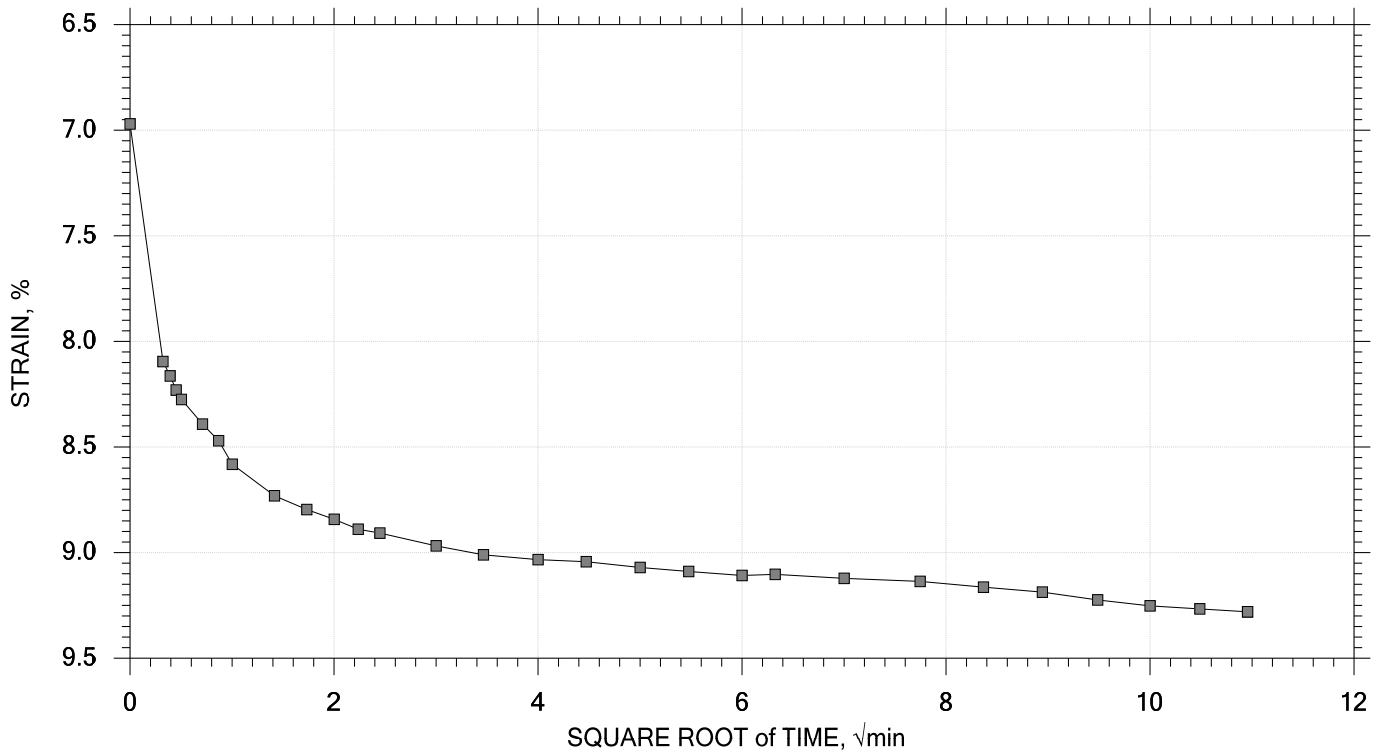
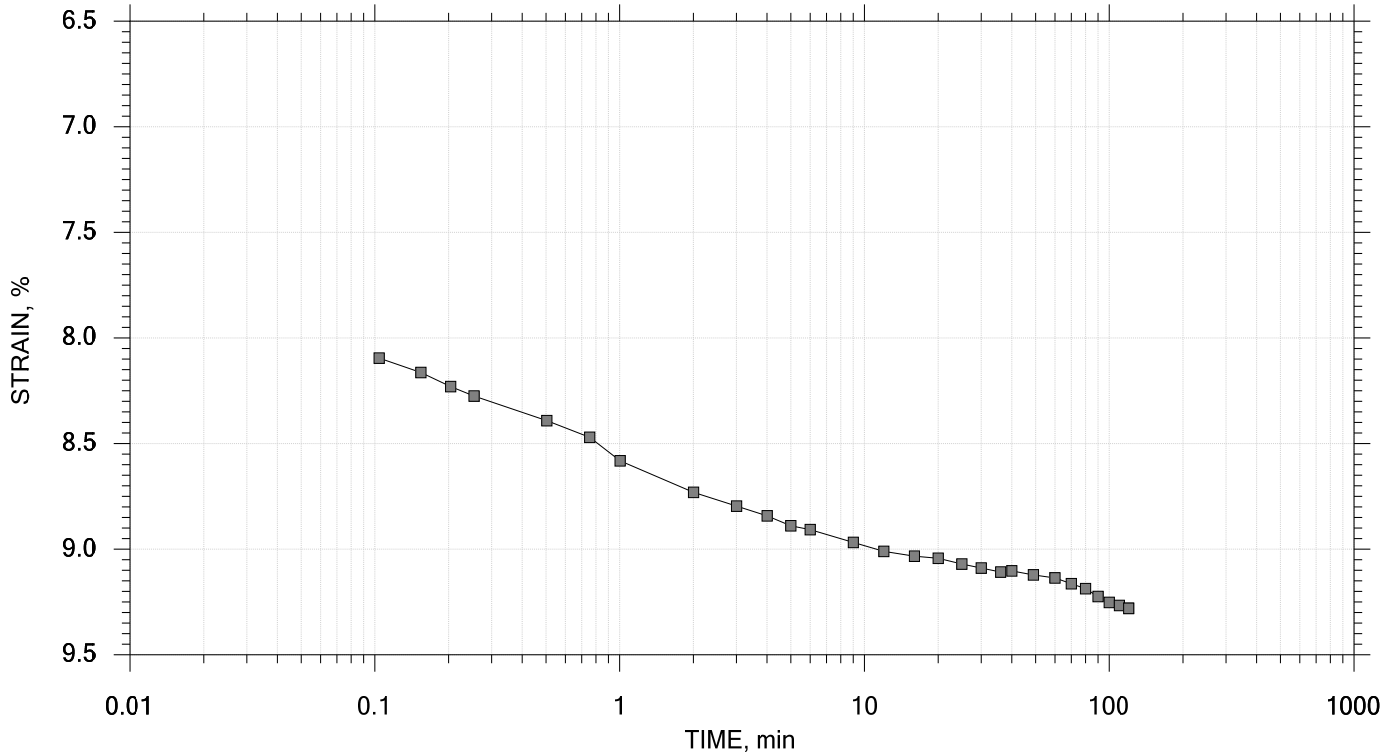
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 8 tsf



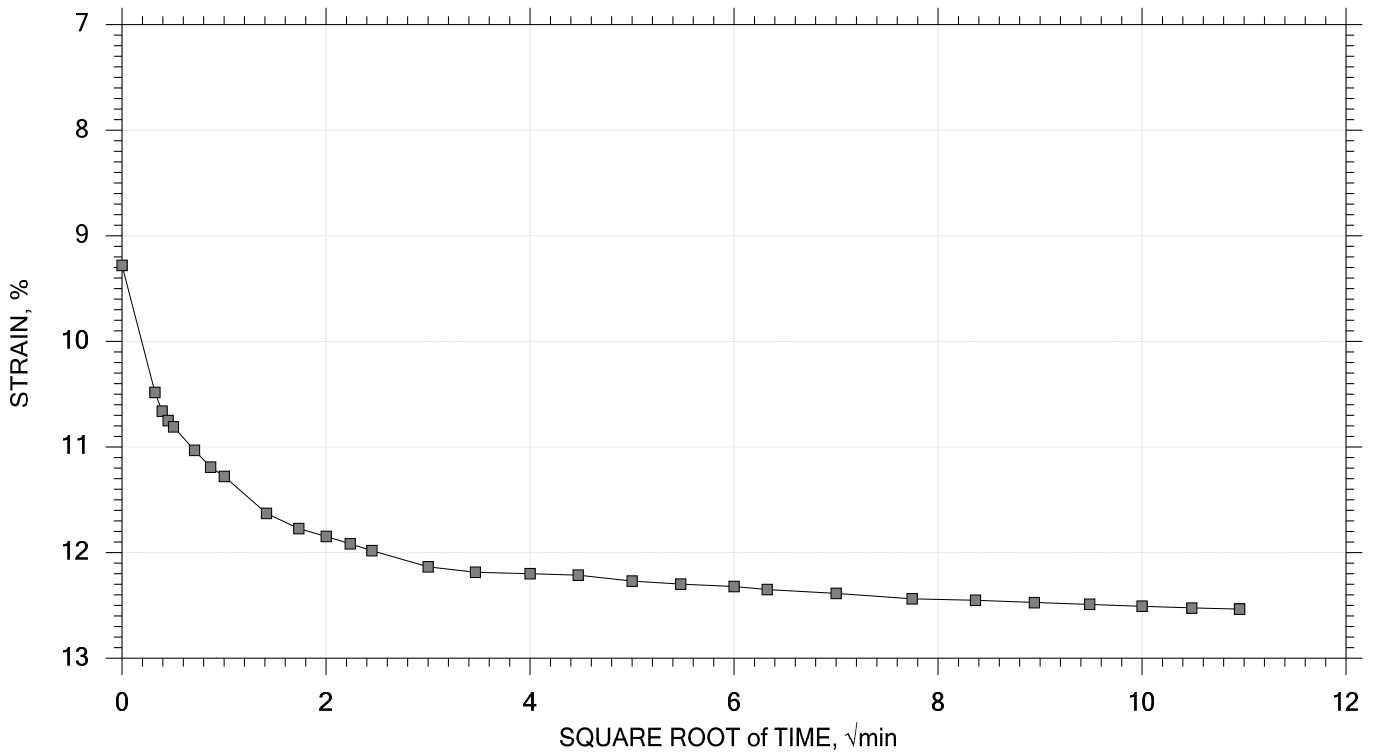
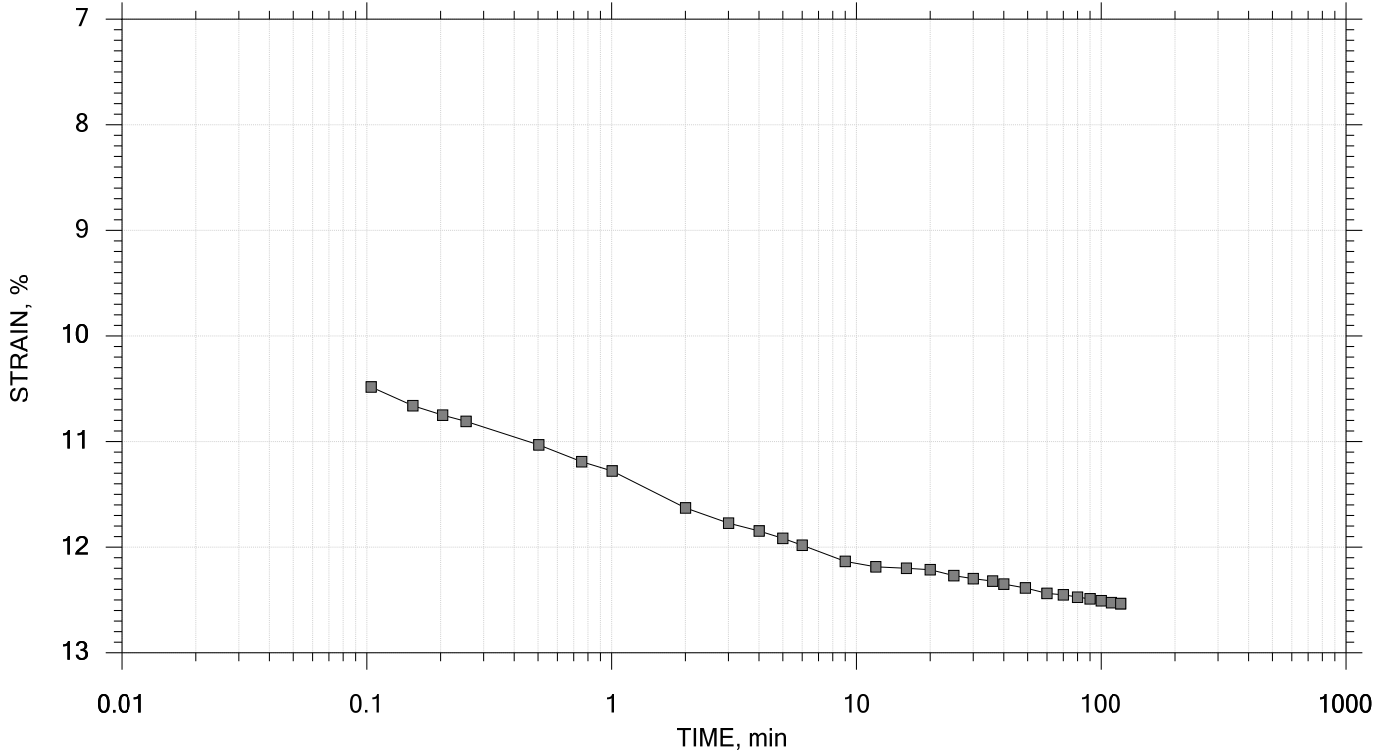
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 16 tsf



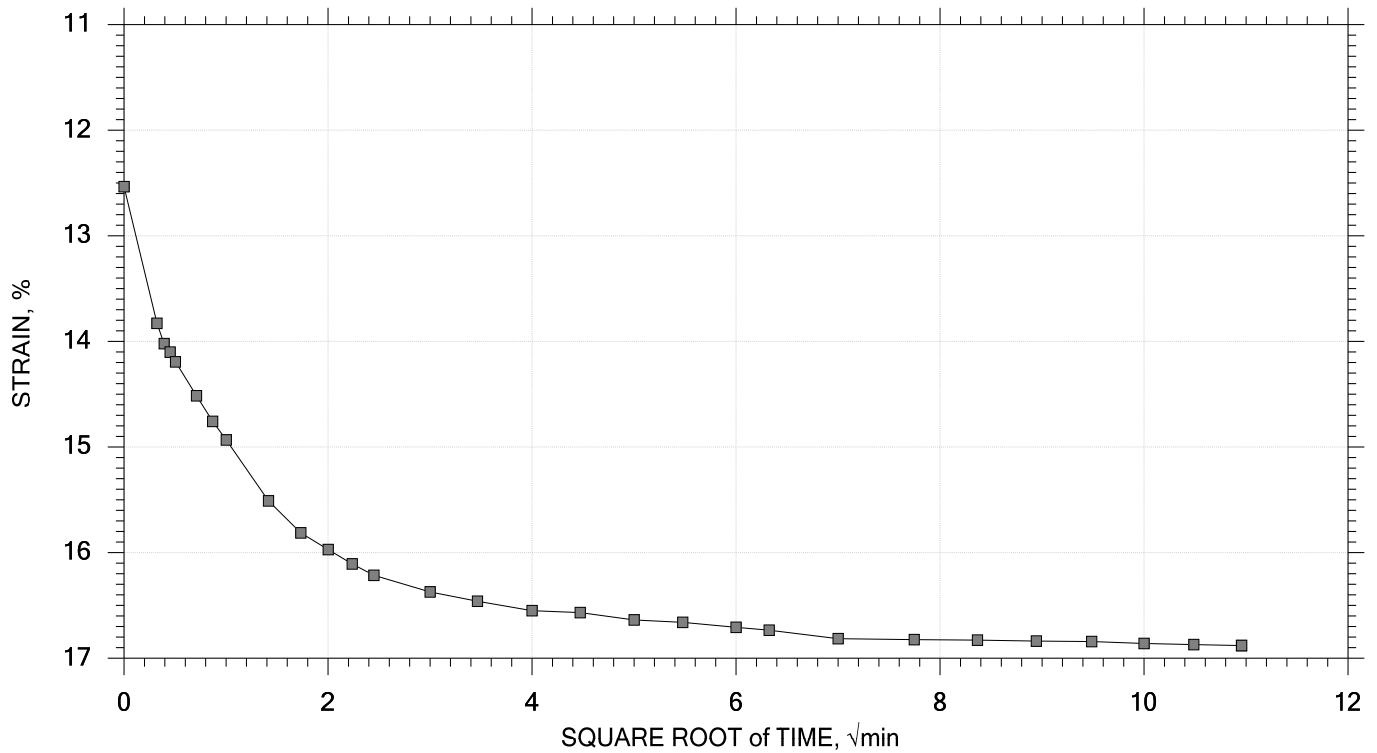
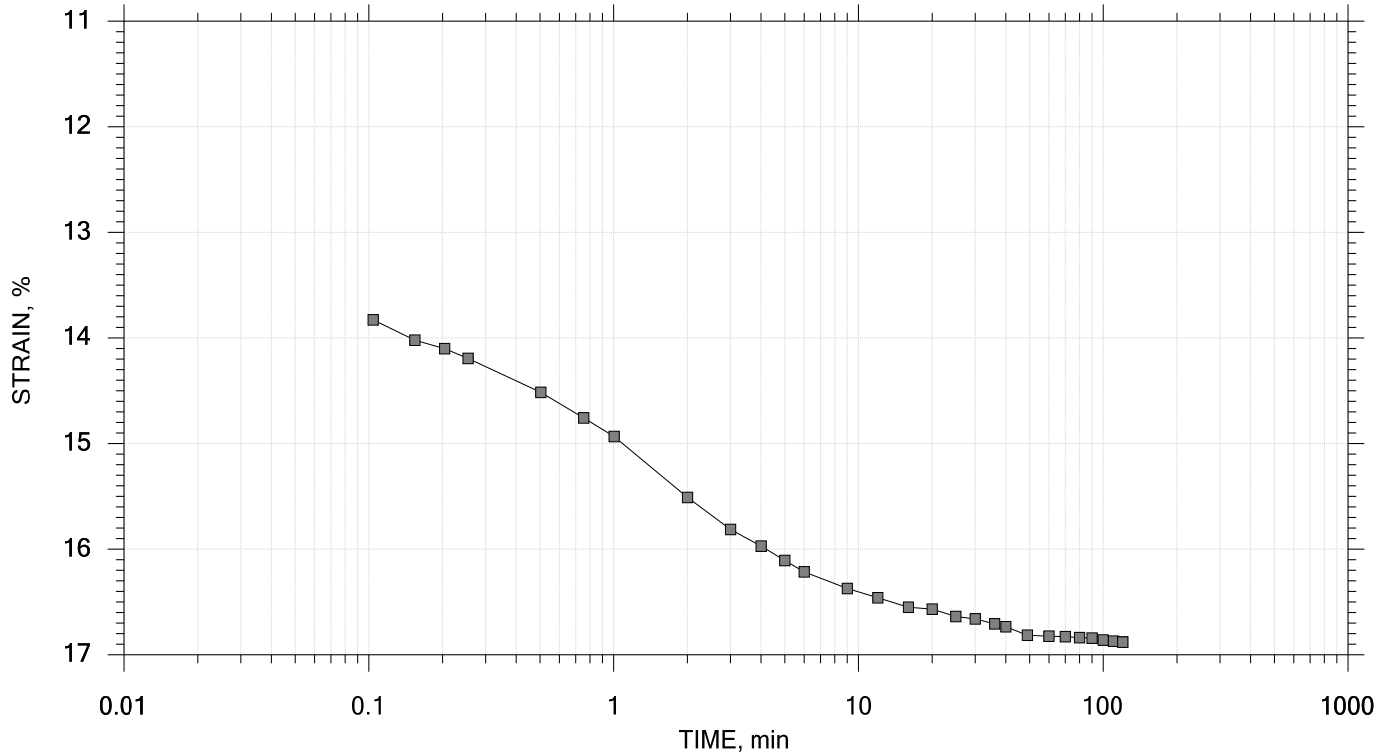
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 32 tsf



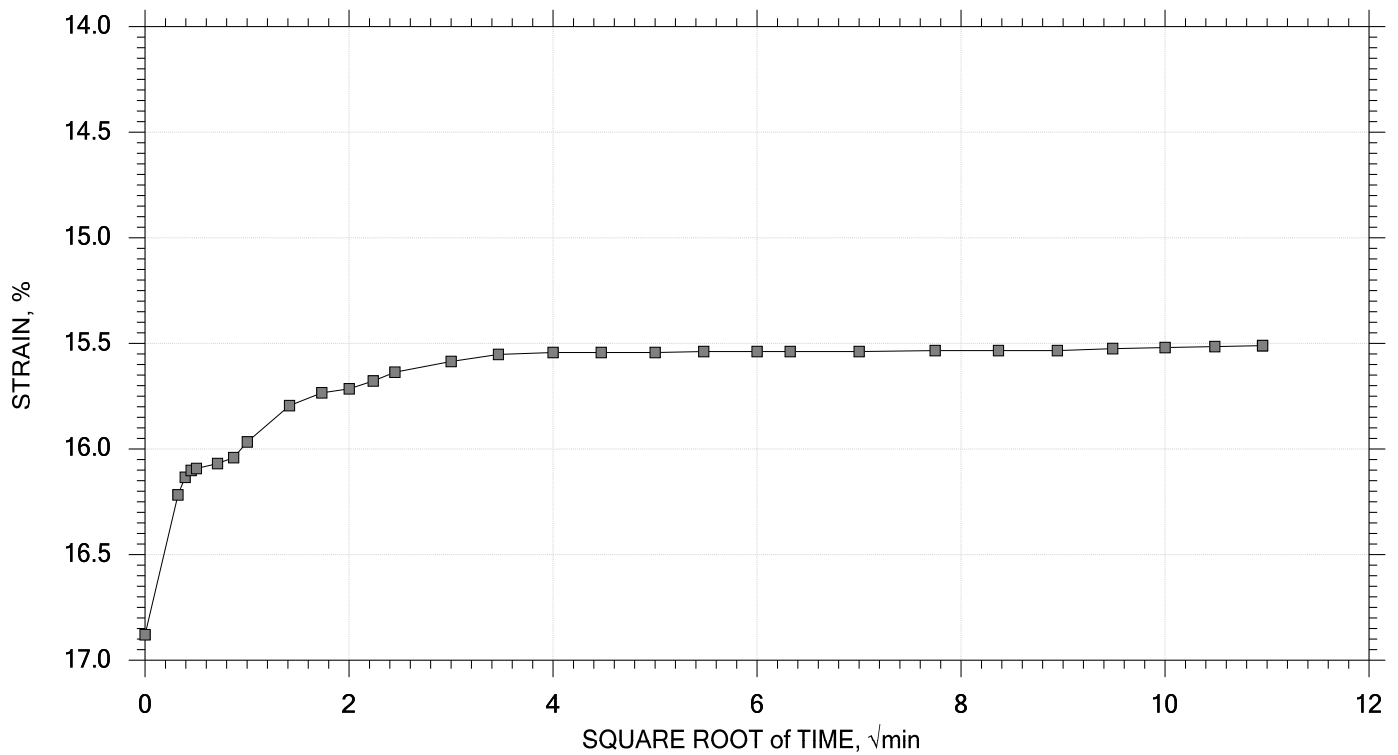
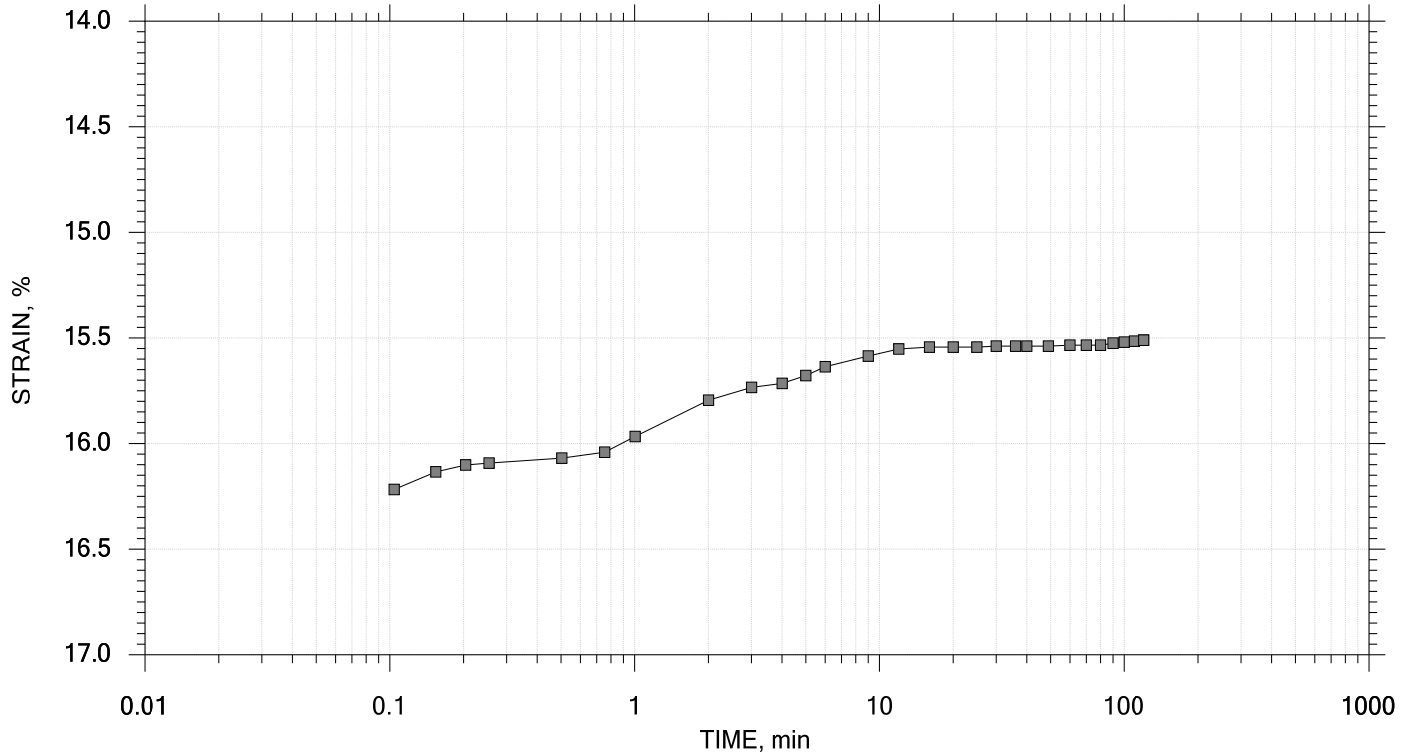
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 8 tsf



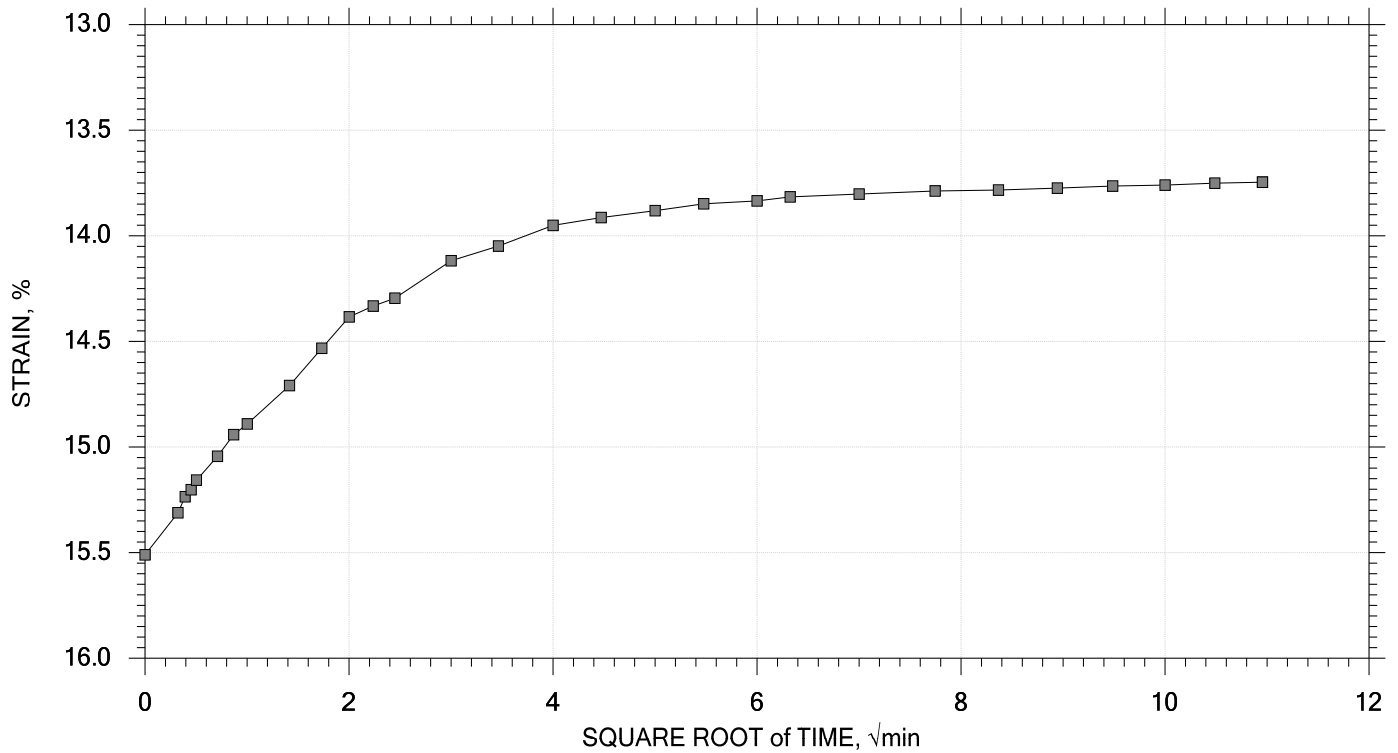
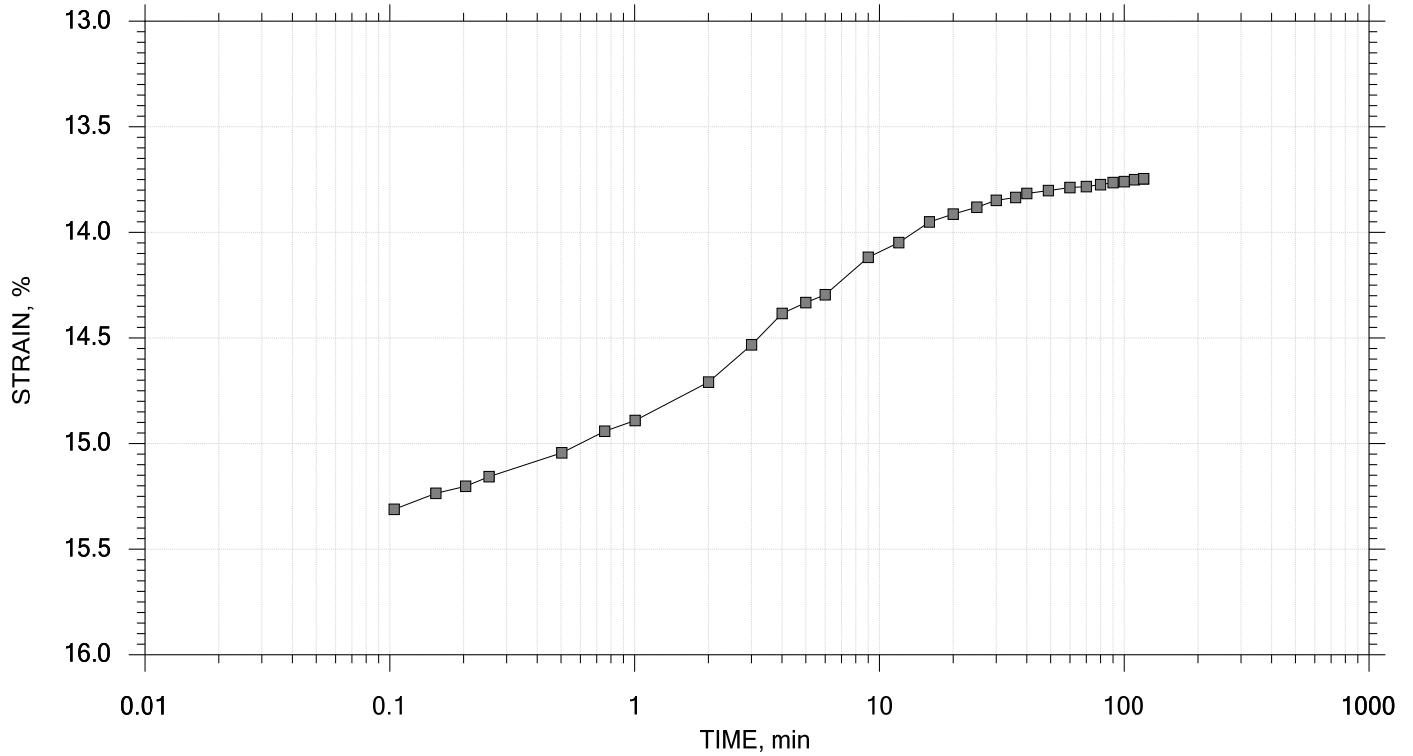
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 2 tsf



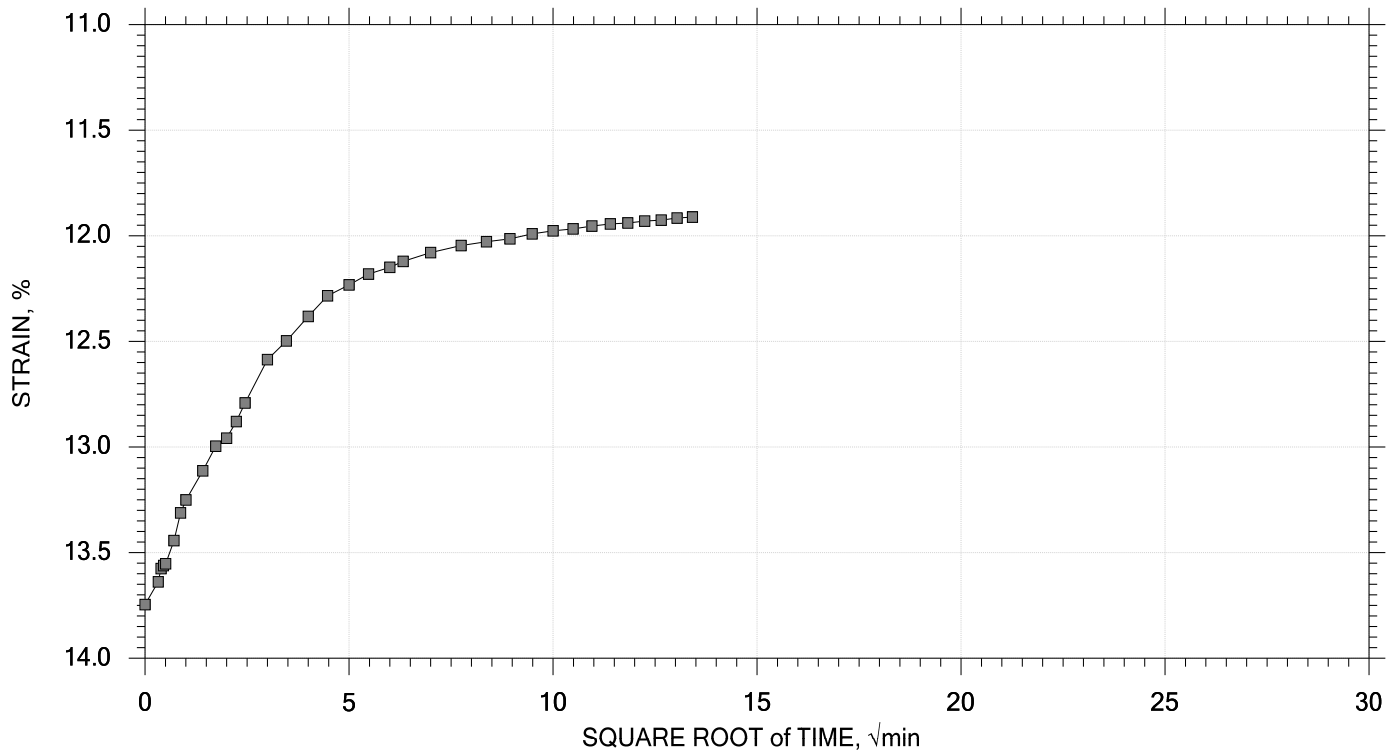
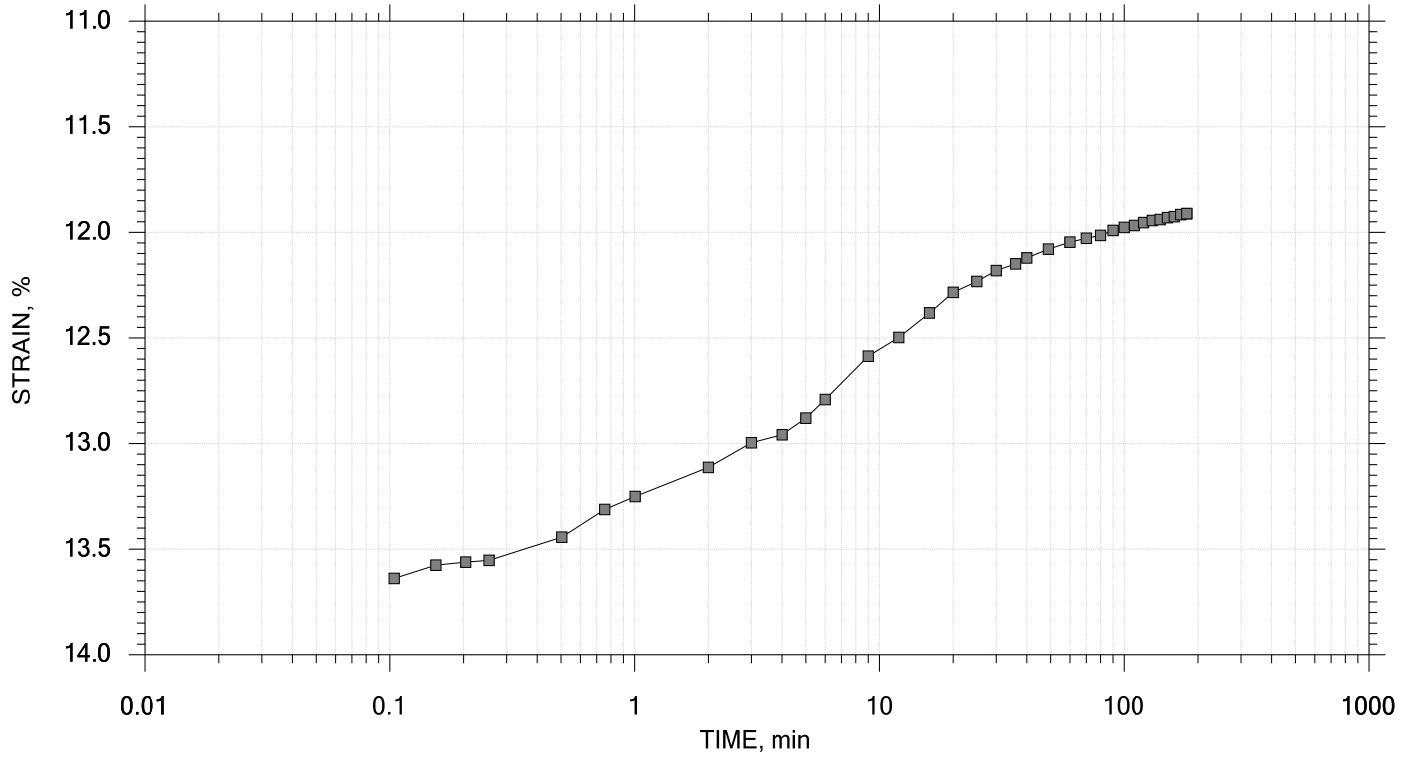
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 0.5 tsf



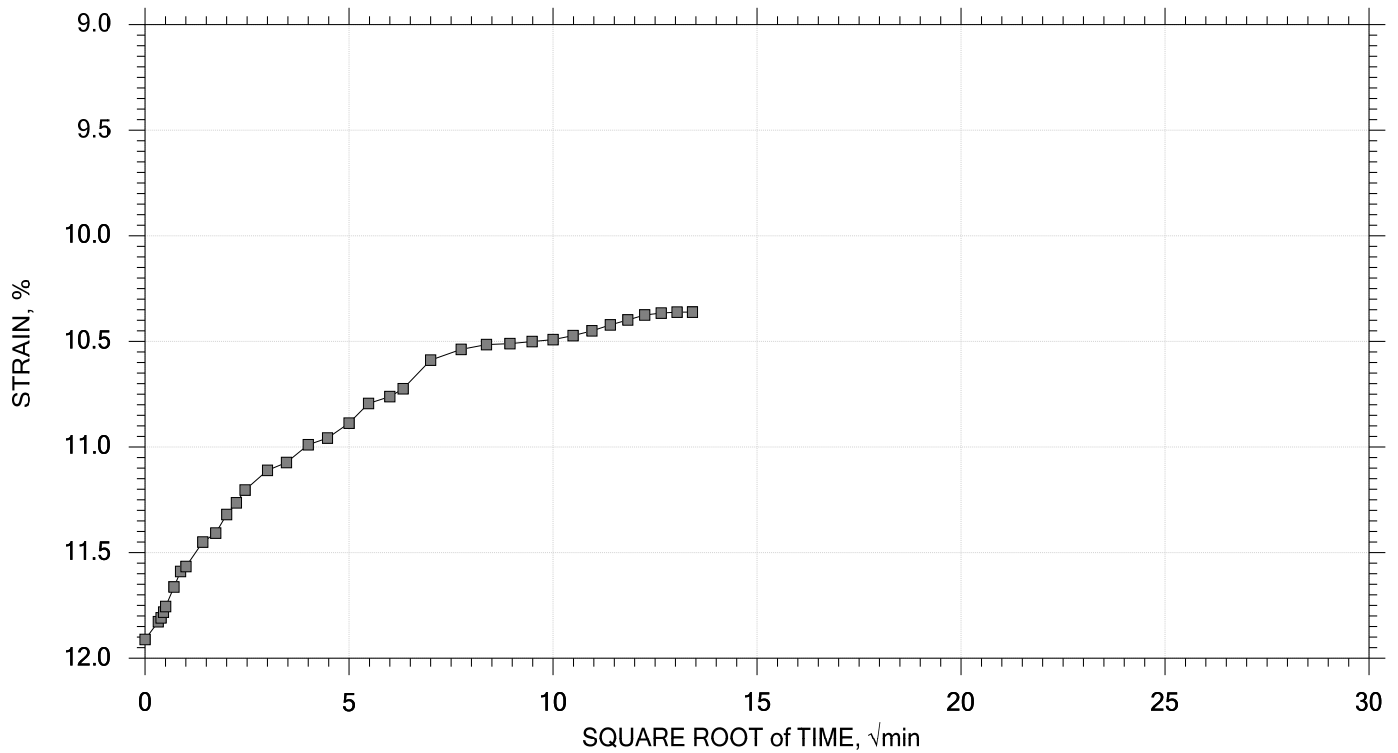
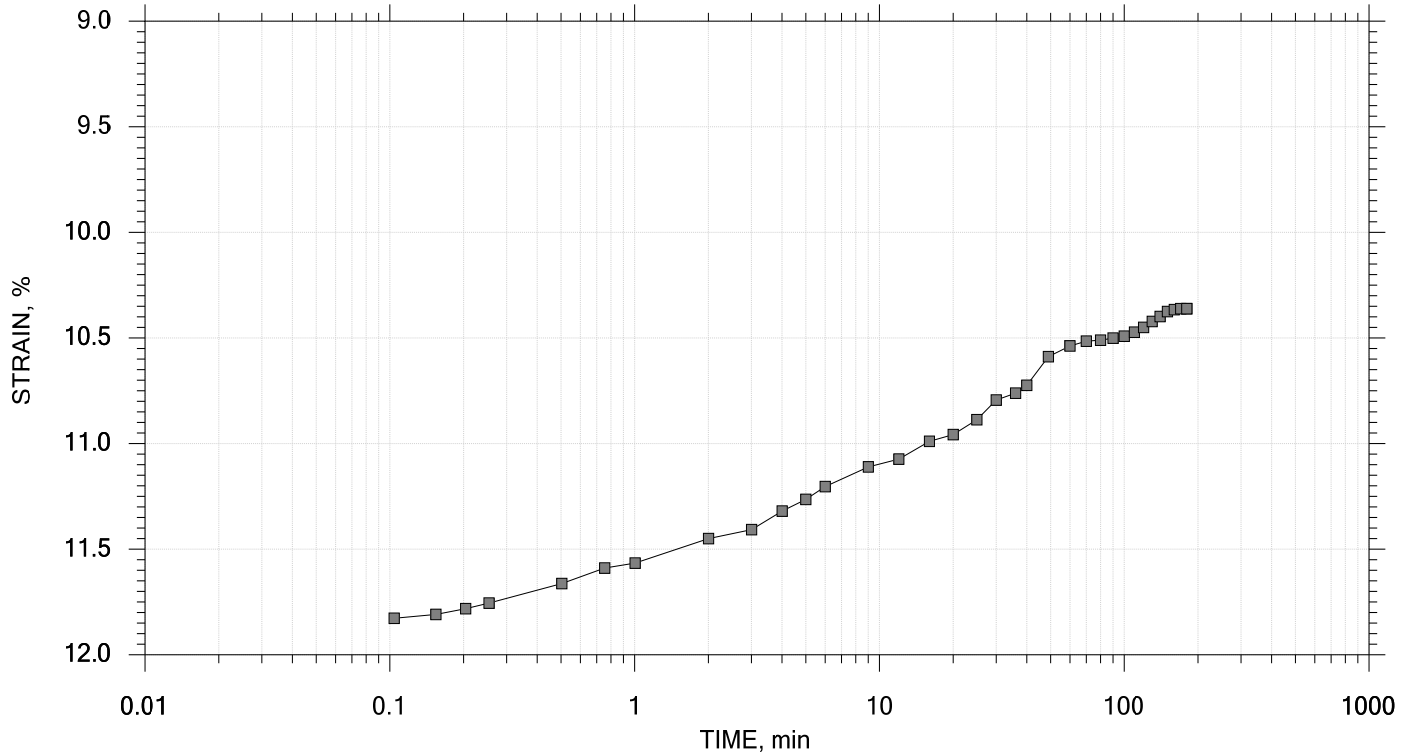
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.125 tsf



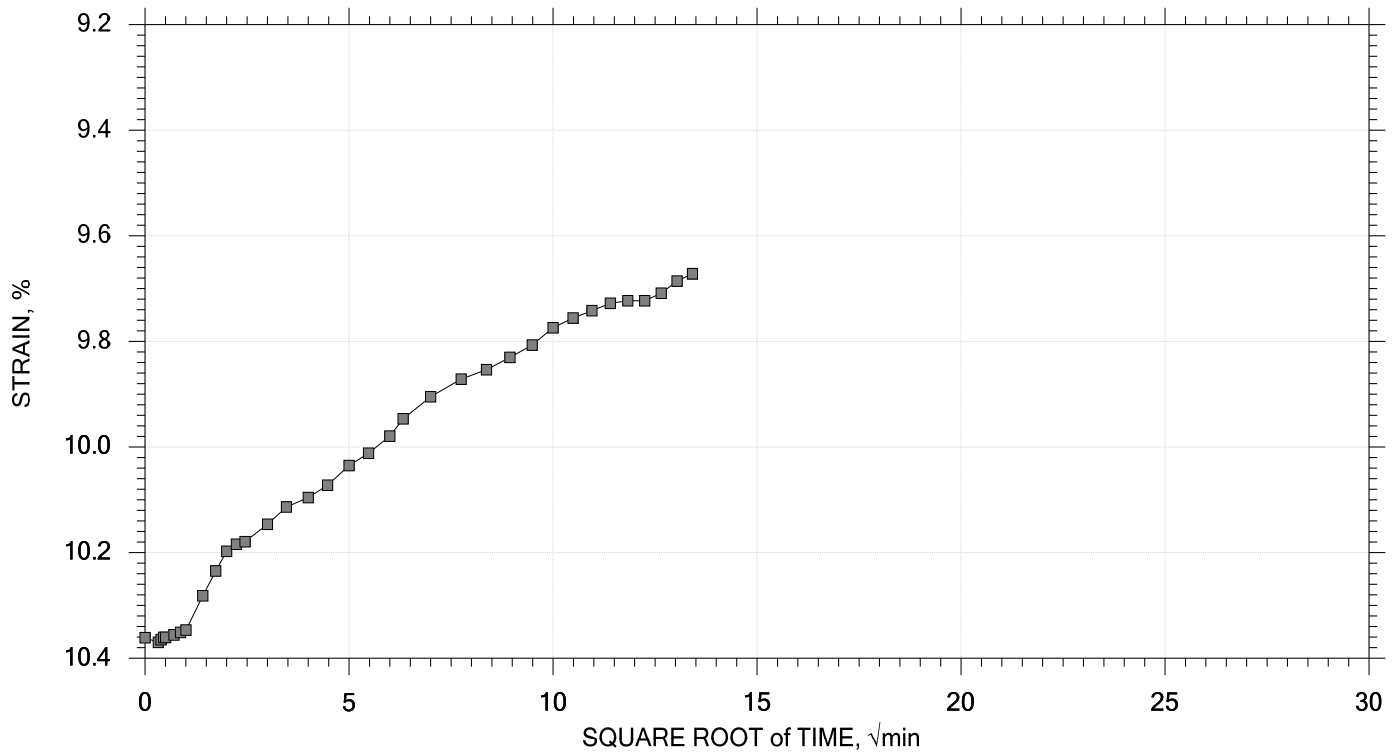
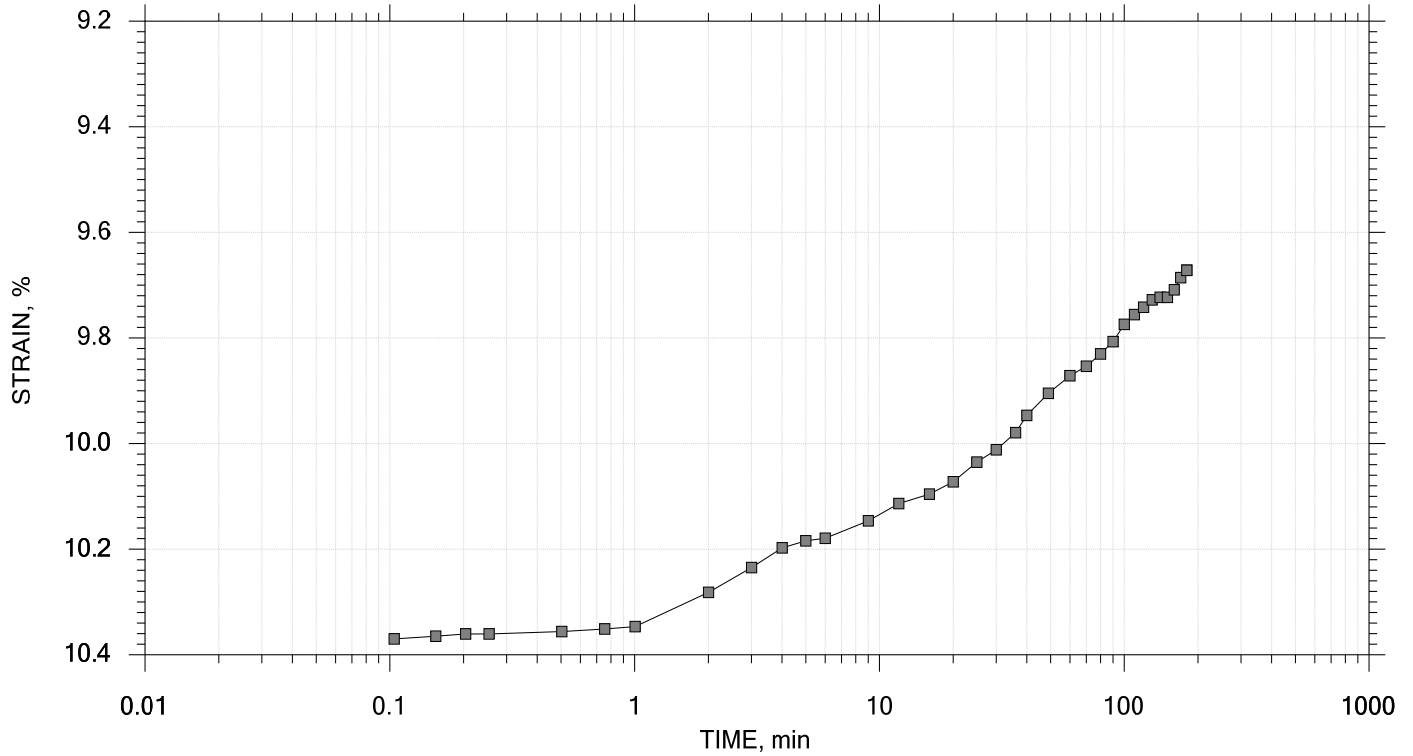
	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

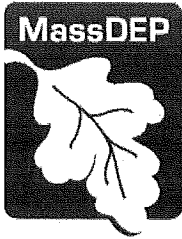
TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf



	Project: Canal Street - Salem Phase 2	Location: Salem, MA	Project No.: GTX-302361
	Boring No.: B-407	Tested By: md	Checked By: njh
	Sample No.: ST-1	Test Date: 06/23/2015	Test No.: IP-1
	Depth: 5-7 ft	Sample Type: intact	Elevation: ---
	Description: Moist, grayish brown clay		
	Remarks: System X, Swell Pressure = 0.0792 tsf		



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

September 30, 2015

Forest River Park Seawall
c/o Woodard and Curran
40 Shattuck Road
Andover, MA 01810
Attn: David White, P.E.

**RE: Request for Minor Project Modification, City of Salem, DPW Contract Number 1999,
Forest River Park, Salem Harbor, Essex County**

Dear Mr. White:

The Massachusetts Department of Environmental Protection Waterways Program (the "Department") has received your request for a Minor Project Modification (MPM), pursuant to 310 CMR 9.22(3), on behalf of the current Licensee, City of Salem, to install a box culvert as part of the Canal Street Flood Mitigation Project at the Forest River Park, in the City of Salem.

The submission includes:

- 1) A letter from Mr. White to me, dated August 31, 2015 requesting an MPM, with an accompanying description of the project, and how the work otherwise complies with the requirements of 310 CMR 9.22(3);
- 2) Drawing S-500A – Copy of license plan (sheet 2 of 4) entitled New Concrete Seawall at pioneer Village, Forest River Park, Locust "B", dated September 1958 with a sketch of the proposed minor modification, dated August 10, 2015;
- 3) Drawing S-505B – A plan entitled Forest River Park Culvert Outfall Structural details Seawall Modifications prepared by Woodard and Curran, dated August 10, 2015;
- 4) A copy of the Order of Conditions for the Canal Street Flood Mitigation Project issued by the Salem Conservation Commission on July 22, 2015.

Based on the representations made in your memoranda and in reliance of the information contained therein, the Department determines that the proposed action falls within the minor

modification standards pursuant to 310 CMR 9.22(3) and does not require the submission of a M.G.L. c. 91 license application. The proposed installation of a box culvert as part of the Canal street Flood Mitigation Project at the Forest River Park represents an insignificant deviation in terms of size, configuration, materials, and other relevant design or fabrication parameters of the original referenced authorization.

The MassDEP will place this letter and the referenced submissions into the license file that originally authorized said work on the project site. The proposed construction activities must conform to and be consistent with all submitted documentation, as well as all other relevant conditions of the original authorization. Please be advised, however, that this Departmental action does not relieve or exempt you of the requirement to obtain all other applicable local, state and federal authorizations necessary to perform said activities.

If you have any questions concerning this matter, please call me at (617) 292-5708. Thank you.

Sincerely,



Jerome Grafe
Regional Planner
Waterways Regulation Program

Cc: Salem Conservation Commission
Mass DEP c.91 License files



Landscape Science/Engineering

Principals: John C. Swallow, PhD, LSP / Robert N. Pine, PE

December 14, 2015

David White, PE
Woodard & Curran
33 Broad St | One Weybosset Hill, Floor 7
Providence, RI 02903

RE: Forest River Park, Salem Massachusetts
Field Investigation and Preliminary Recommendations
P&S Proposal Number: 15161

Dear David,

Pine and Swallow Environmental (P&S) personnel investigated the Forest River Park baseball field area on November 23, 2015, for the purpose of assessing the soil and subgrade conditions. P&S understands that the field area is proposed to be reconstructed and recommendations regarding soil re-use and drainage strategies are required. The purpose of the study was to evaluate the existing topsoil and subsurface drainage conditions and to provide recommendations regarding re-use of existing materials. This letter represents our findings and recommendations based on our limited assessment and testing of the area.

Field Investigation

The soil conditions were examined by manually excavating test pits through the topsoil and into the subsoil layers. The test pits allowed assessment of the topsoil and of the shallow subsoils at discrete sampling locations. Topsoil and subsoil samples were collected to evaluate the gradation, drainage characteristics and horticultural chemistry of the media. Topsoil depth was measured at each sampling location and a general assessment of soil drainage and compaction level was made at each test pit.

In-situ percolation testing was conducted in the subgrade at one location. Shallow/perched water or saturated soils limited additional testing. Pine and Swallow has developed a percolation test method which utilizes perforated canisters, set in coarse sand, to minimize disturbance to in-place soils and to prevent siltation of the test hole during testing. A test hole is excavated to approximately one-inch larger diameter and approximately one-half inch deeper than the dimensions of a test canister. The sides of the test hole are not smoothed. One-half inch of coarse sand is placed in the bottom of the hole and the bucket is placed firmly into the hole. The space around the bucket is then filled with coarse sand. The coarse sand is tamped to firmly fill any void space. The canister is then filled with water and allowed to drain completely or to soak the surrounding soils for a minimum of one-half hour, whichever occurs first. The canister is then re-filled and the rate at which the water

level drops is measured. The percolation rate is the length of time for the water level to drop per inch. Additional infiltration tests on topsoil were conducted with a Turf Tec dual ring infiltrometer.

Compaction of the field area was assessed with a Dickey-John soil compaction probe. The probe device is a manually operated probe with a tee-handle and a gauge that measures the relative amount of force that is required to advance the point of the probe. It has a 1/2" or 3/4" point and a range of 0-350 psi. This device allows quick assessment of the differences in compaction at multiple locations. Our experience is if the 1/2" tip cannot be advanced with full body weight, the soil is over-compacted. Compaction levels between 200-300 psi are relatively adequate for root penetration and levels below 150 psi may be subject to differential settlement.

Soil samples were brought to P&S' laboratory for classification. P&S classified soils and prepared samples for delivery to the University of Massachusetts Soil Testing Laboratory for mechanical gradation, organic content, horticultural parameters and nutrient testing. Results of laboratory tests are attached as well as a Test Pit Location Map and a Soil Description Summary Table. P&S also reviewed the Draft Technical Design Memorandum by Geocomp, dated July 9, 2015.

Field Observations and Laboratory Results

General:

The lawn and field areas observed are characterized by above average quality turf with some weed infestation, primarily white clover, dandelion and plantain. The soil conditions were damp to wet throughout the area, and standing water was observed at several areas of the existing field, particularly at shallow right center field. It appears that portions of the infield area have been recently sodded, presumably to create a turf infield over an older skinned infield. The compaction of the field areas was moderate to loose, however the soil was saturated at many areas, which eases penetration resistance. Topsoil thickness ranged from approximately eight inches at the southwestern portion of the field, to as much as 20-inches of topsoil at the central and northern areas.

The subsoil encountered throughout the site appeared somewhat inconsistent, with the majority being compacted silty gravel, with varying amounts of cobbles and boulders. At one test pit, the topsoil was underlain by fine sandy silt.

Groundwater / Bedrock Conditions:

Evidence of groundwater/perched water was observed within the field areas, both in the test holes excavated in the soil and as standing water at the surface of the field. A period of rain the night before the investigation contributed to the saturated conditions. Due to the poorly drained soils, it was not possible to determine an approximate ground water elevation, however P&S measured standing water at a sump near the field house at 20". Water seeped in from the sides in many of the test

holes. Bedrock was not observed in our shallow test pits but was observed locally ocean side. The Test Boring Reports in the Geocomp Draft Technical Design Memorandum identifies the depth to groundwater in the field area as 7.0 and 7.5 feet respectively, at borings conducted in June of 2015.

Topsoil Evaluation:

Laboratory testing of the topsoil samples from the field area indicates that the samples are relatively consistent and likely represent similar origins. The testing indicates that the majority of the samples have a USDA Textural classification of loam. The field topsoil material has a silt plus clay content of 42.0 to 57.9 percent, with an average of 52.1%, and an organic content average of 4.5%. Approximately 2 to 16 percent of fine to coarse gravel was present within the topsoil matrix. The soil is significantly more fine-grained than is recommended for high-use lawn /athletic field areas. The percentage of clay in the samples was elevated for typical New England topsoil, and ranged from 14 to 18 percent.

The existing topsoil did exhibit reasonably good crumb structure (peds), however the structure of the soil broke down rapidly with manipulation. Crumb structure (peds) develops in some soils over a long period of time and refer to internal soil structures consisting of agglomerations of silt and clay particles that allow water to pass through. Additional soil structures range from minute channels where deep roots penetrated the soils to fractures caused by ice formation and frost heaves. However, when these soils are excavated and manipulated, the peds and other internal structures can be destroyed and the ability of the soils to allow water to pass through is then greatly diminished.

Nutrient levels were from low to medium in the samples tested. Micronutrient levels were normal and the cation exchange capacity of the samples was within an acceptable range. The pH levels of the samples were variable, from 5.7-7.3. The samples with higher pH levels consistently had higher calcium and magnesium levels, indicating that limestone applications have been a bit uneven.

Subgrade Conditions: The field area appears to be mostly underlain by poorly drained sandy silt soil with some stones. Some subsoil consisted more of a silty fine sand and no clear subsoil/topsoil horizon was identified. It is unknown if the subsoil at the site is imported fill, or representative of native conditions. The subgrade was generally loose and easily penetrated with the compaction probe until rock/gravel was encountered. The subsoil was mottled at several locations indicating that the material remains saturated for extended periods of time.

Infiltration Rate: Given the composition of the topsoil and the saturated field conditions, it is apparent that the existing topsoil and subsoil are poorly drained. Perched water entered the test holes at most locations, thus infiltration testing was limited. P&S conducted one infiltration test of the subsoil near the right field dugout and the test canister gained water versus draining any out. P&S also conducted dual ring infiltration tests at two locations where the topsoil was not squishy under foot.

The dual ring infiltrometer measures the vertical only migration of water through the turf. A minimum infiltration capacity for soils at athletic field areas is generally considered 2-inches per hour, with greater infiltration capacity preferred. The results of the dual ring infiltrometer test indicated an infiltration rate of 0.1 inches per hour. The poorly drained soils at the site are not suited for athletic field use.

Discussion

General: Successful turf and optimal growth depend on a number of factors: compaction levels, drainage conditions, planting media, nutrient status and maintenance. Poor drainage, resulting in extreme wetness, can result in anaerobic conditions and rapid deterioration of newly planted turf. Soil wetness is primarily related to ground water conditions, internal soil drainage, surface grading, organic matter content and the gradation of the planting medium.

Any one of the above factors can lead to poor turf conditions. To a limited degree, one factor can compensate for another. Strong surface grading can reduce the effects of poor internal soil drainage and good internal soil drainage can reduce the effects of inadequate surface gradients. However, all of the factors must be appropriately addressed in order to create successful turf grass.

Internal Soil Drainage: The capacity to move water into and through the soil and to prevent saturation of the growing media is essential. The amount of water infiltration is a function of the nature of the soil surface, the gradation of the topsoil, and the surface gradient. For most lawns with healthy turf, essentially all rainfall for low to moderate rates of rain will infiltrate the ground. Approximately one half of rainfall for intense rain events, such as thunderstorms, will infiltrate the ground. Depending on the dryness of the soil at the beginning of a rainfall event, one to two inches of infiltration can result in saturation of the topsoil layer, unless the water can move freely into the subsoil and away from the area. Given the soil gradation of the existing topsoil, the existing field area is subject to slow infiltration rates. The subsoil is also subject to slow infiltration capacity due to the amount of silt and clay in the soil.

Planting Medium Gradation: The grain size distribution of a growing medium affects internal drainage, water holding capacity, compatibility, and nutrient retention. The gradation of the planting medium for high-use lawn areas must contain adequate silt and clay-sized particles and adequate organic material to provide moisture retention and nutrients for turf. However, the amount of silt and clay must be limited. Planting medium, which is too fine-grained affects conditions in four ways. First, water moves slowly through the soil to the subgrade. Second, the soil retains more water, resulting in damp conditions for longer periods of time. Third, the soil is relatively compactable, and this further reduces porosity and water movement. And fourth, the strength of the soil and turf to support vehicles and/or foot traffic is reduced. Optimum grain size distributions balance these factors for either irrigated

or non-irrigated conditions, however, the amount of silt and clay must be limited to promote drainage and exchange of plant/soil gases.

Field observations and laboratory results indicate the topsoil across the existing lawn and field areas is too fine-grained for athletic field areas that are subject to high frequency and high intensity use.

Findings, Conclusions and Recommendations

The purpose of the study was to evaluate the topsoil and subsurface drainage conditions at the Forest River Park Baseball field and to develop recommendations for re-use of the existing planting soil. P&S understands that the existing baseball field is proposed to be reconstructed to include adding fill to raise the grades.

The primary causes for the wetness at the Forest Park baseball field are that both the existing topsoil and the subgrade soils are very poorly drained. The topsoil is very fine-grained, and in places is over 20 inches in thickness. Based on our field testing, the topsoil material infiltrates water at 0.1 inches per hour or less. The subgrade is also very poorly drained. We understand that preliminary plans include raising the elevation of the field, which provides an opportunity to install drainage provisions and also modify the composition of the topsoil to promote drainage.

The findings of our investigation are that the existing topsoil is not compatible for use as an athletic field soil without amendment. Athletic field soil must be well-drained, but also provide adequate organic matter and nutrient holding capacity to support quality turf. The existing subsoil is also too poorly drained for use below athletic fields. Adequate drainage and an appropriate root zone soil are paramount to the success of the new field area.

There are two potential strategies for improving subsurface drainage. If the fill that is used to raise grades has an infiltration rate of less than six inches per hour, we recommend installation of a sand blanket with embedded drain lines. If free draining fill with an infiltration rate of at least six inches per hour is used to grades, it may be possible to embed drain lines within the fill to both control the elevation of groundwater and to provide for drainage for the new soil profile.

We recommend that all of the topsoil and compressible soils be excavated from the athletic field area prior to backfilling. This operation will generate a surplus of topsoil material, which may have re-sale value. The contractor must strip the topsoil in a manner that does not commingle the topsoil and subsoil layers. We recommend stripping the upper 6-8 inches of topsoil from the outfield area and reserving that material for re-use. The remaining topsoil, infield mix, and subgrade soils should then be stripped and hauled away, or used as fill in areas approved by the Engineer. The subgrade should then be thoroughly compacted according to the Geotechnical Engineer.

New Soil Profile: We recommend 12" of sand based root zone mix to support the new turf as discussed below. There are multiple strategies on how to provide drainage to the root zone. We understand that grades will be raised at the field area, 36" or more. If the fill used to raise grades is very pervious, with an infiltration capacity over 6" per hour when compacted to a minimum 95% density, the fill acts as a drainage blanket and no additional sand layer is required. Drain lines may be placed at the bottom of the fill layer and then new topsoil is placed on the fill. Drain line spacing would depend on the infiltration capacity of the fill, but would be in the order of approximately 25 feet, and should be 6" fabric-wrapped corrugated pipe with a sand protective layer around the pipe. If there are inexpensive sources of other fill materials that are not very pervious, a second alternative is offered below.

A different alternative is to have a less controlled fill layer, and install a 12-inch sand drainage layer/blanket above the fill and beneath the topsoil. The drainage blanket should have 12" flat drain lines such as AdvanEdge or equivalent at the bottom of the profile at approximate 20' spacing. It may be possible to reduce the sand blanket thickness to 9", or even 6" if necessary, but the frequency of drain lines would increase to +/-15 feet.

Stripping and Stockpiling Topsoil: The existing soil from the field area should be stripped in a manner that minimal subsoil is incorporated into the topsoil during stripping, as incorporation of subsoil will reduce the horticultural value of the media. Our recommendations for amending the topsoil are based upon the samples collected, however the recommendations are preliminary. We recommend additional sampling after all of the site stripped topsoil is reasonably homogenized and final recommendations for re-use will be provided.

Amended Topsoil: The existing topsoil is acceptable for re-use as a component of manufactured athletic field and planting soil. Though it is very fine grained, the topsoil material has a reasonable crumb structure. The soil is not appropriate for direct re-use because it is too fine-grained. As seen in our field study, the existing topsoil has an infiltration capacity of 0.1 inches per hour or less.

During reconstruction, P&S recommends that the stripped topsoil be amended into sand-based manufactured topsoil with a gradation appropriate for use as an athletic field. This should be accomplished by amending the existing topsoil based on soil tests on the topsoil after stripping and stockpiling.

Based on the laboratory tests, a significant proportion of sand is necessary to increase the physical characteristics of the base topsoil to a level commensurate with high use fields. For athletic field use, our preliminary recommendation is to amend the stripped topsoil with uniformly graded medium to coarse sand meeting specification requirements at an approximate ratio of two and one half parts sand to one part stripped topsoil (2.5S:1T). This will reduce the organic content of the soil below recommended levels, so the addition of organic matter (compost) will also be

necessary. Final ratios will be determined by testing the stripped topsoil, however our preliminary recommendation is to amend each part of the stripped topsoil with two and one half parts sand and 1.0 parts compost (2.5S:1T:1.0C) for athletic field soil.

Recommendations Relative to Process

The construction of athletic fields and planted areas should be conducted after other construction activities are complete. Subgrade elevations should be established to accommodate a 12" thickness of athletic field soil.

It is imperative that the fill and/or drainage blanket work be protected during the topsoil placement process. Topsoil may be placed on the edges of the field and pushed onto the subgrade, the subgrade and topsoil layers may be constructed in sections, or temporary haul roads may be used to dump piles on the field, and then the haul roads are re-loosened and re-compressed. Under no circumstance shall wheeled construction vehicles be permitted to traverse areas of prepared subgrade or drainage blanket without re-work of the area.

After spreading and fine-grading amended topsoil, the lawn and field areas should be re-compacted with two perpendicular passes of the tracks of a small, wide tracked bulldozer, size D-5 or smaller. Wheeled vehicles should be prohibited from traversing any areas after they have been spread with amended topsoil. Any areas that become heavily compacted after placement should be rototilled and re-compacted again. After re-compaction the grades must be checked to ensure proper surface gradients free of surficial inconsistencies. Any surficial inconsistencies observed should be immediately corrected by utilizing in-place materials. Surficial grades should be uniform and allow for the efficient discharge of surface water without ponding. We recommend a minimum gradient of 1.25%.

Following re-compaction and finish grade checks, the seed bed should be prepared with a rock hound or equivalent equipment immediately prior to placing seed or sod.

For the lawn and field areas where sod is proposed, care must be given to the selection of the sod to be used to ensure that fine-grained, low permeability soils are not imported to the site with the sod. Improvement of topsoil and drainage can be rendered ineffective by sealing the surface with silty sod. P&S has had success with sod obtained from Tuckahoe Turf Farm that was cultivated at their Berwick Maine fields, Down East Turf and others. Other suitable sod farm growing media has been obtained at New Jersey farms. Sieve analysis and/or USDA classification of growing media should be made available by all vendors to assure sod that has adequate permeability. P&S recommends that a sample of the sod be submitted for approval prior to delivery to the site.

For all areas, it is essential that the soil is not manipulated while in a wet or frozen condition. Wet soil conditions will not allow for adequate mixing, and may result in prolonged damage to the soil structure by separation of silt and clay from the soil matrix. After seeding or sodding, it is necessary that optimal moisture requirements be maintained until the new grass is established. Adequate irrigation, without over watering, is absolutely essential to the establishment of turfgrass.

Regular maintenance of the field area should include irrigation adjustments, aeration, de-thatching, soil testing, lime and fertilizer applications, overseeding, and control of pests and weeds.

We realize that the cost of implementing an appropriate soil profile at this site is a substantial initial investment. In addition, as with any athletic field, a high level of routine maintenance will be required, including irrigation, repair of damage, fertilization and liming, core aeration and other routine tasks. The cost benefit of constructing athletic fields with appropriate soil profiles is realized in reduced maintenance, and, in particular greatly reducing or eliminating the need to re-build or rehabilitate the field on a regular basis. The fields will not require routine re-habilitation if maintained properly, and they will be able to tolerate high use levels. By maintaining strong, healthy turf, weed infestation will be minimal and will recover from stresses more readily. Properly constructed fields will also typically be playable within one hour after a significant precipitation event, and be available sooner in the spring.

We trust this information is sufficient at this time. If you have any questions, do not hesitate to contact us.

Sincerely,
Pine and Swallow Environmental



Michael Agonis
Environmental Scientist/Project Manager



Robert Pine
Principal

Attachments

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: FRP TP1

Order Number: 18729

Lab Number: S151130-118

Area Sampled:

Received: 11/30/2015





Reported: 12/8/2015

Results

<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>	<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>
Soil pH (1:1, H ₂ O)	5.9		Cation Exch. Capacity, meq/100g	9.8	
Modified Morgan extractable, ppm			Exch. Acidity, meq/100g	6.2	
<i>Macronutrients</i>			Base Saturation, %		
Phosphorus (P)	2.2	4-14	Calcium Base Saturation	27	50-80
Potassium (K)	46	100-160	Magnesium Base Saturation	9	10-30
Calcium (Ca)	525	1000-1500	Potassium Base Saturation	1	2.0-7.0
Magnesium (Mg)	103	50-120	Scoop Density, g/cc	1.06	
Sulfur (S)	10.7	>10	Optional tests		
<i>Micronutrients *</i>			Soil Organic Matter (LOI), %	4.0	
Boron (B)	0.1	0.1-0.5	Soluble Salts (1:2), dS/m	0.07	<0.6
Manganese (Mn)	2.3	1.1-6.3			
Zinc (Zn)	1.4	1.0-7.6			
Copper (Cu)	0.5	0.3-0.6			
Iron (Fe)	4.9	2.7-9.4			
Aluminum (Al)	48	<75			
Lead (Pb)	2.7	<22			

* Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				



Soil and Plant Tissue Testing Laboratory

203 Paige Laboratory
161 Holdsworth Way
University of Massachusetts
Amherst, MA 01003
Phone: (413) 545-2311
e-mail: soiltest@umass.edu
website: soiltest.umass.edu

Recommendations for Data only (including micronutrients)

Comments:

General References:

Interpreting Your Soil Test Results

<http://soiltest.umass.edu/fact-sheets/interpreting-your-soil-test-results>

For current information and order forms, please visit

<http://soiltest.umass.edu/>

Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:

Sample ID: FRP TP 1

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

Order Number: 18814

Lab Number: X151204-106

Received: 12/4/2015

Reported: 12/10/2015

m.agonis@pineandswallow.com
978-448-9511

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>			
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>	<u>Finer Than 2mm % of Sample Passing</u>
Sand	0.05-2.0	58.0	2.00	#10	89.3	100.0
Silt	0.002-0.05	29.7	1.00	#18	83.1	93.1
Clay	<0.002	12.3	0.50	#35	71.9	80.5
			0.25	#60	59.5	66.6
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	0.10	#140	47.0	52.6
Very Coarse	1.0-2.0	6.9	0.053	#270	37.5	42.0
Coarse	0.5-1.0	12.6	0.02	20 um	22.2	24.9
Medium	0.25-0.5	13.9	0.005	5 um	13.8	15.5
Fine	0.10-0.25	13.9	0.002	2 um	11.0	12.3
Very Fine	0.05-0.10	10.6				
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>				
Coarse	0.02-0.05	17.1				
Medium	0.005-0.02	9.4				
Fine	0.002-0.005	3.2				

USDA Textural Class: sandy loam

Gravel Content: (%) 10.7

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: FRP TP2

Order Number: 18729

Lab Number: S151130-119

Area Sampled:

Received: 11/30/2015

Reported: 12/8/2015

Results

<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>	<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>
Soil pH (1:1, H ₂ O)	5.7		Cation Exch. Capacity, meq/100g	9.8	
Modified Morgan extractable, ppm			Exch. Acidity, meq/100g	6.2	
<i>Macronutrients</i>			Base Saturation, %		
Phosphorus (P)	2.3	4-14	Calcium Base Saturation	29	50-80
Potassium (K)	39	100-160	Magnesium Base Saturation	6	10-30
Calcium (Ca)	561	1000-1500	Potassium Base Saturation	1	2.0-7.0
Magnesium (Mg)	77	50-120	Scoop Density, g/cc	1.07	
Sulfur (S)	9.4	>10	Optional tests		
<i>Micronutrients *</i>			Soil Organic Matter (LOI), %	4.0	
Boron (B)	0.1	0.1-0.5	Soluble Salts (1:2), dS/m	0.04	<0.6
Manganese (Mn)	2.5	1.1-6.3			
Zinc (Zn)	1.3	1.0-7.6			
Copper (Cu)	0.5	0.3-0.6			
Iron (Fe)	4.9	2.7-9.4			
Aluminum (Al)	43	<75			
Lead (Pb)	6.3	<22			

* Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):	[Progress bar]			
Potassium (K):	[Progress bar]			
Calcium (Ca):	[Progress bar]			
Magnesium (Mg):	[Progress bar]			



Soil and Plant Tissue Testing Laboratory

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Amherst, MA 01003
Phone: (413) 545-2311
e-mail: soiltest@umass.edu
website: soiltest.umass.edu

Recommendations for Data only (including micronutrients)

Comments:

General References:

Interpreting Your Soil Test Results

<http://soiltest.umass.edu/fact-sheets/interpreting-your-soil-test-results>

For current information and order forms, please visit

<http://soiltest.umass.edu/>

Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:

Sample ID: FRP TP 2

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

Order Number: 18814

Lab Number: X151204-107

Received: 12/4/2015

Reported: 12/10/2015

m.agonis@pineandswallow.com
978-448-9511

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>			
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>	<u>Finer Than 2mm % of Sample Passing</u>
Sand	0.05-2.0	50.7	2.00	#10	84.2	100.0
Silt	0.002-0.05	35.4	1.00	#18	78.9	93.7
Clay	<0.002	13.9	0.50	#35	70.1	83.3
			0.25	#60	60.9	72.4
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	0.10	#140	50.7	60.2
Very Coarse	1.0-2.0	6.3	0.053	#270	41.5	49.3
Coarse	0.5-1.0	10.4	0.02	20 um	26.0	30.8
Medium	0.25-0.5	10.9	0.005	5 um	15.2	18.1
Fine	0.10-0.25	12.1	0.002	2 um	11.7	13.9
Very Fine	0.05-0.10	10.9				
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>				
Coarse	0.02-0.05	18.5				
Medium	0.005-0.02	12.7				
Fine	0.002-0.005	4.2				

USDA Textural Class: loam

Gravel Content: (%) 15.8

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: FRP TP3

Order Number: 18729

Lab Number: S151130-120

Area Sampled:

Received: 11/30/2015






Reported: 12/8/2015

Results

<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>	<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>
Soil pH (1:1, H ₂ O)	6.2		Cation Exch. Capacity, meq/100g	11.7	
Modified Morgan extractable, ppm			Exch. Acidity, meq/100g	5.3	
<i>Macronutrients</i>			Base Saturation, %		
Phosphorus (P)	2.7	4-14	Calcium Base Saturation	43	50-80
Potassium (K)	71	100-160	Magnesium Base Saturation	10	10-30
Calcium (Ca)	997	1000-1500	Potassium Base Saturation	2	2.0-7.0
Magnesium (Mg)	150	50-120	Scoop Density, g/cc	1.00	
Sulfur (S)	11.5	>10	Optional tests		
<i>Micronutrients *</i>			Soil Organic Matter (LOI), %	5.2	
Boron (B)	0.1	0.1-0.5	Soluble Salts (1:2), dS/m	0.09	<0.6
Manganese (Mn)	4.6	1.1-6.3			
Zinc (Zn)	1.4	1.0-7.6			
Copper (Cu)	0.7	0.3-0.6			
Iron (Fe)	4.2	2.7-9.4			
Aluminum (Al)	21	<75			
Lead (Pb)	2.4	<22			

* Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				



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Recommendations for Data only (including micronutrients)

Comments:

General References:

Interpreting Your Soil Test Results

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For current information and order forms, please visit

<http://soiltest.umass.edu/>

Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:

Sample ID: FRP TP 3

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

Order Number: 18814

Lab Number: X151204-108

Received: 12/4/2015

Reported: 12/10/2015

m.agonis@pineandswallow.com
978-448-9511

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>			
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>	<u>Finer Than 2mm % of Sample Passing</u>
Sand	0.05-2.0	44.9	2.00	#10	90.8	100.0
Silt	0.002-0.05	40.8	1.00	#18	86.1	94.9
Clay	<0.002	14.4	0.50	#35	78.6	86.6
			0.25	#60	70.1	77.2
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	0.10	#140	59.9	66.0
Very Coarse	1.0-2.0	5.1	0.053	#270	50.1	55.1
Coarse	0.5-1.0	8.3	0.02	20 um	31.7	34.9
Medium	0.25-0.5	9.3	0.005	5 um	16.9	18.6
Fine	0.10-0.25	11.2	0.002	2 um	13.0	14.4
Very Fine	0.05-0.10	10.9				
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>				
Coarse	0.02-0.05	20.2				
Medium	0.005-0.02	16.3				
Fine	0.002-0.005	4.3				

USDA Textural Class: loam

Gravel Content: (%) 9.2

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

m.agonis@pineandswallow.com
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Sample Information:

Sample ID: FRP TP4

Order Number: 18729

Lab Number: S151130-121

Area Sampled:

Received: 11/30/2015





Reported: 12/8/2015

Results

<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>	<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>
Soil pH (1:1, H ₂ O)	6.3		Cation Exch. Capacity, meq/100g	12.3	
Modified Morgan extractable, ppm			Exch. Acidity, meq/100g	4.3	
<i>Macronutrients</i>			Base Saturation, %		
Phosphorus (P)	0.9	4-14	Calcium Base Saturation	55	50-80
Potassium (K)	70	100-160	Magnesium Base Saturation	8	10-30
Calcium (Ca)	1361	1000-1500	Potassium Base Saturation	1	2.0-7.0
Magnesium (Mg)	120	50-120	Scoop Density, g/cc	0.99	
Sulfur (S)	14.8	>10	Optional tests		
<i>Micronutrients *</i>			Soil Organic Matter (LOI), %	5.3	
Boron (B)	0.2	0.1-0.5	Soluble Salts (1:2), dS/m	0.08	<0.6
Manganese (Mn)	4.7	1.1-6.3			
Zinc (Zn)	0.7	1.0-7.6			
Copper (Cu)	0.5	0.3-0.6			
Iron (Fe)	3.3	2.7-9.4			
Aluminum (Al)	12	<75			
Lead (Pb)	1.7	<22			

* Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				



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Recommendations for Data only (including micronutrients)

Comments:

General References:

Interpreting Your Soil Test Results

<http://soiltest.umass.edu/fact-sheets/interpreting-your-soil-test-results>

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Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:

Sample ID: FRP TP 4

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

Order Number: 18814

Lab Number: X151204-109

Received: 12/4/2015

Reported: 12/10/2015

m.agonis@pineandswallow.com
978-448-9511

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>			
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>	<u>Finer Than 2mm % of Sample Passing</u>
Sand	0.05-2.0	44.5	2.00	#10	90.2	100.0
Silt	0.002-0.05	40.3	1.00	#18	84.9	94.1
Clay	<0.002	15.2	0.50	#35	78.4	86.9
			0.25	#60	70.2	77.8
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	0.10	#140	60.1	66.7
Very Coarse	1.0-2.0	5.9	0.053	#270	50.1	55.5
Coarse	0.5-1.0	7.2	0.02	20 um	33.0	36.6
Medium	0.25-0.5	9.1	0.005	5 um	18.2	20.2
Fine	0.10-0.25	11.2	0.002	2 um	13.7	15.2
Very Fine	0.05-0.10	11.1				
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>				
Coarse	0.02-0.05	19.0				
Medium	0.005-0.02	16.3				
Fine	0.002-0.005	5.0				

USDA Textural Class: loam

Gravel Content: (%) 9.8

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: FRP TP5

Order Number: 18729

Lab Number: S151130-122

Area Sampled:

Received: 11/30/2015





Reported: 12/8/2015

Results

<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>	<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>
Soil pH (1:1, H ₂ O)	6.8		Cation Exch. Capacity, meq/100g	9.7	
Modified Morgan extractable, ppm			Exch. Acidity, meq/100g	1.0	
<i>Macronutrients</i>			Base Saturation, %		
Phosphorus (P)	1.2	4-14	Calcium Base Saturation	76	50-80
Potassium (K)	81	100-160	Magnesium Base Saturation	12	10-30
Calcium (Ca)	1463	1000-1500	Potassium Base Saturation	2	2.0-7.0
Magnesium (Mg)	146	50-120	Scoop Density, g/cc	1.09	
Sulfur (S)	14.2	>10	Optional tests		
<i>Micronutrients *</i>			Soil Organic Matter (LOI), %	3.2	
Boron (B)	0.2	0.1-0.5	Soluble Salts (1:2), dS/m	0.12	<0.6
Manganese (Mn)	1.8	1.1-6.3			
Zinc (Zn)	0.7	1.0-7.6			
Copper (Cu)	0.8	0.3-0.6			
Iron (Fe)	1.4	2.7-9.4			
Aluminum (Al)	9	<75			
Lead (Pb)	1.2	<22			

* Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				



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Recommendations for Data only (including micronutrients)

Comments:

General References:

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For current information and order forms, please visit

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Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:

Sample ID: FRP TP 5

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

Order Number: 18814

Lab Number: X151204-110

Received: 12/4/2015

Reported: 12/10/2015

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978-448-9511

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>			
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>	<u>Finer Than 2mm % of Sample Passing</u>
Sand	0.05-2.0	47.8	2.00	#10	89.2	100.0
Silt	0.002-0.05	37.6	1.00	#18	85.7	96.0
Clay	<0.002	14.6	0.50	#35	79.5	89.1
			0.25	#60	71.4	80.0
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	0.10	#140	59.6	66.8
Very Coarse	1.0-2.0	4.0	0.053	#270	46.6	52.2
Coarse	0.5-1.0	6.9	0.02	20 um	29.9	33.5
Medium	0.25-0.5	9.1	0.005	5 um	16.8	18.8
Fine	0.10-0.25	13.2	0.002	2 um	13.0	14.6
Very Fine	0.05-0.10	14.6				
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>				
Coarse	0.02-0.05	18.7				
Medium	0.005-0.02	14.7				
Fine	0.002-0.005	4.2				

USDA Textural Class: loam

Gravel Content: (%) 10.8

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: FRP TP6

Order Number: 18729

Lab Number: S151130-124

Area Sampled:

Received: 11/30/2015





Reported: 12/8/2015

Results

<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>	<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>
Soil pH (1:1, H ₂ O)	7.3		Cation Exch. Capacity, meq/100g	11.2	
Modified Morgan extractable, ppm			Exch. Acidity, meq/100g	0.0	
<i>Macronutrients</i>			Base Saturation, %		
Phosphorus (P)	1.1	4-14	Calcium Base Saturation	86	50-80
Potassium (K)	78	100-160	Magnesium Base Saturation	13	10-30
Calcium (Ca)	1911	1000-1500	Potassium Base Saturation	2	2.0-7.0
Magnesium (Mg)	170	50-120	Scoop Density, g/cc	1.02	
Sulfur (S)	18.9	>10	Optional tests		
<i>Micronutrients *</i>			Soil Organic Matter (LOI), %	4.7	
Boron (B)	0.3	0.1-0.5	Soluble Salts (1:2), dS/m	0.11	<0.6
Manganese (Mn)	2.4	1.1-6.3			
Zinc (Zn)	0.6	1.0-7.6			
Copper (Cu)	0.6	0.3-0.6			
Iron (Fe)	1.8	2.7-9.4			
Aluminum (Al)	7	<75			
Lead (Pb)	0.9	<22			

* Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				



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Recommendations for Data only (including micronutrients)

Comments:

-When pH is greater than 6.8, Cation Exchange Capacity (CEC) tends to be overestimated.

General References:

Interpreting Your Soil Test Results

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Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:

Sample ID: FRP TP 6

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

Order Number: 18814
Lab Number: X151204-111
Received: 12/4/2015
Reported: 12/10/2015

m.agonis@pineandswallow.com
978-448-9511

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>			
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>	<u>Finer Than 2mm % of Sample Passing</u>
Sand	0.05-2.0	49.2	2.00	#10	97.7	100.0
Silt	0.002-0.05	37.6	1.00	#18	92.8	95.0
Clay	<0.002	13.2	0.50	#35	84.8	86.8
			0.25	#60	74.1	75.9
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	0.10	#140	60.6	62.0
Very Coarse	1.0-2.0	5.0	0.053	#270	49.6	50.8
Coarse	0.5-1.0	8.2	0.02	20 um	33.3	34.0
Medium	0.25-0.5	10.9	0.005	5 um	18.0	18.4
Fine	0.10-0.25	13.8	0.002	2 um	12.9	13.2
Very Fine	0.05-0.10	11.2				
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>				
Coarse	0.02-0.05	16.8				
Medium	0.005-0.02	15.6				
Fine	0.002-0.005	5.2				

USDA Textural Class: loam

Gravel Content: (%) 2.3

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: FRP TP7

Order Number: 18729

Lab Number: S151130-125

Area Sampled:

Received: 11/30/2015





Reported: 12/8/2015

Results

<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>	<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>
Soil pH (1:1, H ₂ O)	6.4		Cation Exch. Capacity, meq/100g	10.4	
Modified Morgan extractable, ppm			Exch. Acidity, meq/100g	4.0	
<i>Macronutrients</i>			Base Saturation, %		
Phosphorus (P)	0.8	4-14	Calcium Base Saturation	51	50-80
Potassium (K)	69	100-160	Magnesium Base Saturation	8	10-30
Calcium (Ca)	1058	1000-1500	Potassium Base Saturation	2	2.0-7.0
Magnesium (Mg)	104	50-120	Scoop Density, g/cc	1.01	
Sulfur (S)	11.9	>10	Optional tests		
<i>Micronutrients *</i>			Soil Organic Matter (LOI), %	4.3	
Boron (B)	0.1	0.1-0.5	Soluble Salts (1:2), dS/m	0.09	<0.6
Manganese (Mn)	4.5	1.1-6.3			
Zinc (Zn)	0.9	1.0-7.6			
Copper (Cu)	0.5	0.3-0.6			
Iron (Fe)	5.1	2.7-9.4			
Aluminum (Al)	21	<75			
Lead (Pb)	1.9	<22			

* Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				



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Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:

Sample ID: FRP TP 7

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

Order Number: 18814

Lab Number: X151204-112

Received: 12/4/2015

Reported: 12/10/2015

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978-448-9511

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>			
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>	<u>Finer Than 2mm % of Sample Passing</u>
Sand	0.05-2.0	46.0	2.00	#10	87.8	100.0
Silt	0.002-0.05	39.4	1.00	#18	83.9	95.6
Clay	<0.002	14.6	0.50	#35	77.9	88.8
			0.25	#60	69.4	79.1
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	0.10	#140	58.0	66.0
Very Coarse	1.0-2.0	4.4	0.053	#270	47.4	54.0
Coarse	0.5-1.0	6.9	0.02	20 um	29.0	33.0
Medium	0.25-0.5	9.6	0.005	5 um	17.3	19.8
Fine	0.10-0.25	13.1	0.002	2 um	12.8	14.6
Very Fine	0.05-0.10	12.0				
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>				
Coarse	0.02-0.05	21.0				
Medium	0.005-0.02	13.3				
Fine	0.002-0.005	5.1				

USDA Textural Class: loam

Gravel Content: (%) 12.2

Soil Test Report

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

m.agonis@pineandswallow.com
978-448-9511

Sample Information:

Sample ID: FRP TP8

Order Number: 18729

Lab Number: S151130-126

Area Sampled:

Received: 11/30/2015

Reported: 12/8/2015

Results

<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>	<i>Analysis</i>	<i>Value Found</i>	<i>Optimum Range</i>
Soil pH (1:1, H ₂ O)	7.4		Cation Exch. Capacity, meq/100g	13.9	
Modified Morgan extractable, ppm			Exch. Acidity, meq/100g	0.0	
<i>Macronutrients</i>			Base Saturation, %		
Phosphorus (P)	1.5	4-14	Calcium Base Saturation	93	50-80
Potassium (K)	66	100-160	Magnesium Base Saturation	6	10-30
Calcium (Ca)	2590	1000-1500	Potassium Base Saturation	1	2.0-7.0
Magnesium (Mg)	95	50-120	Scoop Density, g/cc	1.02	
Sulfur (S)	18.2	>10	Optional tests		
<i>Micronutrients *</i>			Soil Organic Matter (LOI), %	3.7	
Boron (B)	0.2	0.1-0.5	Soluble Salts (1:2), dS/m	0.09	<0.6
Manganese (Mn)	2.3	1.1-6.3			
Zinc (Zn)	0.5	1.0-7.6			
Copper (Cu)	0.7	0.3-0.6			
Iron (Fe)	1.4	2.7-9.4			
Aluminum (Al)	5	<75			
Lead (Pb)	0.8	<22			

* Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				



Soil and Plant Tissue Testing Laboratory

203 Paige Laboratory
161 Holdsworth Way
University of Massachusetts
Amherst, MA 01003
Phone: (413) 545-2311
e-mail: soiltest@umass.edu
website: soiltest.umass.edu

Recommendations for Data only (including micronutrients)

Comments:

-When pH is greater than 6.8, Cation Exchange Capacity (CEC) tends to be overestimated.

General References:

Interpreting Your Soil Test Results

<http://soiltest.umass.edu/fact-sheets/interpreting-your-soil-test-results>

For current information and order forms, please visit

<http://soiltest.umass.edu/>

Particle Size Analysis - Comprehensive with 2mm Passing

Sample Information:

Sample ID: FRP TP 8

Prepared For:

Mike Agonis
Pine & Swallow Environmental
867 Boston Road
Groton, MA 01450

Order Number: 18814

Lab Number: X151204-113

Received: 12/4/2015

Reported: 12/10/2015

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978-448-9511

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>			
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>	<u>Finer Than 2mm % of Sample Passing</u>
Sand	0.05-2.0	42.1	2.00	#10	89.1	100.0
Silt	0.002-0.05	40.0	1.00	#18	84.2	94.5
Clay	<0.002	18.0	0.50	#35	78.4	88.0
			0.25	#60	71.4	80.2
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	0.10	#140	61.7	69.2
Very Coarse	1.0-2.0	5.5	0.053	#270	51.6	57.9
Coarse	0.5-1.0	6.5	0.02	20 um	34.3	38.5
Medium	0.25-0.5	7.8	0.005	5 um	20.9	23.4
Fine	0.10-0.25	11.0	0.002	2 um	16.0	18.0
Very Fine	0.05-0.10	11.3				
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>				
Coarse	0.02-0.05	19.5				
Medium	0.005-0.02	15.0				
Fine	0.002-0.005	5.5				

USDA Textural Class: loam

Gravel Content: (%) 10.9

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SECTION 02 41 14

SELECTIVE SITE DEMOLITION AND RESTORATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Site demolition including clearing, stripping or ordinary excavation of existing bituminous or cement concrete pavements, soils, foundations, bituminous or cement concrete curbs, bituminous or cement concrete sidewalks, grassed areas, demolition, dismantling, replacement and restoration Work, stacking of reusable and disposal of waste and surplus materials and tree protection and removal in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 32 90 00 – Planting and Seeding

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. MassDOT Standard Specifications and Supplements and Construction Details

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

- A. Perform selective Site demolition in accordance with MassDOT Section 100.
- B. Comply with General Requirements for temporary construction controls, protections, and waste disposal.
 - 1. Ensure against damage or injury to buildings, occupants, and adjacent property from falling debris or other causes. Avoid damage to adjacent areas, facilities, and appurtenances.
 - 2. Maintain free and safe passage to and from Site.
 - 3. Legally dispose of waste, surplus and unsatisfactory materials including bituminous or cement concrete, debris, rails and ties, common excavation, cold planning, and reclamation immediately as it accumulates during clearing, grubbing, stripping, demolition, and other Site preparation. Burying is not allowed.

3.02 SITE DEMOLITION

- A. Clear Site of construction debris and waste materials, including grass, bushes, trees, broken concrete, fencing, pipes, lumber and steel pieces, rags and plastics, within limits of Work as shown on Drawings or as directed.
- B. Strip and/or excavate existing bituminous or cement concrete pavements, soils, foundations, bituminous or cement concrete curbs, bituminous or cement concrete sidewalks, grassed areas.
- C. Remove, stack, store and protect field stone masonry wall sections to be reinstalled as necessary to construct drainage improvements or other parts of Work.
 - 1. Remove field stone masonry stones and store for resetting in accordance with MassDOT Section 685 and Drawings.

- D. Remove and stack fencing, lamp posts, letter boxes, signs, guardrails, bike racks, and poles and other usable materials to be reinstalled.
 - 1. Remove fence and store for resetting in accordance with MassDOT Section 665 and Drawings.
- E. Demolish and remove existing bituminous pavement, bituminous and concrete walkways, curbing, grass borders and landscaping, bushes, shrubs and vegetation as necessary to construct drainage improvements. Remove existing obstructions and debris, cut trees, bushes, root stumps, waste stones, wood, lumber, metal, plastic, and other unsuitable materials above, at, or below grade that may interfere with or obstruct the Work, whether or not shown on Drawings.
- F. Remove and stockpile top soil, curb stones, and utility castings and other materials for reuse as shown or as directed by Engineer.
- G. Stockpile recovered materials acceptable to Engineer to be reused on Project and protect against damage or deterioration.
- H. Do not cut, remove, destroy, or trim trees and shrubs unless specifically marked or permitted. Do not remove tree branches using excavating equipment. Provide that required trimming is performed by a licensed arborist.
 - 1. Remove, store, and protect trees designated on Drawings per MassDOT Section 771.
 - 2. Protect trees or vegetation outside limits of Work area.
 - 3. Tree Removal (4-48 inches in diameter)
 - a. Cut existing trees and expose by excavation, remove or cut, as required, tree stumps and root systems as shown on Drawings and as directed. Remove and dispose of tree stumps, roots, organic matter and unsuitable materials.
 - b. Excavation around tree: not to exceed width of sidewalk.
 - c. Depth of excavation for stump removal: not to exceed 5 feet.
 - d. Depth of excavation for removal of a tree root system: not to exceed 2 feet.
 - e. Cut clean and remove root system encountered within limits of sidewalk width as determined by Engineer. Paint cut surfaces of remaining detached roots with stump rot. Clean and paint tree roots still attached to trunk with two coats of an approved chemical root guard to protect tree from later damage.

- f. Transport and carefully stack existing tree grates in good condition and not needed for the Project, or dispose of at no additional cost to Owner, as directed by Engineer.
- I. Protect integrity of remaining structures, appurtenances and equipment during demolition, removal and alteration to existing structures, appurtenances, utility pipes, castings, fences, walkways, posts, stairs and other physical features.
- J. Maintain slopes longitudinally and laterally to ensure proper and continuous drainage. Field adjust sidewalk and roadway gutter grades at driveways and side street intersections to be consistent with existing drainage pattern and provide for an appropriate transition between new and existing side streets and driveways pavement surfaces at intersections.
- K. If cobblestones are encountered, carefully stack excavated cobblestone at no additional cost to Owner.
- L. Leave abandoned underground piping in place, plug or cap and fill with flowable control density fill. Remove or cut abandoned underground piping castings a minimum 12 inches below finished surface and area backfilled.
- M. Cut sections of piping to be removed to nearest solid support or provide appropriate new supports and cap remaining ends before backfilling, unless noted on Drawings or specifically directed by Engineer.
- N. Cut openings in existing masonry Work to provide for a suitable bond, and clean, square and plumb openings for installation of new Work. Thoroughly clean cut surfaces of loosened materials.

3.03 SAWCUTS IN EXISTING PAVEMENTS AND SIDEWALKS

- A. Neatly saw cut edges of excavations in existing pavements and sidewalks along either a straight line or design curved line as shown in Drawings. Ragged, uneven edges are not acceptable.
- B. Saw cut existing pavement through its full depth or to elevation of abutting proposed pavement subgrade, whichever is less, at joints between existing and proposed pavements and at utility trenches through existing pavement to remain. Provide a uniform, vertical surface for proposed pavement joint with existing pavement.
- C. Neatly saw cut edges that become broken, ragged or undermined with a minimum disturbance to remaining pavements or sidewalks prior to placement of abutting proposed pavement.
- D. In areas where an existing concrete sidewalk abuts a building, wall or storefront, and sidewalk is to be reconstructed or removed, saw cut existing sidewalk a

minimum of 6 inches from building wall or storefront, unless otherwise directed by Engineer.

- E. Spray or paint saw cut surfaces with a uniform thin coat of RS-1 asphalt emulsion immediately before placement of hot mix asphalt material against surface.

3.04 REPAIR, REPLACEMENT AND RESTORATION

- A. Match materials of repair or restoration to existing adjacent surfaces in finish and texture as closely as possible. Make joints between new and existing Work inconspicuous.
- B. Replace or restore items damaged, dislocated or dismantled such as field stone masonry walls, fences, lamp posts, letter boxes, masonry boundary walls, City signs, poles, bollards, curb stones, markers, trees, bushes, grassed areas, walkways, stairs, steps, benches, outside lighting and other amenities and physical features designated to remain, to original condition.
- C. Reinstall field stone masonry walls removed as shown per MassDOT Section 690.
- D. Reinstall fencing removed as shown with new posts as necessary per MassDOT Section 665.
 - 1. New posts: per MassDOT Section 600 and Section M8.09.0
- E. Re-plant trees designated on Drawings per MassDOT Section 771 and Section 32 90 00.

3.05 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 02 41 15

DRAINAGE STRUCTURE REMOVAL

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Removal of drainage structures in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 31 00 00 - Earthwork

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. MassDOT Standard Specifications and Supplements and Construction Details

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 REMOVAL

- A. Remove drainage structures identified in accordance with MassDOT Section 140 and Drawings.
- B. Remove and stack castings (frames, covers and grates).
 - 1. Transport and stack castings at City DPW yard if requested by Owner at no additional cost to Owner.
 - 2. If Owner does not wish to keep castings or castings are deemed not serviceable by Engineer, legally dispose of castings at no additional cost to Owner.
- C. Plug inlets and outlets and remove masonry and concrete.
- D. Fill cavity with control density fill specified in Section 31 00 00.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.03 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 03 11 00

CONCRETE FORMING

PART 1 – GENERAL

1.01 SUMMARY

- A. Provide all materials, tools, equipment and labor required for design, preparation and cleaning, construction, and removal of all concrete formwork, and installation of all concrete embedments furnished under other sections, necessary for proper completion of Work in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 03 30 20 - Concrete Placing, Curing and Finishing

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and Payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Concrete Institute International (ACI)
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - b. ACI 301 – Specifications for Structural Concrete
 - 2. ASTM International (ASTM)
 - a. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - b. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.

- B. Product Data
 - 1. Form Ties
 - 2. Form Release Agent
- C. Manufacturer's Instructions
 - 1. Form Ties
 - 2. Form Release Agent
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General
 - 1. Formwork shall conform dimensionally to concrete Work as shown on Drawings. To minimize the number of panel joints, formwork panels shall be largest practicable sizes. Formwork shall be sufficiently tight to prevent leakage.
 - 2. Undamaged smooth form facing materials such as plywood, hardboard, metal, and plastic, that will produce a smooth form finish, shall be used. Formwork shall not result in fins or offsets exceeding 1/8-inch. If used, aluminum forms with un-oxidized surfaces shall be pretreated with a paste made of calcium hydroxide and water, followed by water rinsing, repeated until hydrogen bubbles do not form.
- B. Form Release Agent

1. Non-grain raising, non-staining, and shall not leave a residue on concrete or adversely affect bonding of materials to be applied.
- C. Form Ties
1. Adjustable length, sized to withstand construction loads, and upon removal shall prevent concrete spalling.
 2. Portion of tie remaining embedded in concrete upon removal: at least 1-1/2 inches from both concrete faces. Form tie assembly: provide with cone-shaped depressions at concrete surfaces of at least 1-inch diameter and 1-1/2 inches deep.
 3. Ties shall contain a neoprene waterstop. Tie systems that include plug style waterstops inserted into tie holes after removal of forms are not permitted.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 TECHNICAL REQUIREMENTS

- A. Contractor shall design, erect, shore, brace, and maintain formwork in accordance with ACI 301 to support all loads, including construction loads, until concrete structure can support such loads.

3.02 CONSTRUCTION

- A. Tolerances: in accordance with ACI 117.
- B. Form Alignment
1. At locations where continuous surfaces are formed in successive units, forms shall be tightly fitted over hardened concrete surface to obtain accurate surface alignment and to prevent leakage of mortar and formation of fins, ridges, and other defects.
- C. Chamfered Edges
1. Exposed concrete corners: formed with beveled strips to provide 3/4-inch chamfers, unless otherwise shown, specified, or directed by Engineer.
 2. Omit chamfer where concrete walls, columns, and beams abut masonry walls.

3. Omit chamfer where masonry walls are flush with face of supporting concrete curbs.
 4. Chamfering by grinding is prohibited.
- D. Openings
1. Form openings in concrete where required for other Work. Upon failing to form such openings, provide them in a manner approved by Engineer at no additional cost to the Owner.
 2. Except as specified, fill openings with concrete after installation Work is complete.
- E. Cleanouts and Access Panels
1. Provide temporary openings to facilitate cleaning and inspection prior to concrete placement, including at bottom of wall forms. Cleanout openings are not permitted in exposed concrete, concrete exposed to view upon completion of Work, whether or not it is painted, without approval of Engineer.
 2. Remove refuse and broom clean forms before concrete placement.
- F. Form Release Agent
1. Coat forms with approved form release agent before placement of reinforcing steel. Do not apply form release agent at locations of monolithic construction joints, which are construction joints with all reinforcement continuous through the joint. Excess agent applied to forms, and on reinforcing steel and other surfaces requiring a concrete bond, shall be removed.
 2. Forms for unexposed surfaces may be thoroughly wetted in lieu of approved form release agent immediately before concrete is placed. Use form release agent in freezing weather.

3.03 INSTALLATION OF EMBEDDED ITEMS

- A. General
1. Coordinate setting of anchor bolts, thimbles, inserts, wall pipe, sleeves, and other embedded items. Before placing concrete, ensure that all items are accurately located and firmly secured against displacement.
 2. Items: thoroughly cleaned and free of loose rust, mill scale, dirt and grease. Wood used for removable keys shall be thoroughly dampened before concrete is placed against it.

B. Electrical Conduit

1. May be embedded in concrete provided the following conditions are met. Conduit runs that cannot satisfy these conditions shall be exposed and not embedded in concrete.
2. Outside diameter of conduit shall not exceed 1/3 of concrete thickness.
3. Conduit shall not be placed closer than 3 diameters on center.
4. Conduit shall not significantly impair strength of construction.
5. Conduit shall not be embedded in structural concrete slabs less than 4-inches thick.
6. Only 2 conduits may cross at any point. Sum of outside diameter of crossing conduits shall not exceed 1/3 of concrete thickness.
7. A 1-1/2 inch minimum concrete cover shall be provided for conduits in structural slabs.
8. Conduit shall not be located between bottom of reinforcing steel and bottom of slab.
9. Conduit is not permitted in beams, girders, and columns without approval of Engineer.
10. Aluminum conduit shall not be embedded in concrete.
11. Conduit shall be installed so that cutting, bending, or displacement of reinforcement from its proper location is not necessary.

3.04 REMOVAL

A. Form Removal

1. Remove while ensuring safety of structure. Forms or shoring for slabs, beams, and other suspended members shall not be removed until members are of sufficient strength to safely support their own weight.
2. Newly unsupported portions of structure shall not be subjected to heavy construction or material loading. Provide additional shores or re-shores as required to adequately support members during construction period.
3. Contractor: responsible for proper removal of forms, shores, and bracing.
4. Prevent spalling of concrete surfaces.

5. When forms are removed before curing period is complete as specified in Section 03 30 20, take measures to continue curing providing thermal protection for concrete.
6. Forms may be removed when cumulative time during which temperature of air surrounding the concrete is above 50 degrees F are as follows
 - a. Walls (except tank and containment walls, and those resisting hydrostatic pressure from groundwater), columns, sides of beams and girders, and similar parts of the Work not supporting weight of the concrete: 24 hours.
 - b. Tank and containment walls, and those resisting hydrostatic pressure from groundwater: 7 days. Loosening forms after 24 hours is permitted, but forms shall remain in place to aid curing.
 - c. Elevated concrete structural slabs included Pump Station Dry Well floor slab at EL 12.00 and Pump Station Wet Well cover slab at EL 8.50 plus or minus.
 - 1) Slabs
 - a) Clear span less than 10 feet: 4 days
 - b) Clear span 10 feet to 20 feet: 7 days
 - c) Clear span more than 20 feet: 10 days
 - d. Alternatively to stripping times specified, additional concrete cylinders shall be made using representative concrete, witnessed and approved by the Engineer, and tested at no additional cost to the Owner. Such specimens shall be field cured in accordance with ASTM C31 under conditions that are not more favorable than the most unfavorable conditions for portions of concrete that test specimens represent. Supporting forms and shores may be removed when concrete strength as tested per ASTM C39 is a minimum of 70 percent of specified design strength, as determined by field-cured cylinders according to ACI 301.

B. Tie Holes

1. Filling of form tie holes and concrete finishing are specified in Section 03 30 20.

3.05 CLEANING AND REPAIR OF FORMS

- A. Parts of forms reserved for reuse shall be inspected, cleaned, and repaired. Any parts dented, deformed, or otherwise rendered unfit for reuse shall be discarded.

3.06 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.07 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 03 16 00

CONCRETE SPECIALTIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide materials, tools, equipment, and labor necessary for construction of concrete specialties as specified and shown on the Drawings in accordance with this Section and applicable reference standards listed in Article 1.03.
2. Provide and install concrete expansion and adhesive anchors as specified under each section that corresponds to materials and equipment that is to be anchored.

B. Related Requirements

1. Section 03 30 00 – Cast-In-Place Concrete
2. Section 03 30 20 – Concrete Placing, Curing and Finishing
3. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

- ###### A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Society for Testing and Materials (ASTM)
 - a. ASTM A1064 – Standard Specification Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - b. ASTM C1107 – Standard Specification for Packed Dry, Hydraulic-Cement Grout (Non-shrink)
 - c. ASTM D4832 – Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
2. ICC Evaluation Service (ICC-ES)

- a. ICC-ES AC58 – Acceptance Criteria for Adhesive Anchors in Masonry Elements
- b. ICC-ES AC308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
3. American Concrete Institute (ACI)
 - a. ACI 355.2 – Qualification of Post-Installed Mechanical Anchors in Concrete
 - b. ACI 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 1. Non-Shrink Grout
 2. Expansion Anchors
 3. Epoxy Adhesive Anchors
 - a. ICC-ES AC58 report
 - b. ICC-ES AC308 report
 - c. Allowable and ultimate load tables per embedment depths
 - d. Storage requirements
 - e. Gel and cure times as a function of temperature
 - f. Installation temperature requirements for cartridges and base material
 - g. Drilling method (diamond drill bit shall be prohibited)
 - h. Drill bit diameter and depth of hole for each size anchor
 - i. Hole cleaning procedure and required condition of hole
 - j. Requirements for discarding initial discharge to ensure proper mixing
 - k. Hole filling procedure

1. Time period when anchor cannot be contacted or otherwise disturbed
- C. Shop Drawings
 1. Reinforcement
- D. Design Data and Test Reports
 1. Concrete for equipment pads duct banks
 - a. Submittals as required in Section 03 30 00.
 2. Controlled Low Strength Material
 - a. Submittals as required in Section 03 30 00.
 - b. Both 28-day and 90-day compressive strength test results.
- E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements for anchor installation and as follows.
 1. Anchors: installed by qualified personnel trained to install adhesive anchors.
 2. Adhesive anchors: installed in strict accordance with Manufacturer's Printed Installation Instructions (MPII).
 3. Each installer must have the MPII in their possession at all times.
- C. Certifications
 1. ACI/CRSI Adhesive Anchor Installer Certification or equivalent as approved by Engineer, for installation of adhesive anchors horizontally or upwardly inclined to resist sustained tension loads.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GROUT

- A. Non-metallic, cementitious non-shrink grout in accordance with ASTM C1107, grade C. Provide Five Star Grout by U.S. Grout Company, Crystex or Premier by L&M Construction Chemicals, Inc., Sure-Grip High Performance Grout, by Dayton Superior, or equal.

2.02 EQUIPMENT PADS

- A. Concrete: as specified in Section 03 30 00.

2.03 DUCT BANKS

- A. Provide concrete encased underground electrical duct banks. Concrete: as specified in Section 03 30 00, except it shall have a 3/8-inch maximum aggregate size and a minimum 28-day compressive strength of 3,000 pounds per square inch.
- B. Duct banks: reinforced as detailed where crossing under roads, driveways, parking areas, all areas subject to vehicular traffic, and as specified or shown on Drawings. Extend reinforcement a minimum of 4-feet beyond specified areas.
- C. Coordinate red shake-on red pigmented dye, acid stains, or integral coloring as required in Section 26 05 43.

2.04 CONTROLLED LOW STRENGTH MATERIAL

- A. Rigid-setting mixture of portland cement, sand, and water shall not require vibration during placement, flow without noticeable segregation, self-consolidate, and be excavatable with hand tools.
- B. Sand gradation (U.S. Standard Sieve/Percent Passing)
 - 1. 3/8-inch/100
 - 2. No. 4/95-100
 - 3. No. 16/45-80
 - 4. No. 50/10-30
 - 5. No. 100/2-10
 - 6. No. 200/0-3

- C. Cement, water, and chemical admixtures shall meet the requirements of Section 03 30 00.
- D. The 28-day and 90-day compressive strengths, measured in accordance with ASTM D4832, shall be between 30-80 psi and less than 100 psi, respectively.

2.05 EPOXY ADHESIVE ANCHORS

- A. Approved for use in cracked concrete.
- B. Epoxy adhesive for anchoring reinforcement to concrete shall be a 2-component solid epoxy based system supplied in manufacturer's standard side-by-side cartridge and dispensed through manufacturer's standard static-mixing nozzle. Epoxy adhesive shall be SET-XP or ET-HP by Simpson Strong Tie Co., Inc., HIT-RE 500-SD by Hilti, Inc., or equal.
- C. Epoxy adhesive shall pass creep test requirements of ICC-ES AC58.
- D. The embedment depth shall be per manufacturer's requirements and ultimate strength exceeds tensile strength of bar, and ultimate strength divided by a minimum factor of safety of 3.75 is at least 40 percent of yield strength of bar.
- E. Unless noted otherwise on Drawings, AISI 316 stainless steel rods, nuts, and washers from same manufacturer of adhesive. Rods shall be all-thread.

2.06 EXPANSION ANCHORS

- A. Approved for use in cracked concrete: Hilti Kwik Bolt TZ, Hilti HSL, or equal.
- B. AISI 316 stainless steel unless specifically noted otherwise on Drawings.
- C. Where noted on the Drawings as galvanized: ASTM A123, Class C.

2.07 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EQUIPMENT PADS

- A. New concrete surfaces upon which equipment pads are to be built shall receive a scratched finish in accordance with Section 03 30 20.
- B. Laitance: removed and surface saturated with water for a minimum of 6 hours. Remove excess water and apply epoxy bonding compound as specified in Section 03 30 20.

- C. Equipment pads: sized to suit approved equipment, and reinforced as shown on the Drawings.
- D. Top surface: level within 1/8-inch. Form exposed faces with smooth forms free of sands streaks, bug holes, and honeycomb. Exposed surfaces shall have a smooth, even surface with all exterior corners chamfered. Exposed faces of pads shall receive a rubbed finish as specified in Section 03 30 20.
- E. Anchor bolts, dowels, sleeves, and other fittings required for equipment shall be built in.

3.02 GROUTING

- A. Required for structural, mechanical, and electrical items in accordance with manufacturer's recommendations.
- B. Clean concrete surfaces to receive grout of all contamination and debris. Surface roughening is required if laitance or poor concrete is evident.
- C. Placement: rapid and continuous so that grout completely fills space to be grouted, absent of air pockets.
- D. Grout may be placed by gravity or pumped. When practical, place grout from one side, made to flow to open side to prevent formation of air pockets.

3.03 EXISTING CONCRETE

- A. Where equipment pads are to be constructed, grouting is to be performed, and concrete fills are to be placed against existing concrete, surface preparation shall be required.
 - 1. Clean existing concrete surface of all contamination and debris, and roughen by steel shot blasting, abrasive sand blasting, or water jetting. Use of scabblers, scarifiers, bush hammers, and pneumatic hammers is not permitted.
 - 2. Existing concrete surface: water-saturated for a minimum of 6-hours. Remove excess water immediately prior to placement of new concrete or grout.
 - 3. In areas where equipment pads are to be constructed and concrete fills are to be placed, apply epoxy-bonding compound as specified in Section 03 30 20 to prepared concrete surface prior to concrete placement.

3.04 DUCTBANKS

- A. Provide a minimum of 4-inches of concrete between outside of a duct and surrounding soil with no less than 3 inches of concrete between adjacent ducts.

- B. Cuctbank concrete placements: continuous between manholes and handholes, and between manholes, handholes, and structures.

3.05 EPOXY ADHESIVE ANCHORS

- A. Install adhesive anchors in concrete with a minimum age of 21 days at time of installation.
- B. Provide cartridges with expiration date clearly visible. Material past expiration date may not be used, and immediately removed from Site.
- C. Embedded reinforcement: located with proper equipment prior to drilling to ensure that each drilling location does not coincide with existing reinforcement. Drilling through reinforcement is prohibited.
- D. Diamond drill bits are not permitted. Hammer drills shall be used.
- E. Initial material extruded from each cartridge shall be discarded in accordance with manufacturer's instructions to ensure that all material is properly mixed.
- F. Depth stop: use to ensure correct drilling depth. Drilled holes: blown out with air, thoroughly wire brushed with a repeated back and forth movement, blown out, thoroughly wire brushed, and blown out again. Inject adhesive starting from bottom of hole and slowly withdrawn as filling progresses to prevent air pockets.
- G. Anchored reinforcement shall remain completely undisturbed between manufacturer's specified gel time and full cure time. Zero load shall be applied during this time.

3.06 EXPANSION ANCHORS

- A. Embedded reinforcement: locate with proper equipment prior to drilling to ensure each drilling location does not coincide with existing reinforcement. Drilling through reinforcement is prohibited.
- B. Diamond drill bits are not permitted. Hammer drills shall be used.

3.07 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.08 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 03 20 00

CONCRETE AND MASONRY REINFORCING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide materials, tools, equipment and labor necessary for fabrication and installation of reinforcement as specified and as shown on Drawings in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Concrete Institute (ACI)
 - a. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - b. ACI SP-66 - ACI Detailing Manual
2. ASTM International (ASTM)
 - a. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - b. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars
 - c. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
3. American Welding Society (AWS)
 - a. AWS D1.4 Structural Welding Code – Reinforcing Steel
4. Concrete Reinforcing Steel Institute (CRSI)
 - a. CRSI 10MSP - Manual of Standard Practice

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 - 1. Certified mill reports, including chemical and physical analyses
 - 2. Dowel bar splicers and dowel inserts
- C. Shop Drawings
 - 1. Reinforcement Drawings: comply with ACI SP-66, and include:
 - a. Sizes, dimensions, and locations for reinforcement and supports
 - b. Bending diagrams and schedules
 - c. Splices
 - d. Cover and clearances
 - e. Class designation and details of bar supports
 - f. Pertinent reinforced concrete details with dimensions and elevations
 - g. Items furnished by other trades or under other sections of Specification that are to be cast in concrete where interference with reinforcement may occur
 - h. Reinforcement shall be shown on wall elevations with required sections, on beam elevations with required sections, on plan views of slabs with required sections. Provide plan details where walls intersect.
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

- B. Deliver reinforcement in bundles with tags indicating size, length, and identification mark.
- C. Store materials off ground to prevent soiling and to facilitate subsequent inspection and handling.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 STEEL REINFORCEMENT

- A. General: include all bars, anchorages, stirrups, dowels, ties, tie-wire, chairs and other steel supports, and spacers as specified and noted on Drawings.
- B. Materials
 - 1. Reinforcement bar: formed from new billet steel conforming to ASTM A615, Grade 60 except as otherwise specified.
 - 2. Epoxy coated reinforcement bars: formed from new billet steel conforming to ASTM A775, Grade 60. Epoxy coated reinforcement is only required where specifically noted on Drawings.
 - 3. Flat sheet, plain steel wire fabric conforming to ASTM A1064. Rolls are not permitted.
- C. Tie Wire
 - 1. 16-gauge minimum
 - 2. FS QQ-W-461 annealed black, except for architectural concrete
- D. Bar Supports
 - 1. Chairs, bolsters, spacers and other supports to properly position reinforcement shall conform to bar support recommendations of CRSI 10MSP, and shall be of adequate strength and design to prevent displacement of reinforcement and discoloration of concrete.
 - 2. Supports: Class 1 - plastic protected.
 - 3. Supports for bottom reinforcement of slabs on soil: chairs with integral plates, or precast concrete blocks not less than 4-inches square with a compressive strength equal to surrounding concrete. Precast blocks may

only be used to support reinforcement not more than 3-inches from bottom of slab.

E. Fabrication

1. Fabricate reinforcement in accordance with ACI 117.
2. Steel reinforcement: fabricated to sizes, shapes and dimensions shown on Drawings, details and schedules. Bending: in accordance with CRSI 10MSP. Steel: bent cold and not be bent or straightened in a manner that will injure metal. Bars with kinks or bends not so detailed shall not be used.
3. Bends for stirrups and ties: made around a pin having a diameter not less than 4 times the diameter of bar. Bends for other bars: made around a pin having a diameter not less than 6 times diameter of bar, except for bars larger than 1-inch, pin shall be not less than 8 times diameter of bar.

F. Dowel Bar Splicers and Dowel Inserts

1. Dowel bar splicers: 2-component threaded rebar splice system. Internally threaded component: forged from Grade 60 deformed rebar material free of external machining or welding, containing an integral flange with nailing holes and threaded with Unified National Coarse (UNC) or UN (unified) threads to a depth equal to nominal diameter of threads plus 1/4-inch. Externally threaded splice component: fabricated from Grade 60 deformed rebar material and supplied with rolled threads corresponding with internally threaded component. Root diameter of threads shall provide a minimum cross sectional area equal to cross sectional area of nominal bar size. Manufacturer testing shall indicate ultimate tension failure occurring in nominal bar diameter, not at mechanical splice.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Reinforcement

1. Tolerances shall conform to ACI 117.
2. Placement
 - a. Reinforcement: positioned both horizontally and vertically, and secured and sufficiently rigid to prevent displacement during

concrete placement, securely tied at intersections with tie wire or clips in a manner that will keep metal away from exposed concrete surfaces.

3. Splices
 - a. Reinforcement splices: as shown on Drawings. Where not shown, locate splices away from areas of maximum stress as approved by Engineer.
 - b. Welding only permitted by written approval of Engineer in accordance with AWS D1.4.
 4. Install, support and secure reinforcement within area of continuous concrete placement before beginning.
 5. Reinforcement Adjustment
 - a. Adjust to within allowable tolerances to avoid interference with other reinforcement, conduits, or embedded items.
 - b. Reinforcement shall not be moved beyond allowable tolerances without Engineer's approval.
 - c. Reinforcement shall not be heated, bent or cut without Engineer's approval.
- B. Wire Fabric
1. Install wire fabric in longest practicable sheet.
 2. Adjoining sheets shall be lapped a minimum of 1-1/2 wire spacing's and securely wired together.
 3. Offset end laps in adjacent sheets.
- C. Reinforcement: entirely free from flaking rust, loose mill scale, grease and dirt that might reduce its bond with concrete.
- D. Concrete cover for reinforcement shall conform to dimensions shown on Drawings.
- E. Notify Engineer at least 24 hours before concrete placement. Reinforcement within area of 1 day's concrete placement shall be tied in place and observed by Engineer prior to commencing concrete placement.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

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Salem, Massachusetts

3.03 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide cast-in-place concrete in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 03 30 20 - Concrete Placing, Curing and Finishing

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Concrete Institute International (ACI)
 - a. ACI – 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - b. ACI 301 – Specifications for Structural Concrete
 - 2. ASTM International (ASTM)
 - a. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - b. ASTM C33 – Standard Specification for Concrete Aggregates
 - c. ASTM C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
 - d. ASTM C88 – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
 - e. ASTM C94 – Standard Specification for Ready-Mixed Concrete
 - f. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

- g. ASTM – C143 Standard Test Method for Slump of Hydraulic-Cement Concrete
- h. ASTM C150 – Standard Specification for Portland Cement
- i. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- j. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- k. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete
- l. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete
- m. ASTM C535 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- n. ASTM C595 – Standard Specification for Blended Hydraulic Cements
- o. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- p. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars
- q. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete
- r. ASTM C1157 – Standard Specification for Hydraulic Cement
- s. ASTM C1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
- t. ASTM C1293 – Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- u. ASTM C1567 – Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
- v. ASTM C1582 – Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete
- w. ASTM C1602 – Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
- x. ASTM E329 – Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
 - 1. Product Data
 - a. Admixtures
 - b. Fibermesh
 - 2. Certificates
 - a. Plant certification: concrete plant certified by National Ready Mixed Concrete Association.
 - 3. Design Data for Each Concrete Mixture
 - a. Submit at minimum 14 days before initial placement of concrete.
 - b. Proportions for all ingredients, 28-day design compressive strength, water to cementitious materials ratio, admixture dosages, slump, and air content.
 - c. Test data supporting proportions based upon laboratory trial batches or field test records per ACI 301 Section 4, Concrete Mixtures.
 - 1) Field test data used to determine standard deviation used for establishing required average design strength shall be from within previous 12 months, per ACI 301.
 - 2) Field test data documenting that proposed concrete proportions will produce an average compressive strength equal to or greater than required average compressive strength shall be from within 12 months.
 - 3) Laboratory trial batch data shall be from within previous 24 months.
 - 4. Test Reports
 - a. Provide reports by testing agencies meeting ASTM E329.
 - b. Cement: certified mill reports, not older than 90 days.
 - c. Supplementary cementitious materials: source and test reports for actual material to be used in Work, not older than 90 days.

- d. Fly ash
- e. Ground granulated blast-furnace slag
- f. Aggregate
 - 1) Data not older than 90 days, except test data for soundness, abrasion, and alkali reactivity - not older than 1 year.
 - 2) Fine and coarse aggregate data, except as noted
 - 3) Sources
 - 4) Specific gravity
 - 5) Sieve analyses per ASTM C33 (including fineness modulus of fine aggregate)
 - 6) Organic impurities for fine aggregate per ASTM C40
 - 7) Potential alkali reactivity (not required if a cement containing less than 0.60 percent alkalis is used, per ASTM C33) per ASTM C1260, ASTM C1293, or ASTM C1567
 - 8) Soundness per ASTM C88
 - 9) Abrasion for coarse aggregate per ASTM C131 and ASTM C535
- 5. Manufacture Instructions
 - a. Admixtures
 - b. Fibermesh
- B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Storage and Protection for Material for On Site Batching
 - 1. Carefully store cement immediately upon receipt in a weatherproof structure, as airtight as practical to prevent moisture absorption, stacked

closely to reduce air circulation, but not against exterior walls. Allow easy access for inspection and shipment identification.

2. Transfer bulk cement to elevated airtight weatherproof bins. Test quality of cement that has been stored for suitability if quality is questionable and do not use without approval.
3. Store aggregates to prevent contamination by foreign materials and in separate piles by size. Build coarse aggregate stockpiles in horizontal layers not exceeding 4-feet in depth to avoid segregation.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 SOURCE

- A. Provide concrete supplied from a single commercial ready-mix plant, mixed and delivered in accordance with requirements of ASTM C94.

2.02 CONCRETE MATERIALS

- A. Concrete mixture design
 1. Per ACI 301, Section 4, Concrete Mixtures.
 2. 28-day design compressive strength: 4,500 pounds per square inch, where indicated on drawings. Water to cementitious materials ratio: not to exceed 0.42 except as otherwise specified.
 3. 28-day design compressive strength: 4,000 pounds per square inch, where indicated on drawings. Water to cementitious materials ratio: not to exceed 0.45 except as otherwise specified.
 4. Provide designs of required strength, water to cementitious materials ratio, slump, and workability for placing conditions and specified finishes without segregation.
 5. Slump
 - a. Per ASTM C143.
 - b. Four inches, unless otherwise specified, with tolerance at point of delivery per ACI 117.

- c. Two to four inches before specified mid-range water reducing admixture is added, and a maximum of six inches at point of delivery after admixture is added.
 - d. Two to four inches before specified high-range water reducing admixture is added, and maximum slump of eight inches at point of delivery after admixture is added.
- B. Cement: ASTM C150, Type II cement.
- C. Supplementary cementitious materials
 - 1. Fly ash (optional)
 - a. ASTM C618, Class F
 - b. Maximum loss of ignition: 3.0 percent
 - c. Not less than 15 percent or more than 25 percent of weight of cement plus fly ash
 - 2. Ground-granulated blast furnace (GGBF) slag (optional)
 - a. ASTM C989
 - b. Activity classification: Grade 100 or 120
 - c. Not less than 25 percent or more than 50 percent of weight of cementitious material
 - 3. Fly ash plus GGBF slag
 - a. Maximum 50 percent of total cementitious materials
 - b. Fly ash portion maximum 25 percent of total cementitious materials
 - c. Minimum portland cement: 337 pounds per cubic yard of concrete
- D. Aggregate
 - 1. Meet ASTM C33, as amended herein. Evidence of a satisfactory service record in lieu of testing for alkali reactivity is not permitted.
 - 2. Do not use crushed hydraulic cement concrete for aggregate.
 - 3. Aggregate reactivity testing: per ASTM C1260. Do not use aggregate having a 14 day expansion greater than 0.10 percent (considered potentially reactive), except if tested per ASTM C1567, the 14 day expansion is not greater than 0.10 percent, or if tested per ASTM C1293, the 2-year expansion is not greater than 0.04 percent, or if cement containing less than 0.60 percent alkalis is used per ASTM C33.

4. Fine aggregates: Sand or screenings of gravel or crushed stone, well graded from fine to coarse; clean and free from soft particles, clay, loam and organic matter, with volume removed by sedimentation not more than 3 percent.
- a. Organic impurities testing: per ASTM C40. Color of supernatant liquid above test Sample, not darker than organic plate No. 3.
- b. Grading

U.S. Standard Sieve	Percent Passing
Size 3/8-inch	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	5 - 30
No. 100	0-10

- c. Not more than 45 percent retained between any 2 consecutive sieves listed above. Fineness modulus, not less than 2.3 nor more than 3.1.
5. Coarse aggregates: crushed stone or washed gravel of clean, hard, durable, uncoated particles, free from dust, dirt, or other deleterious substances, and free from thin, flat, or elongated particles.
- a. Nominal maximum aggregate size for slabs poured on ground, foundation mats and footings at least 15-inches thick, except where clear spacing between reinforcing bars is less than 2-inches: 1-1/2 inches.
- b. Nominal maximum aggregate size at all other locations, except as specified otherwise or approved: 3/4-inch.
- c. Nominal maximum aggregate sizes per grading in Table 2 of ASTM C33: No. 467 (1-1/2 inches), No. 57 (1-inch), No. 67 (3/4-inch), No. 7 (1/2-inch), and No. 8 (3/8-inch).

E. Admixtures

1. Air-entraining admixture
- a. Per ASTM C260 and chloride free

- b. Provide air entrainment, except as noted below, per manufacturer's directions and this section to produce the following total entrained air content determined per procedure in ASTM C173/C173M or ASTM C231/C231M.

Nominal Maximum Size Coarse Aggregate (inches)	Air Content By Volume (percent plus or minus 1.5)
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5

- c. Maximum air content for interior concrete slabs to be hard-troweled: 3.0 percent.
2. Mid-range water reducing agents: per ASTM C494, Type A, and with consideration of air entraining effect of water reducing agent.
 3. Water reducing-retarding agents: for use when ambient temperature above 70 degrees F, replace water reducing agent in whole or part with water reducing-retarding agent meeting ASTM C494, Type D. Use amounts to produce concrete with set time equal to that at 70 degrees F without retarder.
 4. Set accelerator: non-chloride type conforming to ASTM C494, Type C or E where allowed under Section 03 30 20.
 5. High-range water reducing agent: ASTM C494, Type F or G (added in plant or field).
 6. Corrosion Inhibiting Admixture: per ASTM C1582 where specifically required on drawings.

F. Water

1. Meet ASTM C1602.
2. Fresh and free from oil, acid, salt, alkali, sewage, organic matter, and other deleterious substances.
3. The amount of water carried on aggregate and effect of admixtures is included in water content. Provide that water carried on aggregate is

- determined periodically by test and amount of free water on aggregate subtracted from water added to mixture.
4. Residual, wash, or other water in drums: completely discharged prior to concrete batching (drums backed out).
 5. Maximum amount of water required to produce a plastic mixture of strength and water to cementitious materials ratio specified and required density, uniformity and workability. Consistency of mixture required for specific placing conditions and methods.
 6. Slump adjustment: not made at wash down, slump rack, or by any other means prior to arrival at point of delivery at Site.
 7. Water added after arrival at Site: accurately metered and recorded on batch ticket.
- G. Fibermesh: micro-reinforcement fibermesh designed to control plastic shrinkage and thermal cracking manufactured from polypropylene or nylon fibers. Concrete supplier may submit their standard polypropylene or nylon micro-fibermesh products for Engineer's review. Fibermesh reinforcement is limited for use for slab-on-grade reinforcement specifically denoted on drawings to be reinforced with fibermesh.
1. Polypropylene fibers: micro-reinforcement system for cast-in-place concrete manufactured from 100 percent virgin homopolymer fibrillated fibers containing no olefin materials that conforms to ASTM C1116.
 - a. Product: Fibermesh 300 by Propex, or approved equal
 - b. Specific gravity: 0.90-0.91
 - c. Dosage rate: 1.5 pounds per cubic yard of concrete.
 2. Nylon Fibers: Multimesh fiber system for cast-in-place concrete manufactured from virgin monofilament nylon fibers that conforms to ASTM C1116.
 - a. Product: Nycon Multimesh nylon fibers by NYCON, or equal.
 - b. Specific Gravity: 1.12-1.15
 - c. Dosage Rate: 1.0 pounds per cubic yard of concrete

2.03 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Advise testing laboratory and field observers minimum 24 hours in advance of placing concrete to allow for scheduling observation and testing.
- C. Assist testing laboratory and Engineer in obtaining and handling Samples at Site and other sources of material.
- D. Provide space and electrical power at Site for facilities to be provided by Contractor's testing agency for proper initial curing and storage of concrete test cylinders to be lab-cured as required by ASTM C31 for 48 hours after casting. For cylinders to be field-cured: per Section 03 30 20.
- E. Contractor's testing agency to store cylinders to be lab-cured at 60 degrees F to 80 degrees F in an environment preventing moisture loss from specimens such as storage in wooden boxes, and placement in damp sand pits. Shield specimens from direct sunlight and radiant heating devices. Control storage temperature by use of heating and cooling devices as necessary and record temperature with a maximum-minimum thermometer.

3.02 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 03 30 20

CONCRETE PLACING, CURING, AND FINISHING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide placing, curing and finishing of cast-in-place concrete accordance with this Section and applicable reference standards listed in Article 1.03.
2. Concrete sampling and field testing by an independent technician certified in accordance with the requirements of ACI Concrete Field Testing Technician – Grade 1 certification program, or the requirements of ASTM C1077. Paid for by Contractor.
3. Laboratory testing of concrete cylinders by an independent, accredited and certified testing laboratory. Paid for by Contractor.

B. Related Requirements

1. Section 03 11 00 – Concrete Forming
2. Section 03 30 00 – Cast-In-Place Concrete

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Concrete Institute International (ACI)
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - b. ACI 301 – Specifications for Structural Concrete
 - c. ACI 306.1 – Standard Specification for Cold Weather Concreting
 - d. ACI 308.1 – Standard Specification for Curing Concrete
 - e. ACI 350.1 – Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
 - f. ACI 306R – Cold Weather Concreting

2. ASTM International (ASTM)
 - a. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - b. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - c. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - d. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
 - e. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar
 - f. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete
 - g. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete
 - h. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - i. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - j. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - k. ASTM C404 – Standard Specification for Aggregates for Masonry Grout
 - l. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
 - m. ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - n. ASTM C920 – Standard Specification for Elastomeric Joint Sealants
 - o. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
 - p. ASTM C1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
 - q. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

- r. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- s. ASTM D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
- t. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials
- u. ASTM D2240 – Standard Test Method for Rubber Property - Durometer Hardness
- v. ASTM E1155 – Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
- w. ASTM E1745 – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

B. Definitions

- 1. Construction joint refers to a monolithic construction joint in which surface between successive placements is prepared to enhance bond and shear transfer and reinforcement is continuous.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data and Manufacturer's Instructions
 - 1. Delivery Tickets
 - a. Provide duplicate delivery tickets at time of delivery for each truckload of concrete delivered
 - b. Serial number of ticket
 - c. Date and Project location
 - d. Name and location of ready mixed concrete plant
 - e. Truck number, time loaded, cubic yardage delivered
 - f. Dispatcher's name
 - g. Mixture design, cement type, and admixtures with brand names

- h. Types and quantities of cement, fly ash and/or slag (if included in approved mix design) and admixtures. Quantities of water and fine and coarse aggregate including moisture content, and nominal maximum aggregate size
 - i. Water added subsequent to plant batching, if any. (Only applicable if total water per mixture design is not added at plant. Addition of water such that water content of approved mixture design is exceeded will be strictly prohibited.)
 - j. Concrete temperature upon delivery
 - k. Unloading time and location
 - 2. Curing Paper
 - 3. Epoxy Bonding Compound
 - 4. Evaporation Retardant
 - 5. Cure and Seal Compound
 - 6. Curing Compound
 - 7. Preformed Joint Filler
- C. Source and Field Quality Control Submittals
 - 1. Methods to be used to protect concrete placed during cold weather. The Engineer's review shall not constitute approval as Contractor shall be responsible for protection of concrete placed during cold weather.
 - 2. Methods to be used to protect concrete placed during hot weather. The Engineer's review shall not constitute approval as Contractor shall be responsible for protection of concrete placed during hot weather.
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Concrete sampling and testing per Article 3.11.
- C. Tightness Test Concrete Tanks per Article 3.12.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

- B. Protection
 - 1. Provisions shall be made for maintaining new concrete in a continuously moist condition for at least seven days after placement
 - 2. Fresh concrete shall be protected from freezing, premature drying, flowing water, and mechanical injury
 - 3. Concrete shall not be placed while rain, sleet, or snow is falling unless acceptable protection is provided. Precipitation shall not be allowed to enter into concrete mix or damage concrete surfaces

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 PREFORMED JOINT FILLER

- A. Preformed joint filler: conform to ASTM D4819, closed cell polyethylene foam isolation joint material, 1/2-inch thick unless noted otherwise on drawings. Joint filler shall be X-Tech by C2 Products, Inc., or equal.

2.02 CURE AND SEAL COMPOUND

- A. Water Based Cure and Seal Compound: conform to ASTM C309, Type 1, and ASTM C1315, Type 1 with minimum 25 percent solids, non-yellowing, non-staining, and UV light resistant.
 - 1. MasterKure CC 1315WB, by Master Builders; Vocomp-25, by W.R. Meadows; Dress & Seal WB 25, by L&M Construction Chemicals, Inc.; or equal shall be provided.
 - 2. Approved use: water based products are preferred and approved for application to surfaces with a surface temperature above 50 degrees F for interior or exterior surfaces.
 - 3. Limitations: not permitted for cold weather application to surfaces with temperatures less than 50 degrees F. Not permitted for surfaces to receive additional concrete fills, chemical hardeners, sealers, waterproofing, and architectural finishes such as concrete stain, paints and coatings, tile, carpet, and floor covering adhesives. Not permitted for surfaces to receive a sack-rubbed finish.
- B. Solvent Based Cure and Seal Compound: conform to ASTM C309, Type 1, and ASTM C1315, Type 1 with minimum 25 percent solids, non-yellowing, non-staining, and UV light resistant.

1. MasterKure CC 250 SB, by Master Builders; CS-309-25, by W.R. Meadows; Dress and Seal 30, by L&M Construction Chemicals, Inc.;
2. Approved use: exterior surfaces with surface temperature above 40 degrees F.
3. Limitations: not permitted for surfaces with a surface temperature less than 40 degrees F. Not permitted for surfaces to receive additional concrete fills, chemical hardeners, sealers, waterproofing, and architectural finishes such as concrete stain, paints and coatings, tile, carpet, and floor covering adhesives. Not permitted for surfaces to receive a sack-rubbed finish.

2.03 CURING COMPOUND

- A. Curing Compound: conform to ASTM C309, Type 1, Class A.
 1. 1300 Clear, by W.R. Meadows; L&M Cure, by L&M Construction Chemicals, Inc.;
 2. Approved use: building wall footings, building foundation walls, exterior face of basement walls, and concrete sidewalks.
 3. Limitations: not permitted for building interior surfaces; exterior concrete equipment pads; concrete tank structures.

2.04 DISSIPATING CURING COMPOUND

- A. Curing Compound: conform to ASTM C309, Type 1, Class B resin based curing compound that will normally oxidize and begin to wear off in 30 to 60 days.
 1. 1100 Clear, by W.R. Meadows; L&M Cure W, by L&M Construction Chemicals, Inc.;
 2. Approved Use: concrete sidewalks and building floor slabs to receive carpet, tile, and floor covering adhesives.

2.05 CURING PAPER

- A. Curing Paper: Conform to ASTM C171, for regular or white waterproof paper.

2.06 EPOXY BONDING COMPOUND

- A. Epoxy Bonding Compound: conform to ASTM C881, contain 100 percent solids, and be moisture tolerant. Sikadur 32 Hi-Mod or Sikadur 32 Hi-Mod LPL, by Sika Corporation; Sure-Bond J-58, or J-58 LPL, by Dayton Superior; or equal shall be provided.

2.07 EVAPORATION RETARDANT

- A. Evaporation Retardant: water based polymer liquid placed on fresh concrete to control rate of evaporation and extend workability. E-CON as manufactured by L&M Construction Chemicals, Inc.; SikaFilm by Sika Corporation; MasterKure ER 50 by Master Builders; or equal.

2.08 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONCRETE PLACEMENT AND JOINTING

- A. Tolerances: tolerances shall conform to all requirements of ACI 117 except as modified.
- B. Cold Weather Requirements
 - 1. Cold weather concreting provisions shall be followed during cold weather: any and all periods when for more than three consecutive days average daily outdoor temperature drops below 40 degrees F. Average daily temperature is average of highest and lowest temperature during period from midnight to midnight. When temperatures higher than 50 degrees F occur during more than half of any 24-hour duration, period shall not be regarded as cold weather.
 - 2. When freezing temperatures may occur during periods not defined as cold weather, concrete surfaces shall be protected against freezing for at least first 24 hours after placing.
 - 3. Concrete shall not be placed on frozen subgrade. Insulate or heat subgrade to ensure temperature above 32 degrees F when concrete is placed.
 - 4. All embedment's having a cross sectional area of 1.0 square inch or greater, and including #9 reinforcing bars, shall be at a temperature not less than 10 degrees F at time of concrete placement.
 - 5. Thermal protection must be provided immediately after concrete placement. Procedures for covering, insulating, housing, and/or heating concrete shall be pre-arranged. Except when supplemental heat is provided, R-value of insulation shall be per recommendations of Chapter 9 of ACI 306R.
 - 6. Accelerating admixtures shall be approved at Engineer's discretion, however those containing calcium chloride shall not be permitted

7. When combustion heaters are used, flue gases shall be vented to exterior of enclosures
8. Concrete shall be placed and maintained at following minimum concrete placement temperatures, measured at concrete surface
 - a. Sections of less than 12-inch minimum dimension: 55 degrees F
 - b. Sections of 12 to 36 inches minimum dimension: 50 degrees F
9. Concrete placement temperature shall not be higher than minimum concrete placement temperature by more than 20 degrees F
10. Minimum concrete temperature as mixed shall be: 5 degrees F higher than minimum concrete placement temperature when air temperature is above 30 degrees F; 10 degrees F higher when air temperature is between 0 and 30 degrees F; and 15 degrees F higher when air temperature is less than 0 degrees F.
11. Temperature shall be monitored at surface of concrete, including at corners and edges, which are more vulnerable to freezing. Concrete surface temperature and corresponding outside air temperature shall be recorded a minimum of twice per each 24 hour period
12. Concrete shall be maintained at minimum specified temperatures for a protection period of 6 days. When an approved accelerating admixture is used protection period may be reduced to 4 days.
13. Slabs, regardless of air content, shall not be exposed to freezing temperatures when exposed to rain, snow or other water sources, prior to reaching a compressive strength of 3,500 psi. For hard-troweled slabs, which have a maximum air content of 3.0 percent, see Article 3.07, paragraph C.3 for additional requirements.
14. Concrete shall be cooled gradually at end of protection period. Maximum allowable temperature drop at concrete surface during first 24 hours after protection period shall be: 50 degrees F for concrete sections of less than 12-inch minimum dimension; and 40 degrees F for concrete sections of 12 to 36-inch minimum dimension.

C. Hot Weather Requirements

1. Temperature of concrete when placed shall not exceed 90 degrees F. When air temperature is 90 degrees F and above, procedures to cool mixture ingredients may be warranted. These include: providing shaded storage for aggregate, frequent sprinkling or fog spraying of coarse aggregate, and using chilled batch water and/or ice. Forms and reinforcement shall be sprinkled with cold water just prior to concrete

placement. When possible, placement of slabs should be scheduled after walls and roof structure are in place in order to minimize problems associated with direct sunlight and/or drying winds. Newly placed concrete shall be protected from direct sunlight.

2. Records shall be maintained of: time and location of concrete placement, air temperature, weather conditions (i.e. calm, windy, clear, and/or cloudy), relative humidity, and concrete temperature as delivered and after placement.
3. When air temperature is 90 degrees F and above: time between addition of water to cement or cement to aggregate, whichever occurs first, and time of concrete placement shall not exceed 60 minutes, except upon approval of Engineer when all tests for air content, slump and temperature are acceptable.

D. Placing

1. Concrete shall be handled from truck to place of final deposit as rapidly as practicable by methods preventing segregation and/or loss of ingredients.
2. Time between addition of water to cement, or cement to aggregates, whichever occurs first, and placement of concrete shall not exceed 90 minutes. When air temperature is 90 degrees F and above, this time shall be reduced to 60 minutes. These times may be exceeded only upon approval of Engineer, and only if all tests for air content, slump, and temperature are also acceptable.
3. Water shall be removed from all forms and excavations and Work shall be kept dry during placement. No water shall be thrown on, allowed to flow over, or rise upon concrete until it is thoroughly set.
4. Prior to placement of slabs on soil, subgrade shall be moist with no free water and no muddy or soft spots.
5. Concrete shall be directly deposited as close as possible to its final location, and shall be deposited in such manner so as to maintain a homogeneous, plastic, approximately horizontal surface.
6. Where concrete may contact soil while being placed, free fall shall be limited to a maximum of 3 feet. Concrete that has been contaminated by soil and/or other foreign matter shall be rejected. Accumulation of concrete on forms and/or on reinforcement above level of placement shall be avoided. Splashing of concrete upon formwork that is set for a subsequent concrete placement shall be prevented due to resulting marks on finished concrete.

7. Re-tempering of concrete and concrete placement against partially hardened concrete shall not be permitted. A concrete placement, once started, shall be carried out as a continuous operation until placement of entire section between construction joints is complete.
- E. Runways: provided for wheeled concrete handling equipment which shall not be wheeled over reinforcement. Runways shall not be supported upon reinforcement that is part of Work.
- F. Chuting
1. Minimum slope shall be 3 horizontal to 1 vertical and maximum slope shall be 2 horizontal to 1 vertical. Between these limits, slope shall be that which will prevent segregation and ensure continuous flow.
 2. A baffle shall be provided at end of chute to prevent segregation. If end of chute is more than 3-feet above surface of deposit, a spout shall be used. Spout shall be kept full of concrete with end kept as near as practical to surface of deposit.
 3. Chute shall be steel or steel lined, and sections shall have same slope throughout. Aluminum chutes are not permitted.
 4. Chute shall be thoroughly flushed with water before and after each use, water discharged outside forms.
- G. Pumping: inside diameter of pipes and hoses used to convey concrete shall be a minimum of three times maximum size aggregate of mixture. In order to minimize altering concrete properties, long vertical sections at end of pump line shall be avoided. A horizontal hose run, a hose loop, or a slide gate at end of hose may be used to reduce loss of entrained air.
- H. Compaction
1. Provide at least one standby vibrator, and at least one for each three in use.
 2. Concrete may be deposited in one or multiple layers. Each layer shall be compacted by mechanical internal vibrating equipment supplemented by hand spading, rodding, and tamping as required. Depth of each layer shall not exceed smaller of 36-inches and depth that can be properly vibrated with equipment used. When deposited in multiple layers, vibrator shall penetrate previous layer approximately 6-inches. Ensure initial setting of previous layer does not occur prior to placement of subsequent layer.
 3. Vibrators shall be relocated frequently, and over-vibration resulting in segregation shall be prevented. Vibrators shall not be used to move

concrete within forms. Concrete shall be thoroughly consolidated around reinforcement, embedments, and into corners of forms.

4. Ensure that vibrator is kept several inches clear of waterstops.
5. Where internal vibration is impractical, use of form vibrators will be considered, and will be allowed only with Engineer's written approval. When allowed, vibrator shall be placed so that motion is horizontal

I. Construction Joints

1. Construction joints shall be located where shown on Drawings, or, if not shown, locations shall be approved by Engineer. Where required to be watertight, waterstops as specified in Section 03 11 00 shall be used.
2. Horizontal construction joints: laitance shall be removed immediately after initial set and surface shall be roughened in an acceptable manner that exposes aggregate uniformly and doesn't leave laitance or loose aggregate. After concrete has set to a degree that precludes laitance removal by shovels or scrapers, Contractor shall remove it, and create a roughened surface, by water jetting or other effective method. Use of pneumatic hammers is not permitted.
3. Vertical construction joints: surface shall be thoroughly cleaned of laitance by water jetting, or by wire brushing followed by air blasting.
4. Before concrete is placed against set concrete, surface shall be thoroughly wetted with standing water removed. Horizontal construction joints shall be in a saturated surface dry condition: saturated for a minimum of 6-hours, with standing water removed.
5. Where noted on Drawings, and as approved by Engineer where an unplanned interruption within a concrete placement has occurred, epoxy-bonding compound shall be used in accordance with manufacturer's instructions.
6. Reinforcement shall be continuous at construction joints unless otherwise shown on Drawings. Waterstops shall be provided where called for in Contract Documents. All necessary precautions to ensure that waterstop is properly located and aligned and remains so during concrete placement shall be taken. In event that waterstop is improperly located, allowing a tolerance of plus or minus 1/2-inch, Engineer may order waterstop extended, or replaced, or such other action as deemed necessary, and at no additional cost to Owner.

J. Existing Concrete

1. Where concrete is placed against existing concrete, following surface preparation shall be required.
2. Existing concrete surface shall be cleaned of all contamination and debris, and roughened by steel shot blasting, abrasive (sand) blasting, or water jetting (hydrodemolition). Use of scabblers, scarifiers, bush hammers, or pneumatic hammers is not permitted.
3. Existing concrete surface shall be water-saturated for a minimum of six hours, after which excess water shall be removed immediately prior to placement of new concrete.
4. Apply epoxy-bonding compound to prepared concrete surface prior to concrete placement.

3.02 CURING AND PROTECTION

A. Temperature

1. When ambient temperature falls below 40 degrees F or rises above 95-degrees F, a record shall be kept of concrete temperatures and of protection given to concrete during placement and curing.
2. Temperature of in-place concrete shall be surface temperature of concrete. Surface temperature may be determined by placing temperature sensors in contact with concrete surfaces or between concrete surfaces and covers used for curing, such as insulation blankets or plastic sheeting.

B. Curing

1. Provide curing per ACI 308.1 except as modified.
2. During cold weather, as previously defined, application of water shall not be required. Curing shall be accomplished by use of curing paper, curing compounds, cure and seal compounds, or other approved methods. Thermal blankets are not an approved curing method and shall be used in conjunction with curing provisions previously stated.
3. Provisions shall be made for maintaining new concrete in a continuously moist condition for a minimum of 7 days. Curing shall commence as soon as possible after final finishing when it will not mar, erode, or stain concrete surface.
4. Curing shall be accomplished by use of curing paper, curing compounds (except as noted below), wet methods (ponding, fog spray, damp sand or burlap, sprinkling, soaker hoses) or other methods.

5. Water used for curing shall be no more than 20 degrees F cooler than concrete surface temperature.
6. Concrete slabs to receive a coating or bonded finish, including chemical hardeners, that aren't wet cured, shall be covered with curing paper as specified, laid with side joints lapped 4-inches and end joints lapped 6- inches. Paper shall be applied no earlier than 24 hours and no later than 30 hours after finishing slab and shall be left in place at least seven days. Wet methods shall be used for first 24-30 hours. Slab surface shall be maintained in a wet condition beneath paper at all times. Joints shall be taped and paper shall be weighted to prevent displacement. Tears during first 7 days after a slab is completed shall be immediately repaired.
7. Curing paper shall also be used to protect newly poured concrete floors from damage. Where heavy tools and/or equipment may be used, provide additional protection as required. Only light traffic will be permitted until 7 days after concrete placement. Slabs shall be protected from damage for Contract duration, with any and all damage repaired by Contractor at no additional cost to Owner.
8. Use of a curing compound or cure and seal compound on surfaces to receive applied toppings, chemical hardeners, water repellents, coatings, or a rubbed or bonded finish will not be allowed. Where used, curing compound shall be applied immediately following disappearance of surface water sheen after final finishing pass for slabs, and immediately upon removal of forms for formed concrete. Apply two coats per manufacturer's installation instructions. Apply each coat uniformly with no gaps in coverage. If applied by spray, provide additional spray tank and spray nozzles as required to provide uninterrupted application of product. Cure and seal compounds have high solid content and shall be applied by trays and rollers, if application by spray tanks is not completed in a timely manner and to satisfaction of Engineer.
9. Soaker hoses shall be used at tops of walls and columns before forms are removed. Wood forms shall be kept continuously wet in hot weather.

3.03 DEFECTIVE CONCRETE

- A. Engineer may direct Contractor to remove and replace, at no additional cost to Owner, concrete Work that is not formed as shown and/or specified in Contract Documents, or that contains a defective surface.
- B. Upon Engineer's approval, minor imperfections may be patched as specified herein.

3.04 REPAIR OF SURFACE DEFECTS AND PATCHING

- A. After form removal, all form ties shall be cut off, all fins and irregularities removed, and all defective areas, holes, honeycombs, cavities and irregularities shall be repaired where surface finish defects exceed finish tolerances of Article 3.05.
- B. Exposed patchwork shall match adjacent finish and shall include a sack rubbed finish to blend repair into adjacent surfaces, and cured and protected as specified for concrete.
- C. Filling Form Tie Holes: tie holes shall be filled solid with mortar in same manner as specified under patching above.

3.05 FINISH OF FORMED SURFACES

- A. General
 - 1. Concrete surfaces "exposed to view" shall be defined as those exposed to view upon completion of Work, whether or not a painted finish is specified. Surfaces which will be covered by fill, such as exterior faces of walls, shall not be considered exposed to view.
 - 2. Surface tolerance classes indicated herein are specified in ACI 117, and include abrupt surface irregularities that are measured within 1-inch of irregularity, and gradual surface irregularities measured as maximum gap between concrete and near surface of a 5-foot straight-edge, measured between contact points.
- B. Surface Finish – 1.0 (SF-1.0)
 - 1. SF-1.0 shall be provided for formed surfaces not exposed to view for concrete not containing liquids and/or gases, and not below design groundwater elevation.
 - 2. Patch voids larger than 1 1/2-inch wide or 1/2-inch deep.
 - 3. Remove projections larger than 1-inch.
 - 4. Tie holes need not be patched.
 - 5. Surface tolerance Class D, with formed surface irregularities not more than 1-inch.
- C. Surface Finish – 2.0 (SF-2.0)

1. SF-2.0 shall be provided for formed surfaces not exposed to view for concrete not containing liquids, and/or gases, and below design groundwater elevation.
 2. Patch voids larger than 3/4-inch wide or 1/2-inch deep.
 3. Remove projections larger than 1-inch
 4. Fill tie holes
 5. Surface tolerance Class D, with formed surface irregularities not more than 1-inch.
- D. Surface Finish – 3.0 (SF3.0)
1. SF-3.0 shall be provided for formed surfaces exposed to view, for exterior face of walls to receive waterproofing per Section 07 10 00, and for concrete not containing liquids, and/or gases.
 2. Patch voids larger than 1/2-inch wide or 1/4-inch deep. For surfaces to receive waterproofing, patch all voids per waterproofing manufacturer's written installation instructions.
 3. Remove projections larger than 1/8-inch. For surfaces to receive waterproofing, remove all projections per waterproofing manufacturer's written installation instructions.
 4. Fill tie holes
 5. Surface tolerance Class C, with formed surface irregularities not more than 1/2-inch.
- E. Grout-cleaned rubbed finish (Sack-Rubbed)
1. Following surfaces shall receive a grout-cleaned rubbed finish and have a smooth and even surface, free of bug holes, when completed:
 - a. Exterior exposed concrete formed surfaces
 - b. Sides of concrete equipment pads
 2. Wet surface, and apply a thin coat of medium consistency neat cement slurry to concrete surface by means of bristle brushes to provide a bonding coat. Before slurry has dried or changed color, grout comprising one part cement to 1-1/2 parts sand meeting ASTM C144 or ASTM C404, with sufficient water to produce consistency of thick paint, shall be applied and scrubbed into voids, with excess removed. Cement shall be that used in concrete mix adjusted with white cement as necessary to match color of exposed concrete. Grout shall be applied with slightly damp pads of coarse

burlap approximately 6-inches square used as a float, and shall be well scrubbed into surface to provide a dense mortar.

3. Mortar shall be allowed to partially harden for 1 to 2 hours depending upon weather conditions. Work in direct hot sunlight shall be avoided. In hot dry conditions concrete shall be kept damp during this period with a fine fog spray. Grout shall not be allowed to remain on surface too long as it will become very difficult to remove. Grout shall not be left on concrete overnight.
4. After grout has hardened sufficiently, all that can be removed with a trowel shall be.
5. Surface shall then be allowed to dry thoroughly, and be rubbed vigorously with clean, dry burlap to completely remove any dried grout. There should be no visible film of grout remaining after rubbing.
6. Entire rubbing operation shall be completed in a single working day. Sufficient time shall be allowed for this.
7. On following day, concrete shall again be wiped clean with dry burlap to remove dust. Use of burlap containing old hardened mortar may be used since it will act as a mild abrasive. After this treatment, no build-up film should remain on surface, but if it does, a fine abrasive stone shall be used to remove it without breaking through surface film of parent concrete. Do not work up a lather.
8. After application of surface grout, surface shall be thoroughly washed down with stiff brushes and concrete maintained in a continuously damp condition for at least 3 days above 50 degrees F by periodic application of a fine fog spray, use of damp fabric covered with polyethylene or other methods.

3.06 FINISHING OF RELATED UNFORMED SURFACES

- A. Tops of exposed walls and similar unformed surfaces shall be struck off smooth and hand steel troweled to produce a smooth hard level surface. Line and elevation shall be pre-established by means of preset wood screeds, which shall be removed during troweling operation.
- B. After troweling is completed and after curing period, surface shall be dry honed to a smooth non-directional surface texture satisfactory to Engineer.

3.07 FINISH OF SLABS

- A. General

1. Evaporation retardant specified may be used in accordance with manufacturer recommendations to control plastic shrinkage cracking and as an aid in slab finishing operations. Conditions that may warrant its use include: high temperature, low humidity, high winds, and direct sunlight.
2. Loss of bleed water and surface drying shall be allowed to proceed naturally. Means to accelerate drying such as applying dry cement, sand, or other materials shall be prohibited.

B. Floor Flatness and Floor Levelness

1. Flat slabs shall be level with a tolerance of 1/8-inch in 10-feet. Sloped slabs shall be true to gradient shown, within a tolerance of 1/8-inch in 10-feet. Slabs shall be pitched to drains as indicated on Drawings.

C. Floated Finish

1. Slabs to receive a seamless floor finish or roofing, and all tank bottom slabs, shall receive a floated finish. Floating shall also precede a troweling, where a troweled finish is required as specified below. After consolidating, screeding, and leveling, slab shall not be worked further until it is ready for floating.
2. Floating shall begin when water sheen has disappeared, and when slab has stiffened sufficiently to allow proper operation of a power-driven float. Hand floating with wood, aluminum or magnesium floats shall be used at locations inaccessible to power-driven float.
3. Surface trueness shall be verified at this stage with a 10-foot straightedge applied in multiple angles. High spots shall be cut down and low spots filled so that finished surface is true. Slab shall then be immediately refloated to a uniform, smooth, granular texture.

D. Troweled Finish

1. All interior slabs left exposed shall receive a troweled finish.
2. Surface shall be finished with power floats as specified above for floated finish, followed by power trowels, and finally hand trowels. First power troweling shall produce a smooth surface relatively free of defects but which may contain trowel marks. Subsequent trowel shall be by hand after surface has sufficiently hardened. Surface shall be thoroughly consolidated by hand troweling, and final troweling shall be done when a ringing sound is produced as trowel is moved over surface. Finished surface shall be free of trowel marks and uniform in texture and appearance.

3. Interior concrete slabs to be hard-troweled shall have a maximum air content of 3.0 percent. After curing period, they shall be protected from freezing temperatures for a minimum of 8 weeks. Thereafter, and for duration of Contract, if such slabs might be subject to freezing temperatures, they shall be fully sheltered from rain, snow and all other water sources.
 4. Subsequent trowels shall be by hand after surface has sufficiently hardened. Surface shall be thoroughly consolidated by hand troweling, and final troweling shall be done when a ringing sound is produced as trowel is moved over surface. Finished surface shall be free of trowel marks and uniform in texture and appearance.
- E. A broom finish shall be provided for all exterior slabs, sidewalks, platforms, ramps, exterior stairs and as specified herein or shown on Drawings. After floating, and between initial and final set, surface shall be given a coarse transverse scored texture by drawing a broom across surface.
- F. After consolidating, screeding and leveling, surface shall be roughened with stiff brushes or raked before final set. At sloped surfaces scratches shall be made parallel to direction of slope, to facilitate subsequent cleaning.
- G. A wood float finish, a broom finish with open pores, or a finish as otherwise required by waterproofing manufacturer shall be provided for concrete slabs that will receive a wet slurry application of cementitious waterproofing.

3.08 CLEANING CONCRETE

- A. Cleaning during progress of Work shall not be permitted. Cleaning shall not commence until structure is entirely completed.
- B. Rust and other stains and discolorations shall be removed with a non-etching cleaning agent used in accordance with manufacturer's instructions. Cleaning of all surfaces to receive a painted finish is also required.
- C. Rust stains may be removed by applying a bleaching agent such as oxalic acid. Acid etching, sandblasting, or cleaning by other methods may be used as approved by Engineer.

3.09 FIELD QUALITY CONTROL

- A. General:
1. Provide in accordance with Division 01 General Requirements.
 2. During progress of Work, an independent, accredited and certified testing laboratory shall conduct concrete testing as specified herein, including

preparation and testing of concrete cylinders. All testing shall be paid for by Contractor.

3. Field technicians in charge of sampling concrete; testing for slump, unit weight, air content, and temperature; and making and curing test specimens shall be certified in accordance with requirements of ACI Concrete Field Testing Technician – Grade 1 certification program, or requirements of ASTM C1077.
4. Scheduling: Contractor to advise testing laboratory and field technician(s) a minimum 24 hours in advance of placing concrete to allow for scheduling observation and testing.
5. Test Cylinder Storage: provide space and electrical power at Site for temperature controlled storage of concrete laboratory test cylinders to be standard cured per Section 03 30 00. Temperature controlled storage containers to be provided by testing agency.

B. Field Testing and Sampling Procedures

1. Concrete samples shall be taken in accordance with ASTM C172 for slump, entrained air, unit weight, and strength tests.
2. Entrained air content and slump requirements are listed in Section 03 30 00.
3. Air Content: test in accordance with ASTM C173 or ASTM C231. Pumped concrete shall be sampled and tested for air content at point of placement, as opposed to at point of delivery. Upon Engineer's approval: once slump loss and loss of entrained air due to pumping is established, correlated acceptance limits at point of delivery, where sampling and testing may then be performed, shall be made applicable. When pump line configuration is changed significantly, sampling and testing shall again be performed at point of placement until new acceptance limits at point of delivery may be determined.
4. Slump: measured in accordance with ASTM C143 at point of delivery.
5. Temperature shall be measured in accordance with ASTM C1064 at point of delivery
6. Test Cylinders: concrete cylinders shall be prepared in accordance with ASTM C31 and be 4-inches in diameter by 8-inches tall. Refer to Article 3.11, part D for number of cylinders required.
 - a. Lab-Cured (Standard Cured) Cylinders: field cured in temperature controlled storage per Section 03 30 00. Cylinders shall be

transported to testing lab within 48 hours of forming, but not sooner than 8 hours after final set.

- b. Field Cured Cylinders: cured in field under conditions that are not more favorable than most unfavorable conditions for portions of concrete that cylinders represent.
- C. Laboratory Testing of Test Cylinders:
1. Cylinders shall be tested for compressive strength in accordance with ASTM C39.
 2. Test concrete cylinders per Article 3.11, Part D.
 3. Compressive strength shall be average strength of three cylinder breaks per ASTM C39 and tested at 28-days.
 4. Test Results: submit test results to Engineer and concrete supplier within 24 hours of laboratory testing.
- D. Field and Laboratory Testing Frequency:
1. Minimum field testing frequency for each day concrete is delivered and placed at project site shall be as follows.
 - a. Take concrete test cylinders at frequency stated herein from truckload determined by technician, contractor, or engineer
 - b. 1st truck load: test air content, slump, and temperature.
 - c. 2nd and 3rd truck load: no testing unless noted otherwise.
 - d. 4th truck load: test air content, slump, and temperature
 - e. 5th and 6th truck load: no testing unless noted otherwise
 - f. 7th truck load: test air content, slump, and temperature.
 - g. Repeat test frequency for additional truckloads of concrete delivered during each day of concrete placement.
 - h. Concrete temperature shall be tested for each truckload of concrete during cold weather or hot weather as defined within this specification.
 - i. Contractor or Engineer shall increase testing frequency as required to verify mix designs, address workability concerns, and to ensure all concrete placed complies with specifications
 2. Lab-Cured (Standard Cure) Cylinders:
 - a. Lab-cured cylinders are required for all concrete on project, and shall be in addition to field-cured cylinders, where provided.

- b. One set of 5 cylinders shall be prepared for each 100 cubic yards, or fraction thereof, of each different mix placed in each single day; or for each 5,000 square foot of slab or wall surface area placed each day.
 - c. Test one cylinder at 7-days, three at 28-days, and reserve one cylinder for 56-days.
 - d. Test 56-day cylinder as needed or requested by Contractor or Engineer.
3. Field-Cured Cylinders:
- a. Contractor is responsible for taking additional field-cured test cylinders to verify concrete compressive strength prior to tightness testing concrete tanks, backfilling concrete basement walls, or early removal of formwork.
 - b. One set of 3 field-cured cylinders shall be prepared for each 100 cubic yards, or fraction thereof, of concrete placed in each single day.
 - c. Test field cured cylinders at 14 days or as requested by Contractor or Engineer.
- E. Acceptance Criteria and Additional Testing Requirements:
- 1. Concrete strength shall be evaluated in accordance with ACI 301 Section 1.6.5, "Evaluation of Concrete Strength Tests", and Section 1.6.6, "Acceptance of Concrete Strength".
 - 2. Construction will be considered potentially deficient if concrete fails to meet any requirements that affect strength and durability of structure, including but not necessarily limited to
 - a. Low strength concrete per ACI 301, Section 1.6.5, "Evaluation of Concrete Strength Tests", and Section 1.6.6, "Acceptance of Concrete Strength"
 - b. Water-to-cementitious materials ratio higher than that of specified mix
 - c. Reinforcing steel size, quantity, strength, position or arrangement that does not meet requirements of Contract Documents
 - d. Reinforced concrete that differs from dimensions or locations shown on Drawings
 - e. Curing that does not meet requirements of Contract Documents, including premature formwork removal
 - f. Hot or cold weather concreting that doesn't meet requirements of Contract Documents

- g. Mechanical damage from accidents or fire
 - h. Poor construction practices
- F. Engineer may order load and/or core tests in accordance with ASTM C 42. Such testing shall be paid for by Owner if concrete is proven to meet requirements specified.

3.10 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.
- B. Submit signed and completed concrete tank tightness testing forms for each tank basin required to be tested.

END OF SECTION

SECTION 11 66 00

ATHLETIC EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide athletic and recreational equipment in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Institute of Steel Construction (AISC)
 - 2. American Sports Builders Association (ASBA)
 - 3. ASTM International (ASTM)
 - 4. American Welding Society (AWS)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data: for each type of product indicated.
- C. Shop Drawings: for each type of product indicated.
- D. Certificates: for site furnishings, signed by manufacturers.
- E. Design Data/Submittals
 - 1. Submit signed and sealed drawings and calculations by a licensed professional engineer in state Work is taking place for baseball dugouts.

- F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
 - 1. Maintenance Data – submit 3 copies of each manufacturer’s maintenance data in an Operation and Maintenance manual.
 - 2. Warranties – submit 3 copies of each manufacturer’s warranty in an Operation and Maintenance manual.
 - 3. Operation and Maintenance Manual – at end of project submit 3 copies of an Operations and Maintenance Manual in a 3-ring binder. Outside of binder shall contain Project name, Contractor’s name, Owner’s name and date. Manual shall contain product data, maintenance data and warranties.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements and as follows for manufacturer/fabricator.
 - 1. Minimum 3 years’ successful experience in manufacture/fabrication of type of equipment specified.
- C. Qualifications: per Division 01 General Requirements and as follows for installers.
 - 1. Minimum 3 years’ successful experience in installation of type of equipment specified.
- D. Samples: for each exposed finish.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Aluminum: alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes.
- B. Steel, Iron and Stainless Steel: free of surface blemishes.
- C. Fiberglass: multiple laminations of glass-fiber reinforced polyester resin with UV light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and manufacturer's standard finish.

- D. Plastic: color impregnated, color and UV light stabilized, and mold resistant.
- E. Anchors, Fasteners, Netting, Fittings, and Hardware: manufacturer's standard or as specified; commercial quality, tamperproof, vandal and theft resistant.

2.02 BATTING CAGE

- A. Acceptable level of quality: equivalent to Model LGLLT-P, Little League Single Arc Pole Batting Tunnel with 7030 Batting Tunnel Net, 14 feet wide by 45-5/6 feet long by 13 feet high, with 1-3/4-inch square mesh, net attachment extension arm, and stainless steel hardware as manufactured by Sportsfield Specialties.
 - 1. Ground sleeve mounted
 - 2. Arced/cantilevered 4-inch diameter aluminum posts
- B. Acceptable level of quality for batting cage surface: equivalent to Item No. NTOV1PM34-U PM-34, unpadded non-infilled artificial turf as supplied by On Deck Sports.
 - 1. Pile height: 1/2-inch.
 - 2. Face weight: 34-ounces
 - 3. Color: green
 - 4. Fibers: polypropylene.

2.03 BASEBALL DUGOUTS

- A. Acceptable level of quality: equivalent to enclosed modular Long Gone Baseball/Softball Dugout as manufactured by Sportsfield Specialties.
 - 1. Size: 8-feet wide by 32-feet long; first base side includes one 6-foot long storage room for total length of 38-feet.
 - 2. Wall frames: fabricated of 3-1/2 inch by 3-1/2 inch by 3/16-inch thick steel square tube with factory pre-drilled 8-inch by 8-1/4-inch steel base mounting plates, welded construction, 3-5/8 inch by 1-1/4 inch by 20-gauge flange steel studs and track attached with screws.
 - 3. Maximum allowable spacing between rear structural steel columns is 8-feet on center and between front structural steel columns is 16-feet on center.
 - 4. Roof frame: fabricated of 3-1/2 inch by 3-1/2 inch by 3/16-inch thick steel square perimeter and transverse tubes and 3-inch by 2-inch by 14 gauge rectangular longitudinal tubes, welded construction. Maximum allowable roof frame width is 9-feet 8-inches.

5. Structural steel wall and roof frames powder coated primer and finish. Owner to choose standard color.
6. Acceptable level of quality for roofing material: equivalent to 29-gauge, Classic Rib® style corrugated metal with J- channel drip cap installed on front and sides. Owner to choose standard color.
7. Carbon steel anchoring hardware, epoxy, and lifting eye bolts included.
8. Steel, vinyl or custom siding: horizontal lap siding installed over a minimum thickness of 7/16-inch Oriented Strand Board (OSB), APA rated sheathing wrapped with flash spun High Density Polyethylene (HDPE) breathable fabric. Owner to choose standard color.
9. Finished interior walls: covered with a minimum thickness of 1/2-inch medium density overlay (MDO) fir plywood manufactured with 100 percent waterproof adhesives and coated with resin treated fiber overlay that provides smooth painting surface; seams sealed with caulk and covered with wood batten trim strips. Wall surface and wood trim: hand spackled, sanded and sealed with exterior grade primer and paint finish. Owner to choose standard color.
10. Storage closet: standard 6-foot by 8-foot size, integrated with enclosed modular dugout unit roof and siding structure. Includes one 3-foot wide by 6-foot 8-inch high galvanized 18-gauge steel hollow door with honeycomb flush core, galvanized 16-gauge steel door frame, 3 stainless steel hinges, 1 lever handle and lockset, 1 door sweep, 1 closer, 1 threshold and 1 weather strip. Door and door frame receive powder coated primer and finish. Standard color to be chosen by Owner. Interior walls finished with primed 7/16-inch OSB Panels attached with screws to 3-5/8 inch by 1-1/4 inch by 20-gauge flange steel studs.

B. Dugout Accessories

1. Provide pre-assembled bat, helmet, and storage cubby units and accessories constructed of exterior grade A plywood with solid ash trim and stainless steel assembly hardware; minimum 3 coats of marine grade polyurethane.
 - a. Bat and helmet cubby: 90-inches high by 60-inches wide by 36- inches deep with sixteen 14-inch by 11-3/8-inch helmet cubbies and eight 14-inch by 8-1/2-inch bat cubbies.
 - b. Two wall shelf cubbies: 12-inches deep by 6-3/4 inches high by 96- inches long with hardwood coat hooks located every 16-inches on center.

- c. Two wall helmet cubbies: 16-inches deep by 24-inches high with 14-3/4-inch helmet cubbies, 96 inches long with hardwood coat hooks located every 16-inches on center.
- d. Provide two 12-foot long polyboard team benches per dugout, semi-permanent mount, powder coated aluminum frame, and standard powder coat finish. Owner to choose standard colors.
- e. Final location of dugout accessories to be approved by Owner.

2.04 OUTFIELD FENCE RAIL CAP

- A. Acceptable level of quality: equivalent to Yellow Poly-Cap, Item No. MAS-01162; manufactured by White Line Equipment.

2.05 FOUL POLES

- A. Acceptable level of quality: equivalent to Model LGFPW415, 15-foot foul pole with wing and sleeve mounting, powder coated yellow finish, manufactured by Sportsfield Specialties.

2.06 BASEBALL BASES, PITCHER'S RUBBER AND HOME PLATE

- A. Provide set of bases, acceptable level of quality: equivalent to 14-inch Soft Touch® Progressive Release Bases with ground mounts and plugs, distributed by BSN Sports.
- B. Pitcher's rubber: acceptable level of quality: equivalent to MacGregor® 4-Way Pitcher's Rubber, Youth Size, Model BBPR4YTH; distributed by BSN Sports.
- C. Home plate: acceptable level of quality: equivalent to MacGregor® Wood-Filled Home Plate, Standard Version, Model BBHPSAFE; distributed by BSN Sports.

2.07 BASKETBALL HOOPS

- A. Acceptable level of quality: equivalent to Ultimate Playground Basketball Systems, Model BA873U-BK, manufactured by Bison Inc. which includes a 42" x 72" polycarbonate backboard with a breakaway goal, a black pole finish, a lifetime limited warranty for the pole, and a 1-year limited warranty for the goal.

2.08 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of athletic field equipment specified in this Section where required.
- B. Construct concrete footings and foundations as shown on Drawings. Set sleeves plumb, level and true.
- C. Erect equipment plumb, level and true. Check equipment for alignment and hold in position during placement and finishing operations.
- D. Set up basketball hoop/goal and netting. Install hoops/goals and appurtenances in accordance with manufacturer's specifications and recommendations, Shop Drawings, and Drawings.
- E. Install basketball hoop/goal poles with concrete footings.
- F. Install dugouts on concrete pads in accordance with manufacturer's written instructions and Drawings.
- G. All bolts shall be peened over.
- H. Install synthetic turf for batting cage in accordance with manufacturer's written instructions and Drawings. Secure synthetic turf with 6-inch flat head spikes every foot along perimeter, every 4-inches along seams, and intermittently throughout remainder of turf surface. Install seams with seaming tape and adhesive in accordance with the manufacturer's written instructions. Minimize seams and locate in areas of less traffic and wear. Seam locations to be approved by Engineer.
- I. Install batting cage in accordance with manufacturer's written instructions and Drawings.

3.02 REPAIR/RESTORATION

- A. After erection and installation are complete, touch up portions damaged during transportation and erection using same finish to match.

3.03 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide labor, tools, equipment, and materials to furnish and install electrical work as specified in accordance with the Drawings, this Section, and applicable reference standards listed in Article 1.03.
2. Coordinate with local electric utility to provide new electrical service as shown on Drawings. Payment for costs associated with the work of the utility company shall be covered by the owner.

B. Related Requirements

1. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)
2. Institute of Electrical and Electronics Engineers (IEEE)
3. National Electrical Code (NEC)
 - a. NEC 110.16 Arc-Flash Hazard Warning
4. National Electrical Manufacturers Association (NEMA)
5. Underwriters Laboratories (UL)
6. National Fire Protection Association (NFPA)
 - a. NFPA 70E Standard for Electrical Safety in the Workplace
7. Occupational Safety Health Act (OSHA)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.
- B. Coordinate with work of other trades to prevent interferences and delay of construction progress.
- C. Coordinate with local utility companies and make installations for their services in accordance with utility company requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
- C. Shop Drawings
- D. Certificates: materials certifications
- E. Source and Field Quality Control Submittals
 - 1. Reports, permits, and easements for installation, use, and operation
 - 2. Test reports, inspections, and meter readings
- F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
 - 1. Compile warranties into a set of vinyl covered three ring binders, tabulated and indexed for easy reference.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Storage and Protection
 - 1. In the event of damage, immediately make repairs or provide replacements as approved by Engineer. If apparatus has been subject to possible damage by water, dry thoroughly and put through tests as directed by Engineer.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.
 - 1. Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
 - 2. Investigate each space through which equipment must pass to reach its final location. If necessary, manufacturers will be required to ship material in sections sized to permit passing through restricted areas.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. UL materials and equipment unless it can be demonstrated that no UL standards exist for a specific item or class of equipment.
- B. Materials required for complete installation: new, first quality, specification grade or better, subject to acceptance of Engineer.
- C. Materials and equipment furnished and installed shall meet the most stringent efficiency standards of the local utility to qualify for the maximum rebate.

2.02 INTERCHANGEABILITY

- A. Interchangeability of equipment, subassemblies, parts, motors, starters, relays and other items is essential. Similar items: same manufacturer, type, model and dimensions.
- B. Engineer reserves the right to reject any submittal which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers, and require that source of materials be unified to maximum extent.

2.03 MANUFACTURER'S NAMEPLATE

- A. Each piece of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place. Nameplate of distributing agent is not acceptable.

2.04 FIELD FABRICATED NAMEPLATES

- A. Laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified indicated on Drawings. Nameplate inscription shall identify equipment name, function, and when applicable, position. Nameplates: 0.125-inch-thick matte finish surface, melamine plastic with square corners, and black with white letters. Align lettering and engrave into core. Minimum size of

nameplates shall be 1 by 2.5 inches. Lettering: minimum of 0.25-inch-high normal block style. Label electrical equipment with the following:

1. Panel Name
2. Fed from Panel Name & CKT #
3. Amps
4. Volts
5. Phase

2.05 ARC FLASH LABEL

- A. Provide arc flash labels for electrical equipment with operating voltages greater than 50 volt per NEC 110.16.

2.06 WARNING SIGNS

- A. Exterior warning and caution signs: weather resistant, nonfading, preprinted cellulose acetate butyrate signs with 20 gauge, galvanized steel backing, with colors, legend, and size appropriate to location.
- B. Interior warning and caution signs: aluminum with preprinted baked enamel finish and punched for fasteners. Colors, legend, and size appropriate to location.

2.07 WIRE AND CABLE MARKERS

- A. Underground line marking tape: permanent, bright colored, continuous printed, metal backed, plastic tape compounded for direct burial service not less than 6 inches wide. Printed legend indicative of general type of underground line below.
- B. Wire labels
 1. Wire sizes No. 4 and smaller: vinyl or vinyl cloth, self-adhesive, wraparound, wire markers with preprinted numbers and letters.
 2. Wire sizes No. 4 and larger and multi conductor cables: marked with one-piece, nylon locking marker ties. Acceptable level of quality: equivalent to Panduit PLM Series.
- C. Reference Section 26 05 43 for further requirements.

2.08 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 COORDINATION

- A. Prior to starting Work, inspect installed work of other trades and verify that work is complete to point where installation may commence.
- B. Field verify all locations and dimensions to ensure that equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and Regulations, the Contract Documents, and referenced standards.
- C. Lay out Work in advance where cutting and drilling of floors, walls, ceilings, or other surfaces is necessary for installation. Repair damage to building, piping, or equipment by skilled mechanics of the trades involved.
- D. Immediately notify Engineer in writing if discrepancies are discovered. Do not proceed with installation until all discrepancies have been fully resolved.

3.02 TEMPORARY POWER

- A. Furnish, install, maintain, and remove temporary electrical power and lighting systems, including lamps, in accordance with NEC, local utility company, and OSHA.
- B. Arrange for temporary electric service with local utility company.

3.03 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations and all pertinent codes and Regulations.
- B. Inspect all equipment. Replace or repair dented, scratched, or otherwise damaged items and paint to match original finish. Notify Engineer for inspection and acceptance.
- C. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete or supported from or on other structural components, as they are constructed.
- D. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom.
- E. Determine final routing of raceways by structural conditions, interferences with other trades and terminal locations on apparatus.
- F. Provide fittings and boxes for complete raceway installation where circuits are shown as home-runs.

- G. Furnish and install wiring and raceway systems for security alarm, fire alarm, telephone and intercommunications systems. These are not indicated on Drawings.
- H. Provide each lighting and each receptacle circuit with its own neutral, dedicated to that circuit. A common neutral for more than 1 signal phase circuit is not allowed.
- I. Furnish and install all required supports and wiring to clear encroachment where lighting fixtures and electrical items are shown in conflict with locations of structural members and mechanical or other equipment.
- J. Support surface mounted panel boxed, junction boxes and conduits by spacers to provide a clearance between wall and equipment.
- K. Upon completion of all installation, lamping, and testing, thoroughly inspect exposed portions of electrical installation and completely remove all exposed labels, soils, markings and foreign material.

3.04 MARKING AND LABELING

- A. Label panelboards, indoor transformers, cabinets, control panels and other specified equipment with engraved laminated plastic plates with engraved letters. Punch tapes with mastic backings are not acceptable.
- B. Mark starters, disconnect switches and other specified equipment with engraved laminated plastic plates and engraved letters. Where individual switches or circuit breakers in power or distribution panel boards do not have cardholders, mark with 1/2-inch-high labels.
- C. Tie and mark labels to pull string at each end of each empty conduit, for identification. Label junction boxes with circuits provided for future use with appropriate circuit designation.
- D. Provide typewritten identification of each circuit for panelboards directories.

3.05 WIRE AND CABLE MARKERS

- A. Tag control circuit conductors at both ends and at junction box splices using wire and cable markers with identification numbers as designated on equipment wiring diagrams. Provide typed listing to identify conductors by number and use.
- B. Identify spare conductors, individually, at both ends and at junction box splices with number between 1 and 999. Do not duplicate numbers.
- C. Identify wire numbers on terminal block marking strips.

- D. Provide permanent plastic name tag indicating load for each feeder for all junction boxes, handholes and manholes. Label all process motor wires to yard equipment in handholes and manholes.

3.06 WORK PERFORMANCE

- A. Electrical work: accomplished with all affected circuits or equipment de-energized. When electrical outage cannot be accomplished in this manner for required Work, the following requirements are mandatory.
 - 1. Electricians must use full protective equipment, certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, while working on energized systems in accordance with NFPA 70E.
 - 2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
 - 3. Before initiating any Work, a job specific Work plan must be developed by Contractor and Owner. Work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
 - 4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from Owner.

3.07 TEST & SETTINGS

- A. Provide services of an independent testing agency to perform specified tests outlined in their respective specification sections.
- B. Provide necessary material, equipment, labor and technical supervision to perform and complete the electrical acceptance tests as required.
- C. Acceptance tests as specified are defined as tests and inspections required to determine that equipment involved is acceptable as delivered to job Site, that equipment may be energized for final operational tests and is in accordance with the Specifications.
- D. Final acceptance of equipment and workmanship will depend upon performance characteristics as determined by subject tests, in addition to complete operation tests, on all electrical equipment to show that it will perform the functions for which it was designed.
- E. Implement necessary adjustments, corrections, modifications or replacements to meet specified requirements if test and inspection data submitted indicates deficiencies in operation or manufacture of electrical apparatus.

- F. Upon completion of remedial Work, testing agency shall repeat all tests on components previously found deficient on first test, or any additional test if required. Contractor to have all remedial Work completed as required by second or additional tests.

3.08 POSTED OPERATING INSTRUCTIONS

- A. Provide operating instructions for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel. Operating instructions shall include the following.
 - 1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment
 - 2. Start up, proper adjustment, operating, lubrication, and shutdown procedures
 - 3. Safety precautions
 - 4. Procedure in the event of equipment failure
- B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

3.09 CLEANING

- A. When Work is complete, tested and accepted, clean all light fixtures, equipment, and exposed surfaces that have been directly affected by the Work. Contractor shall keep premises in neat and orderly condition at all times. At completion of Work, clean up, remove any excess materials from Site, and dispose of legally.

3.10 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.11 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.12 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide labor, tools, equipment, and materials necessary to install wires, cables, and connectors in accordance with the Plans, this Section, and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 26 05 00 – Common Work Results for Electrical

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. Institute of Electrical and Electronic Engineers (IEEE) Compliance
 - a. Standard 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors
 - 2. National Electrical Code (NEC)
 - 3. National Electrical Manufacturers Association (NEMA)
 - a. WC 5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - b. WC 7 Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - c. WC 8 Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - 4. National Fire Protection Association (NFPA)
 - 5. Underwriter's Laboratories (UL)
 - a. UL Standard 83 Thermoplastic-Insulated Wires and Cables

- b. UL Standard 486A-486B Wire Connectors
- c. UL Standard 854 Service Entrance Cable

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product data
 - 1. Product data for electrical wires, cables, and connectors
 - 2. Product data for Megger insulation testing instrument
 - 3. Report sheets for Megger testing
- C. Manufacturer Reports
 - 1. Furnish manufacturer's product data, test reports, and materials certifications as required
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.
- C. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General

1. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection to comply with Project's installation requirements, NEC and NEMA standards.
2. Provide color-coding for phase identification as specified.
3. Provide factory applied nylon or polyvinyl chloride (PVC) external jackets on wires and cables for pulls in raceways over 100 feet in length, for pulls in raceways with more than 3 equivalent 90-degree bends, for pulls in conduits underground or under slabs on grade, and where indicated.

B. Service & Distribution Wiring

1. 98 percent conductivity copper
2. 600-volt insulation, type XHHW
3. UL listed for underground use in wet locations at 75 degrees C
4. Use XHHW for #4 and larger and THHN/THWN or XHHW for #6 and smaller

C. Building Wiring

1. 98 percent conductivity copper
2. 600-volt insulation, type, THWN/THHN, or XHHW
3. Stranded conductor: 14 AWG and larger
4. Minimum branch circuit: 12 AWG
5. Minimum 10 AWG for 120-volt circuits more than 100 feet long
6. Minimum 10 AWG for 277-volt circuits more than 230 feet long

D. Control Wiring

1. Control wiring for digital/discrete signal wiring, shall be 600V, minimum 14 AWG, THHN/THWN, copper stranded, unless specifically indicated otherwise.

2. Instrument cable for analog signal wiring (4-20mA DC) shall be shielded, 2-conductor, 300 volt rated, minimum 18 AWG, Belden No. 8760, Alpha Wire, or approved equal. Provide 600 volt rated cable where cable occupies the same enclosure and/or raceway with voltages greater than 300 volt as specified below.
 3. Single Shielded Pair Instrument Cable
 - a. Tinned copper, XLPE insulated stranded conductors, 18 AWG minimum, twisted pair with overall shield, stranded tinned 18 AWG copper drain wire and overall PVC jacket. Rated for 600 volts minimum and conforming to UL 1581. Cables: rated for tray cable (TC) use where installed within a cable tray.
 1. Multi-paired Shielded Instrument Cable
 - a. Tinned copper, XLPE insulated stranded conductors, No. 16 AWG minimum, twisted pairs with shield over each pair, stranded tinned No. 18 AWG copper drain wire, and overall PVC outer jacket. Rated for 600 volts minimum and conforming to UL 1581 or UL 13. Cables shall be rated for TC use where installed within a cable tray.
- E. Splices
1. No. 10 and smaller with 600-volt pressure type insulated connector of wire-nut type, or equal; soldered and crimped type not allowed. Wire nut acceptable level of quality: equivalent to Buchanan type B-Cap and Minnesota Mining (3M) type Scotchlok.
 2. No. 8 and larger with solderless lugs or solderless connectors of locktite or similar type properly taped with plastic insulating tape, acceptable level of quality: equivalent to Minnesota Mining Co. #33, then 2 half-lap servings of friction tape, acceptable level of quality: equivalent to Manson.
 3. UL listed wire connector systems for use with underground conductors.
 4. Service entrance conductors: installed without splices. Electrical equipment feeders: spliced only where shown or specifically approved. Install control and metering conductors without splices.
 5. Splices: made only by specific permission of Engineer and then only in manholes or pull boxes and sealed watertight with a heat-shrunk insulation.
 6. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacture's

torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A-486B.

7. UL listed splice for underground wires, ducts buried, in conduit and in ducts. Connectors and splices: waterproof.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 WIRE AND CABLE INSTALLATION

- A. Install wire and cables in conduit of size and type indicated on Drawings and Specifications.
- B. Install electrical cables, wires, and connectors in compliance with NEC.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.
- D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips, which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- E. Conceal cable in finished spaces.
- F. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.
- G. Size conductors so voltage drop does not exceed 3 percent for branch circuits or 5 percent for feeder/branch circuit combination.
- H. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- I. Provide color coded feeder and branch circuit wiring at termination and splice locations. System neutrals: designated in addition to phase conductors. Equipment grounds: green.
- J. In general, install wiring for the following systems in separate conduits. Do not mix categories in a single raceway.
 1. 120-volt power wiring

2. 120-volt control wiring, including, digital input and output signals
 3. 24-volt DC control wiring, including, digital input and output signals
 4. 24-volt DC analog control wiring (4-20mA)
 5. Communications wiring
 6. Special & Emergency Systems
- K. Conductors 600 volts and below: color coded in accordance with the following.

CONDUCTOR	120 / 208 COLOR	480 / 277 COLOR
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	White / Gray
Equipment Grounds	Green	Green

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Test each electrical circuit after permanent cables are in place with terminators installed, but before cable or wire is connected to equipment or devices to demonstrate that each circuit is free from improper grounds and short circuits.
- C. Megger Test insulation resistance between phases and from each phase to ground for each of the following feeder and motor branch circuits.
 1. Secondary Service Entrance
 2. Field Lighting Circuits
- D. Provide Engineer with 48 hours advanced notice of Megger Testing.
- E. Measure insulation resistance with a digital Megger insulation testing instrument in accordance with manufacturer's recommendations.
- F. Consider cable faulty if insulation resistance measures less than 50 megohms. In moist environments, bag ends of cable to prevent faulty Megger test.
- G. Replace cable that fails insulation test or fails when tested under full load conditions with new cable for the full length and retest.

- H. Test below grade service or feeder splice with water immersion Megger test in presence of Engineer. Immerse splice in a grounded water immersion bath for 24 continuous hours prior to and during test. Criteria for failure: as described for cable above.

3.03 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

- A. Provide labor, tools, equipment, materials and appurtenances necessary to furnish and install grounding materials in accordance with the Drawings, this Section, and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounded System
 - 2. IEEE 141 Recommended Practice for Electric Power Distribution for Industrial Plants
 - 3. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems
- B. InterNational Electrical Testing Association (NETA)
- C. National Electrical Code (NEC)
 - 1. Article 250 Grounding and Bonding
- D. Underwriters Laboratories (UL)
 - 1. UL 467 Grounding and Bonding Equipment

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.

- B. Product Data
 - 1. Grounding equipment and appurtenances.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide each electrical grounding system with assembly of materials required for complete installation including wires/cables, connectors, lugs, clamps, ground rods, bonding jumpers and accessories.
- B. Provide electrical grounding conductors for grounding connections matched to power supply wiring materials and sized according to NEC.
- C. Provide electrical connectors, lugs, clamps, bonding jumpers and accessories as recommended by the respective manufacturer for the particular application, unless other indicated.
- D. Ground rods: solid copper clad, 3/4-inch diameter by 10 feet long.
- E. Insulated conductors: green in color.
- F. Ground bus: bare annealed copper bars of rectangular cross section, 1/4-inch by 3-inch by length as required, with 98 percent conductivity, rigidly attached to structure.
- G. Bonding strap conductor and connectors: soft copper, 0.05-inch-thick, and 2-inches wide, except as indicated.
- H. Pressure connectors: high conductivity plated units.
- I. Bolted clamps: heavy-duty units listed for the application.
- J. Exothermic welded connections: provided in kit form and selected for specific types, sizes, and combinations of conductors and other items to be connected.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GROUNDING & BONDING

- A. Ground main service entrance ground bus or lug to neutral of incoming service, to enclosure, to building steel, to ground rods or grounding ring, to rebar in concrete footing, and main cold water pipe. Install grounding bushings or service conduits. Use exothermic style ground connections to ground rods and building steel.
- B. Use of conduit system for ground conductor is not allowed.
- C. Provide and install 600 volt insulated bonding conductors throughout distribution system with connection to bonding or grounding terminal on each panel and panel board with connections to other equipment where specifically indicated and noted.
- D. Provide continuous bonding conductors where possible. Provide approved pattern compression connectors where splices are required. Insulate connectors to equivalent thickness of conductors.
- E. Provide grounding system for grounded circuit conductors of dry type transformer secondaries in accordance with NEC. Use exothermic style ground connections to building steel. Enclose grounding conductors in schedule 40 polyvinyl chloride (PVC) conduit.
- F. Provide equipment grounding conductors in conduits containing power, control, or instrumentation conductors on load side of service equipment or on load side of a separately derived system.
- G. Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except larger sizes indicated or specified take precedence. Use of metallic conduit systems for equipment grounding recognized by NEC is not permitted.
- H. Install grounding bushings on conduits at both primary and secondary entrances to transformers. Ground transformer enclosures to bushings.
- I. Install bonding jumper for flexible metal conduit unless fittings are approved for grounding or otherwise comply with NEC.
 - 1. Size jumper to match over-current device.
 - 2. Green insulation

3. Connect to grounding bushing at each end.
- J. Ensure entire electrical system is electrically continuous and permanently and effectively grounded, including all electrical equipment and motors.
1. Locate ground rods with minimum of 2 rod lengths from each other and at least same distance from any other grounding electrode. Connect ground conductors to ground rods by exothermic welds except at test wells and as otherwise indicated. Drive rods until tops are 24 inches below finished floor or final grade except as otherwise indicated.
- K. Route grounding electrode conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- L. Ensure that grounding electrode conductor connections to interior piping, structural members, and the like are accessible for periodic inspection during life of the structure.

3.02 BONDING FOR OTHER TRADES

- A. Bond signal raceways, water piping, heating piping and metallic air ducts together and to grounding conductor with No. 8 soft drawn bare solid conductors. Make connections to pipes with cast clamps of like material as pipes to which attached, to ducting terminated in a secure manner by best practical means, bonding across any flexible or insulated connections.
- B. Install bonding conductors in a neat manner properly shaped for contour of surface involved and properly supported. At locations remote from main service entrance panel boards, bond to the largest nearby raceway.

3.03 FIELD TESTING

- A. Provide services of an independent testing agency to perform specified tests for the following systems.
1. Ground resistance – testing company shall perform testing in accordance with NETA standards and procedures. Submit testing results on NETA forms. Testing data: certified by the respective agency. Test results shall indicate recommended action for sub-par test results. Results shall list recommended test values that should be obtained for new installation.
- A. Measure ground resistance without soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall of potential 3-point method in accordance with IEEE 81. Simple moisture addition is not acceptable.

- B. Ground/resistance maximum values as follows
 - 1. Equipment rated 500 kVA and less: 10 ohms.
 - 2. Equipment rated 500 kVA to 1000 kVA: 5 ohms.
 - 3. Equipment rated over 1000 kVA: 3 ohms.
 - 4. Unfenced substations and pad mounted equipment: 5 ohms.
 - 5. Fence grounds: 10 ohms.
- C. Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values.

3.04 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide the labor, tools, equipment, and materials necessary to furnish and install raceways, boxes, and supporting devices in accordance with the Plans, this Section, and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 26 05 00 – Common Work Results for Electrical
 - 2. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Concrete Institute (ACI)
 - a. ACI 318 Building Code Requirements for Reinforced Concrete
 - 1) Article 6.3 Conduits and Pipes Embedded in Concrete
 - 2. American National Standards Institute (ANSI)
 - a. ANSI/NEMA C80.1 American National Standard for Electrical Rigid Steel Conduit (ERSC)
 - b. ANSI/NEMA C80.3 American National Standard for Steel Electrical Metallic Tubing (EMT)
 - c. ANSI/NEMA C80.5 American National Standard for Electrical Rigid Aluminum Conduit (ERAC)
 - d. ANSI/NEMA FB 1 American National Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

- e. ANSI/NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
- 3. National Electrical Code (NEC)
 - a. NEC Article 404.8
- 4. National Electrical Manufacturers Association (NEMA)
- 5. National Fire Protection Association (NFPA)
 - a. NFPA 70 National Electrical Code (NEC)
- 6. Underwriters Laboratories (UL)
 - a. UL 1 Standard for Flexible Metal Conduit
 - b. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations
 - c. UL 514A Standard for Safety Metallic Outlet Boxes
 - d. UL 514B Conduit, Tubing, and Cable Fittings
 - e. UL 514C Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
 - f. UL 6 Electrical Rigid Metal Conduit - Steel
 - g. UL 797 Electrical Metallic Tubing – Steel
 - h. UL 870 Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data: cabinets and enclosures.
- C. Shop Drawings
 - 1. Floor boxes and boxes, shop fabricated enclosures and cabinets.
- D. Certificates: material certifications.
- E. Manufacturer Reports: test reports.

- F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 CONDUIT, RACEWAYS & FITTINGS

- A. Provide conduit with 3/4-inch diameter minimum, except where specifically shown smaller on Drawings.
- B. Conduit, connectors, and fittings: approved for installation of electrical conductors.
- C. Refer to Table 3.01A for approved conduit installation guidelines.
 - 1. Electrical Metallic Tubing (EMT)
 - a. EMT: thin wall rigid metallic conduit in straight lengths, elbows, or bends conforming to ANSI/NEMA C80.3 and requirements of UL 797.
 - b. Couplings and connectors: steel compression fittings. Provide insulated-throat type connectors where EMT enters outlet boxes, cabinets, or other enclosures, with a locknut. Fittings must meet the requirements of ANSI/NEMA FB 1.
 - 2. Rigid Galvanized Steel Conduit
 - a. Rigid galvanized steel conduit (RGS), including couplings, elbows, bends, and nipples, shall conform to requirements of UL 6 and ANSI/NEMA C80.1. Steel fittings: galvanized by hot-dip process.
 - b. Fittings: threaded and conform to ANSI/NEMA FB 1.
 - c. Gaskets: solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at lowest point of a conduit run where drainage is required.

- d. Covers with captive screws, accessible after Work has been completed.
3. Rigid Aluminum Conduit
 - a. Rigid aluminum conduit (RAC) including couplings, elbows, bends, and nipples, conforming to requirements of UL 6 and ANSI/NEMA C80.5.
 - a. Fittings: threaded and conforming to ANSI/NEMA FB 1, galvanized by hot dip process, unless manufacturer dictates aluminum for specific application.
 - b. Gaskets: solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.
 - c. Covers with captive screws, accessible after Work has been completed.
4. Rigid Plastic Conduit
 - a. PVC Schedule 40: conduit made of polyvinyl chloride (PVC) compound, homogeneous plastic material free from cracks, holes or foreign inclusions, rated for use with 90-degree C conductors, UL Listed. Use solvent cement to join conduits as manufactured the same as the conduit manufacturer.
 - b. PVC Schedule 80: Heavy wall PVC conduit that shall be made of polyvinyl chloride compound that shall be homogeneous plastic material free from cracks, holes or foreign inclusions. Conduit shall be rated for use with 90 degree C conductors, UL Listed. Use solvent cement recommended by manufacturer to join conduits.
5. Flexible Metallic Conduit
 - a. Flexible metallic (FM) conduit in accordance with UL 1.
 - b. Liquid tight flexible metallic conduit with protective jacket of PVC extruded over flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.
 - c. Fittings for flexible metallic conduit meeting requirements of UL 514B, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.
6. Wireways
 - a. Wireways and auxiliary gutters for use in exposed, dry locations: prefabricated channel-shaped sheet metal trough with hinged or

removable covers, associated fittings, and supports for housing, and protecting electrical wires and cables in accordance with UL 870.

- b. Straight sections of trough, elbows, tees, crosses, closing plates, connectors, and hanging brackets: constructed from commercial quality sheet steel not less than 16-gage. Sheet metal component parts: cleaned, phosphatized, and coated with corrosion-resistant gray paint.
- c. Straight sections of wireways and auxiliary gutters: solid or have knockouts as indicated in both sides and bottom, 3 inches on center.
- d. Straight sections: not more than 5-feet long, with covers held closed with screws.

7. Conduit Seals

- a. Factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Provide cast in place water stop wall sleeve with mechanical pipe seal between conduit and sleeve. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

2.02 SUPPORTING DEVICES

- A. Supports, support hardware, and fasteners protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors: hot dip galvanized unless material is inherently corrosion resistant.
- B. Refer to Table 2.02A for approved supporting device installation guidelines.

1. Conduit Supports

- a. Single run hangers: galvanized steel conduit straps or clamps, or cast metal beam clamps. Perforated straps and spring steel clips and clamps are not permitted.
- b. Group run hangers: minimum 12-gauge galvanized preformed U-channel rack with conduit fittings; 25 percent spare capacity.
- c. Hanger rods: threaded steel, 3/8-inch diameter, or as identified on the Drawings.
- d. Vertical run supports: minimum 12-gauge galvanized preformed U-channel struts with conduit fittings.

2. Equipment and Lighting Supports
 - a. 12-gauge galvanized preformed U-channel struts with fixture and conduit fittings, as applicable, unless otherwise indicated on Drawings.
3. Corrosive Area Supports
 - a. Clamp hangers, pipe straps, and clamp back spacers for use with PVC-coated rigid metal conduit with 40 mil gray PVC exterior coating.
 - b. Nonmetallic PVC material clamp hangers and pipe straps for use with PVC nonmetallic conduit.
 - c. Hanger Rods: 20 mil gray PVC exterior coated rod with threaded ends only 3/8 inch and 1/2 inch sizes as required.
 - d. Strut Support: 20 mil gray PVC exterior coating strut. Standard channel, slotted channel, and back to back channel are acceptable.
 - e. Provide stainless steel supports and accessories in lieu of PVC coated supports when indicated in Table 2.02A below.

TABLE 2.02A – Supporting Devices

Location/Equipment	Acceptable Support Type
Electrical & Control Rooms	Galvanized Steel U-Channel
Utility & Mechanical Rooms	Galvanized Steel U-Channel
Exterior	Galvanized Steel U-Channel

2.03 BOXES AND FITTINGS

- A. Boxes must have sufficient volume to accommodate number of conductors entering box in accordance with requirements of NFPA 70 and UL 514A.
- B. In general, boxes that are exposed to weather, process areas, normally wet locations, and locations exposed in mechanical spaces: cast-metal. Boxes in all other finished areas: sheet metal. Boxes installed in corrosive areas, such as the chemical feed room: nonmetallic.
- C. Refer to Table 2.03A for approved enclosure types.
 1. Sheet Metal Outlet Boxes
 - a. Sheet metal outlet boxes: standard type galvanized steel, minimum 4 inch square or octagon by 1-1/2 inch deep.

- b. Luminaire and equipment supporting boxes: rated for weight of equipment supported; include 2-inch male fixture studs where required.
 - c. Single wall type: minimum size, 4-inch square by 1-1/2 inch or 2-1/8 inch deep, except as noted. Provide dry wall device covers raised 3/4 inch minimum to ensure flush finish mounting.
 - d. Ganged wall type: minimum depth 3 inches except as noted, ganged as required under common plate to contain devices shown. On 277-volt circuits, ganged boxes for switches shall contain only 1 circuit or equipment box with permanent barriers per NEC Article 404.8.
2. Cast Outlet Boxes
- a. Type FS shallow and type FD deep, cast ferroalloy
 - b. Provide number of threaded hubs as required.
 - c. Use in all exterior, damp and locations exposed in mechanical spaces.
 - d. Provide gasketed cover and accessories by box manufacturer for complete weatherproofing. Provide correct box to accept weatherproof covers as specified.
3. Sheet Metal Pull & Junction Boxes
- a. Sheet metal boxes: standard type galvanized steel and conform to UL 50.
 - b. Box dimensions: minimum 4-inch square or octagon by 2-1/2 inch deep.
 - c. Sizes up to 12 by 12 by 6 inches: screw-type or hinged covers.
 - d. Sizes greater than 12 by 12 by 6 inches: hinged covers.
 - e. Boxes: sized to accommodate all incoming raceways.
4. Nonmetallic Outlet, Device, and Wiring Boxes
- a. Boxes: molded polyvinyl chloride (PVC) or fiberglass units of type, shape, size, and depth to suit location and application, conforming to ANSI/NEMA OS 2 and UL 514C.
 - b. Boxes equipped with threaded screw holes for device and cover plate mounting, with molded cover of matching material suitable for application and location installed.

TABLE 2.03A – Electrical Enclosure Types

Location/Equipment	Acceptable Enclosure Type
Electrical & Control Rooms	NEMA 1G
Utility & Mechanical Rooms	NEMA 12
Exterior	NEMA 3R

2.04 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONDUIT

- A. Uses Permitted
1. Provide liquid tight flexible metal conduit for final 24 inches of connections to motors or control items subject to movement or vibration.
 2. RGS for exterior aboveground installations unless otherwise noted.
 3. PVC coated rigid steel conduit or as scheduled below, for installation in corrosive areas and other areas identified on Drawings.
 4. Rigid galvanized steel exposed raceways in manufacturing areas, utility rooms, mechanical rooms and warehouse areas below 15 feet.
 5. Electrical metallic tubing (EMT) conduit and raceway runs in finished areas concealed in or behind walls, above ceilings, or exposed on walls and ceilings, 15 feet or more above finished floors, not subject to mechanical damage.
 6. Schedule 40 PVC conduit for exterior direct buried installations. Schedule 40 PVC conduit for exterior concrete encased installations. Schedule 80 PVC conduit for underground installations under driveways. Transition from underground and from concrete encasement to riser: PVC coated rigid steel conduit to a minimum of 12 inches above finished floor or finished grade elevation. Elbows: prefabricated rigid steel to prevent wire burn through. Reference Section 26 05 43 for further requirements.
 7. Install conduit seals for conduit penetrations of slabs on grade, exterior walls below grade, and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal. Provide seals for interior of conduits that penetrate exterior or water bearing walls, consisting of gland type sealing bushings or RTV closed cell silicone foam.

8. Refer to Table 3.01A below for approved conduit types.

TABLE 3.01A – Conduit Types

Location/Equipment	Approved Conduit Type
Electrical & Control Rooms	Electrical Metallic Tubing
Utility & Mechanical Rooms	Electrical Metallic Tubing
Exterior	Rigid Galvanized Steel

- B. Install power, lighting, control, emergency light and power, special-service systems and all related components in accordance with NFPA 70, enclosed in separate conduit or separate conduit systems as indicated on Drawings and as specified.
- C. Any run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain no more than equivalent of three 90-degree bends, including bends located immediately at outlet or fitting. Make field bends in accordance with manufacturer's recommendations. Install conduit and fittings free of dirt and trash, not deformed or crushed. Empty conduit shall have a pull rope installed.
- D. Install conduit with minimum of 3 inches of free air space separation from mechanical piping.
- E. Conceal conduit in finished areas. Install conduit passing through masonry or concrete walls in sleeves. Securely clamp and support conduit at least every 10 feet vertically and 8 feet horizontally. Fasten galvanized pipe straps to structure with bolts, screws, and anchors. Wooden masonry plugs are not allowed.
- F. Install exposed conduits, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or sidewalls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
- G. Do not run conduits exposed on the exterior surface of buildings. Seal conduits penetrating exterior walls below grade, at grade floors, or below grade floors to prevent moisture migration. Seal exterior of conduit with a mechanical pipe seal. Interior conduit seal: gland type sealing bushing or RTV closed cell silicone foam. Ensure conduits do not retain water against seals.
- H. Seal raceways penetrating fire rated walls, floors, and partitions with a fire rated sealant.

- I. Support conduits with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the raceway system to ventilation ducts. Attach conduit supports to building. Support conduits on each side of bends and on a spacing not to exceed the following; 6 feet for conduits smaller than 1 1/4 inches and 8 feet for conduits 1 1/4 inches and larger. Support riser conduits at each floor level with clamp hangers. Securely anchor underground conduits to prevent movement during placement of concrete or backfill. Use precast separators and heavy gauge wire ties or other approved fasteners.
- J. Support conduit connections to boxes and fittings not more than 36 inches from connection point. Support conduit bends not more than 36 inches from each change in direction. Install conduit in neat symmetrical lines parallel to centerlines of building construction and building outline. Multiple runs: parallel and grouped whenever possible on common supports. Seal exposed ends of conduit without conductors with watertight caps or plugs.
- K. Provide bonding wires in flexible conduit for all circuits. Flexible conduit is not considered a ground conductor.
- L. Provide liquid tight flexible metallic conduits in wet and oily locations and to complete connection to motor-driven equipment.
- M. Electrical connections to vibration-isolated equipment: made with flexible metallic conduit in a manner that will not impair function of equipment.
- N. Install polypropylene pull rope with a tensile strength not less than 130 pounds in empty conduit.
- O. Embed electrical conduit in concrete according to provisions of ACI 318 Article 6.3, provided the following conditions are met.
 - 1. Outside diameter of conduit does not exceed 1/3 of concrete thickness. Maximum conduit outside diameter does not exceed 3 inches when embedded in slab.
 - 2. Conduit is not placed closer than 3 diameters on center. Route conduit to minimize crossing of different conduit runs.
 - 3. Conduit is not embedded in structural concrete slabs less than 4 inches thick.
 - 4. Provide 1-1/2-inch minimum concrete cover for conduits in structural concrete slabs.
- P. Installation of Underground Conduit
 - 1. Minimum of 3/4-inch conduit in or under concrete slab on grade.

2. Make all joints liquid tight and gas tight where conduits are installed in concrete slabs, on the ground, underground, or exposed to the weather.
3. Bury all underground conduit, except under concrete slabs placed on fill, to a depth of at least 30 inches below finished grade unless otherwise indicated on Drawings.
4. Slope ducts to drain away from buildings into manholes and handholes. Adjust final slopes to coordinate with existing Site utilities.
5. Install on undisturbed soil where possible. Concrete encase conduits as shown on Drawings. Use pit run gravel and sand, placed 8-inch lifts and compacted for backfill.
6. Reference Section 26 05 43 for further requirements.

Q. Installation of Rigid Metal Conduit

1. Ends of conduit: cut square, reamed and threaded, and joints brought butt-to-butt in couplings. Joints: mechanically tight. Protect conduit against damage and entrance of water or foreign material during construction.
2. Provide factory-made elbows for ninety-degree bends of conduit with a diameter larger than 1 inch. Conduit elbows larger than 2 1/2 inches: long radius. Field-made bends and offsets: made with approved hickey or conduit-bending machine. Changes in directions of runs: made with symmetrical bends or cast-metal fittings.
3. At connections to sheet metal enclosures and boxes, a sufficient number of threads shall project through to permit bushing to be drawn tight against end of conduit. Locknut: pulled up to draw bushing into firm electrical contact with box. Fasten conduit to sheet metal boxes and cabinets with 2 locknuts where required by NFPA 70, where insulating bushings are used, where bushings cannot be brought into firm contact with the box, and where indicated.
4. Make conduit joints with tapered threads set firmly. Ream each length of conduit cut in the field before installation. Where conduit is threaded in the field, each threaded end shall consist of at least 5 full threads. Use corrosion-inhibitive compound on conduit threads or locations where original hot galvanized surface has been compromised.
5. Provide conduit stubbed-up through concrete floors for connections to free-standing equipment, except motor-control centers, cubicles, and other items of equipment, with a minimum 12-inch riser above floor slab if of sufficient thickness; if not, provide a floor box and set flush with finished

floor. Terminate conduits installed for future use with a coupling and plug set flush with floor.

3.01 SUPPORTING DEVICES

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with building structural system and other electrical installations.
- C. Conform to manufacturer's recommendations for selection and installation of supports.
- D. Install individual and multiple raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
- E. Support parallel runs of horizontal raceways together on trapeze type hangers.
- F. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners specifically designed for supporting single conduits or tubing.
- G. Arrange support in vertical runs so load produced by weight of raceway and enclosed conductors is carried entirely by conduit supports with no weight load on raceway terminals.
- H. Support miscellaneous electrical components as required to produce same structural safety factors specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- I. Install sleeves in concrete slabs and walls and other fire rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed fire-stopping sealant in gaps between sleeves and enclosed conduits and cables.

3.02 BOXES AND FITTINGS

- A. Install pullboxes where necessary in conduit system to facilitate conductor installation. Conduit runs longer than 100 feet, or with more than 3 right angle bends, shall have a pull box installed at a convenient intermediate location.
- B. Mount boxes and enclosures to building structure with supporting facilities independent of conduit entering or leaving the boxes.

- C. Provide bonding jumpers around concentric or eccentric knockouts.
- D. Installation of Outlet Boxes
 - 1. Use nonmetallic boxes in corrosive areas such as chemical feed area and as designated on the Plans.
 - 2. Use explosion proof boxes in hazardous areas as identified on Drawings.
 - 3. Use cast metal boxes in all other locations. Each box with associated covers and fittings shall have a NEMA rating for each location installed.
- E. Installation of Pull and Junction Boxes
 - 1. Use general-purpose NEMA 1 boxes in finished areas with framed construction.
 - 2. Use dust-tight and oil-tight NEMA 12 boxes in other dry interior areas.
 - 3. Use watertight NEMA 3R boxes for exterior and wet locations on outdoor structure where moisture is present.
 - 4. Use corrosion resistant watertight NEMA 4X boxes for wet locations and corrosion filled areas.

3.03 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

- A. Provide labor, materials, equipment and incidentals as required to furnish and install underground duct banks, manholes and handholes including all necessary excavation, backfill and surface restoration in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 26 05 00 – Common Work Results for Electrical
 - 2. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
 - 3. Section 26 05 26 – Grounding and Bonding for Electrical Systems
 - 4. Section 26 05 33 – Raceways and Boxes for Electrical Systems
 - 5. Section 26 21 00 – Low-Voltage Electrical Service Entrance

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American National Standards Institute (ANSI)
 - a. ANSI A14.3 American National Standards for Ladders - Fixed - Safety Requirements
 - 2. ASTM International (ASTM)
 - a. ASTM A48 Standard Specification for Gray Iron Castings
 - b. ASTM C858 Standard Specification for Underground Precast Concrete Utility Structures
 - c. ASTM D2444 Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

- d. ASTM D543 Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
 - 1) Section 7, Procedure 1
 - e. ASTM D570 Standard Test Method for Water Absorption of Plastics
 - 1) Sections 5, 6.1, and 6.5
 - f. ASTM D635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
 - g. ASTM D756 Standard Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions
 - 1) Procedure E
 - h. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - i. ASTM G154 Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
- 3. Institute of Electrical and Electronic Engineers (IEEE)
 - 4. National Electrical Code (NEC)
 - 5. National Electrical Manufacturers Association (NEMA)
 - 6. National Electric Safety Code (NESC)
 - 7. Occupational Safety and Health Administration (OSHA)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.
- B. Coordinate installation with piping and other underground systems and structures and locate clear of interferences. Coordinate manhole and handhole installation with piping, sheet piling and other underground systems and structures and locate clear of interferences.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.

- B. Product Data: for nonmetallic conduit and manhole accessories.
- C. Shop Drawings
 - 1. Layouts showing proposed routing of duct banks and locations of manholes, handholes and areas of reinforcement
 - 2. Profiles of duct banks showing crossings with piping and other underground systems
 - 3. Typical cross sections
 - 4. Installation procedures
 - 5. Manufacturer's technical information for manholes, handholes and accessories proposed for use
 - 6. Drawings showing interior and exterior manhole and handhole dimensions and details of openings, jointing, inserts, reinforcing, size and locations of openings, and accessory locations
 - 7. Certificate of concrete and steel used in underground pre-cast concrete utility structures, according to ASTM C858
 - 8. Record Drawings
 - a. Layouts showing actual routing of duct banks including dimensions and depth of top of duct bank below grade. Record Drawings for duct banks should also include cross sections of duct bank indicating circuit, use, conduit size, orientation and number of conduits.
 - b. Locations of manholes, handholes, and areas of reinforcement
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 DUCT BANK CONDUIT

- A. Duct: Schedule 40 and Schedule 80 PVC conduit and fittings in accordance with Section 26 05 33.
- B. Rigid steel conduit and fittings in accordance with Section 26 05 33.
- C. Install shielded instrumentation and communications cable in ferrous metal, steel conduit throughout entire run of conduit from end to end.

2.02 HANDHOLES

- A. Pull/splice box underground enclosures: constructed of polymer concrete consisting of sand and aggregate bound together with polymer resin. Provide internal reinforcement by means of steel, fiberglass, or a combination of the two. Handholes for installation in roadways: concrete reinforced H20 traffic rated.
- B. Enclosure
 - 1. Enclosure must be manufactured with open or closed bottom and removable cover. Enclosures: green or concrete gray in color.
 - 2. Design enclosures to be installed flush to grade with cover fitting flush to box.
 - 3. Suitable for installation in either direct or buried native soil, embedded in concrete, or embedded in asphalt surfacing. A concrete collar is required for installation in asphalt.
 - 4. Stackable design enclosures for greater installation flexibility.
 - 5. Covers equipped with minimum of 2 stainless steel lockdown mechanisms with ELECTRIC logo recessed in cover.
 - 6. Enclosure covers with recessed access point to allow for removal of cover with a hook. Place access points to allow for greatest amount of leverage and safety possible.
 - 7. Enclosures designed and suitable for installation and use through temperature range of minus 40°C (minus 40°F) to 60°C (140°F).
 - 8. Certified copy of test reports must be signed and stamped by a registered professional Engineer and submitted prior to shipment of products.
- C. Material Requirements

1. Permanent deflection of any surface shall not exceed 10 percent of the maximum allowable static design load deflection.
2. Provide skid resistant covers with maximum coefficient of friction of 0.50 on top surface of cover. Coatings are not allowed.
3. Covers must be able to withstand 70 foot-pound impact administered with 12-pound weight having a C tup in accordance with ASTM D2444, without puncturing or splitting. Perform test with cover resting on a flat, rigid surface.
4. Covers with molded lettering, ELECTRIC or COMM as applicable
5. Fastening devices used to secure box cover capable of withstanding minimum torque of 15 foot-pounds and minimum straight pullout strength of 750 pounds.
6. Material tested according to ASTM D543, Section 7, Procedure 1, for chemical resistance.
7. Comply with the following acceptance standards.
 - a. ASTM D570
 - b. ASTM D635
 - c. ASTM D756
 - d. ASTM D790
 - e. ASTM G154

2.03 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Concrete shall be measured, mixed and placed, and compacted as required in Division 03.
- B. Provide not less than 3 inches of concrete between outside of duct and the earth. Provide not less than 2 inches of concrete between adjacent ducts. Refer to Drawings for spacing requirements. Provide side forms for each duct bank.
- C. Provide continuous duct line concrete pours between manholes or handholes, and between manholes or handholes and structures.

- D. Extend concrete envelopes through the finished flush with inside surfaces where duct lines pass through concrete walls. Provide watertight construction joints.
- E. Reinforce duct banks when laid on backfill covering new pipelines, roads, parking lots or anything subject to vehicular traffic. Beneath these areas, install reinforcing bars as shown on Drawings, extending 10 feet beyond area needing protection.
- F. Lay duct lines in trenches on mats of well graded gravel not less than 6 inches thick.
- G. Provide red electrical duct banks for safety purposes.
- H. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3 inches per 100 feet.
- I. Make raceway entrances to buildings and vaults with hot dipped rigid galvanized steel conduit not less than 10 feet long. Provide hot dipped rigid galvanized steel conduit for conduits not concrete encased for runs below floor slabs in slab-on-grade construction. Conduits concrete encased for runs below floor slabs in slab-on-grade construction: encased under the slab to their respective equipment.
- J. Raceway terminations at manholes: with end bells for polyvinyl chloride (PVC) conduit and insulated throat grounding bushings with lay-in type lugs for metal conduit.

3.02 PROJECT CONDITIONS AND COORDINATION

- A. Coordination with Other Underground Utilities
 - 1. Locate existing underground utilities through use of underground utility piping location services company. Locate existing underground utilities and piping prior to any excavation.
 - 2. Coordinate conduit routing, duct bank and manholes with other new and existing underground utilities. Revise locations and elevations as required to suit field conditions and ensure conduits, duct runs, manholes, and handholes do not interfere with existing and new underground utilities and piping.

3.03 INSTALLATION

- A. Provide excavation and backfilling required for ductbank manhole and handhole installation.
- B. Make ductbank installations and penetrations through foundation walls watertight.

- C. Assemble ductbanks using non-magnetic saddles, spacers, and separators. Position separators to provide 3-inch minimum separation between outer surfaces of ducts.
- D. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate concrete to ensure filling of all spaces between ducts.
- E. Make bends with sweeps of not less than 48-inch radius or 5-degree angle couplings.
- F. Transition from non-metallic to PVC coated rigid steel conduit where duct banks enter structures or turn upward for continuation above grade. Terminate ducts in insulated grounding bushings. Continue ducts inside buildings with steel, metallic conduit.
- G. Terminate ducts in suitable end bells where ducts enter manholes and handholes.
- H. Provide expansion and deflection fittings in accordance with Section 26 05 33.
- I. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials that can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.
- J. Slope duct runs for drainage toward manholes and away from buildings with a slope of approximately 3 inches per 100 feet.
- K. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately 1/4 inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to make certain that no particles of earth, sand or gravel have been left in the duct.
- L. Install bare stranded copper duct bank ground cable in each duct bank envelope. Make ground electrically continuous throughout entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of underground duct system. Provide ground clamp and bonding of each steel conduit extension where necessary to maintain continuity of ground system. Terminate ground conductor at last manhole or handhole for outlying structures.
- M. Install warning ribbon approximately 12 inches below finished grade over underground duct banks. Identifying ribbon: PVC tape, 3 inches wide, yellow color, permanently imprinted with CAUTION BURIED ELECTRIC LINE BELOW in black letters.

- N. Plug and seal empty spare ducts entering buildings and structures. Seal ducts in use entering buildings and structures. Provide watertight seal, acceptable level of quality: equivalent to O-Z/Gedney Type Dux Duct Sealing Compound.
- O. Install duct banks in conformance with NEC and NESC.
- P. Install manholes and handholes where shown on Drawings. Verify final locations in field.
- Q. Complete installation of manholes and handholes so structures are watertight. Provide expansion and deflection fitting for each conduit entry into manholes.
- R. Provide sump opening in manhole floor.
- S. Provide grading rings or brick stacks for manholes when required to adjust manhole cover to proper grade. Stacks: minimum 12 inches in height, constructed on roof slab or cone section on which manhole frame and cover will be placed. Height of stack: as is necessary to bring manhole frame to proper grade.
- T. Cable Racks
 - 1. Provide cable hooks to support each cable on each rack along cable run within manholes.
 - 2. Individually support each cable at each hook on porcelain insulators.
 - 3. Securely tie each cable in place at each insulator block to prevent excessive movement of insulators, cables, or fireproof tape in manhole. Tie cables with non-metallic 3/4 inch strapping tape, acceptable level of quality: equivalent to 3M, or tie down with nylon straps.
- U. Extend conduits 3 inches above concrete slab surface, unless otherwise indicated. Conduits: bushed to protect cables and provide means for grounding.
- V. Ductbank conduit spacers: non-metallic, snap together intermediate and bottom pieces, sized for conduit diameter and code spacing, acceptable level of quality: equivalent to Carlon Span-Loc. Separators: compatible with conduit utilized. Stagger joints of conduits by rows and layers to provide duct line with maximum strength. During construction, protect partially completed duct lines from entrance of debris such as mud, sand, and dirt by means of suitable conduits plugs. As each section of duct line is completed, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the size of the conduit, shall be drawn through each conduit, after which a brush having diameter of the duct, and stiff bristles, shall be drawn through until conduit is clear of all particles of earth, sand and gravel. Immediately install conduit plugs. Provide plastic pull rope with minimum of 3 additional feet at each end, in spare ducts.

3.04 DUCT BANK INSTALLATION

- A. Bends shall have a radius greater than 36 inches or 12 times conduit inside diameter, whichever is greater.
- B. Install duct with minimum slope of 4 inches per 100 feet. Slope duct away from building entrances.
- C. Install no more than equivalent of three 90-degree bends between pull points.
- D. Provide suitable fittings to accommodate expansion and deflection where required.
- E. Use suitable separators and chairs installed not greater than 4 feet on center. Conduit separation: per code, and not less than 3 inches.
- F. Securely anchor duct to prevent movement during concrete placement. Use re-bar holders at spacers and secure with No. 4 re-bar driven into earth at a minimum of 1 foot.
- G. Connect to manhole wall using No. 6 re-bar dowels. Locate dowels at each corner, and 12 inches on center. Insert dowels minimum 3 inches into manhole and 3 feet into duct bank.
- H. Tops of Concrete-Encased Ducts
 - 1. Not less than 24 inches and not less than shown on Drawings, below finished grade.
 - 2. Not less than 30 inches and not less than shown on Drawings, below roads and other paved surfaces.
- I. Tops of Direct Burial Ducts and Conduits
 - 1. Not less than 24 inches and not less than shown on Drawings, below finished grade.
 - 2. Not less than 30 inches and not less than shown on Drawings, below roads and other paved surfaces.

3.05 PRE-CAST MANHOLE INSTALLATION

- A. Install and seal pre-cast sections in accordance with manufacturer's instructions.
- B. Install manholes plumb.
- C. Attach cable racks to inserts after manhole installation is complete.

- D. Provide minimum 12-inch gravel bedding under manholes, and 12 inches of gravel fill around manholes.
- E. Grout and seal conduit and ductwork penetration watertight.

3.06 CABLE PULLING

- A. Inspection, handling, storage, temperature conditioning prior to installation, bending and training limits, pulling limits, and calculation parameters for installation of cables must comply with manufacturer's recommendations. For ease of installation and prevention of cable damage, utilize quadrant blocks located properly along cable run.
- B. Cable lubricant: soapstone, graphite, or talc for rubber or plastic jacketed cables.
- C. Provide lubricants for assisting in pulling or jacketed cables specifically recommended by cable manufacturer.
- D. Cable pulling tensions shall not exceed maximum pulling tensions recommended by cable manufacturer.
- E. Medium voltage cables: individually fire/arc proofed.

3.07 CABLE TERMINATING

- A. Protect terminations of insulated power and lighting cables from accidental contact, deterioration of coverings and moisture by use of terminating devices and materials. Make terminations using materials and method indicated or specified, or as designed by written instruction of cable manufacturer and termination kit manufacturer.

3.08 GROUNDING

- A. Ground ductbanks with bare stranded copper ground wire run within ductbank and bonded and grounded at both ends. Conduit shall not be used as ground conductor.
- B. Ground manholes with ground rods. Provide bare stranded copper ground wire from ground wire loop to bond together and ground manhole cover frame, ladder support bracket, concrete inserts, cable racks, duct bank ground conductors, and shields of any medium voltage cables that are spliced in the manhole.
- C. Install a ground rod for each manhole. Bond exposed metal manhole accessories and concrete reinforcing rods with bare copper wire and connect to ground rod and ductbank ground cable. Provide foam sealant for rod penetration in manhole floor for watertight seal.

- D. Install a bare stranded copper duct bank ground cable in each duct bank envelope. Make ground electrically continuous throughout entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of underground duct system, manholes, and handholes. Provide ground clamp and bonding of each steel conduit extension, where necessary, to maintain continuity of ground system.

3.09 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.10 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.11 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 21 00

LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide the labor, tools, equipment, and materials necessary to provide service entrance Work as defined on Drawings, in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 26 05 00 – Common Work Results for Electrical
 - 2. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American National Standards Institute (ANSI)
 - 2. Institute of Electrical and Electronic Engineers (IEEE)
 - 3. National Electrical Code (NEC)
 - a. Articles 230, 250, and 338
 - 4. National Electrical Manufacturers Association (NEMA)
 - 5. Underwriters Laboratories (UL)
 - a. UL 50 Electrical Cabinets and Boxes
 - b. UL 854 Service Entrance Cables
 - c. UL 869 Electrical Service Equipment

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 - 1. Furnish manufacturer's product data, test reports, and materials certification as required
 - 2. Submit manufacturer's data on service entrance equipment and accessories
- C. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Conductors
 - 1. Copper conductors with XHHW insulation, 600 volt rated
 - 2. Cable identifications shall indicate manufacturer's name, wire size, voltage and insulation type.
 - 3. Provide spade connectors and lug extensions as required to accommodate service conductors at transformer.
- B. Metering

1. Provide utility meter and meter enclosure for building service as required by local utility company.
 2. Coordinate metering requirements with utility company for complete installation in accordance with utility company's specifications.
- C. Manholes, Handholes and Pullboxes
1. Provide in accordance with Section 26 05 43.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Wire services for 120/208 volts, three phase, 4-wire, wye connected as indicated on Drawings.
- B. Provide and install required conduit wire, pullboxes, and accessory items to accomplish Work involved in providing electrical service as shown on Drawings.
- C. Coordinate service Work with Owner and utility company to ensure proper timing of installation and connection of equipment.
- D. Obtain permits and provide materials and labor necessary for interfacing with utility equipment to install electric service.
- E. Furnish and install electrical conduits for low voltage cables, and low voltage wire and accessory items to accomplish Work detailed in Drawings.
- F. Furnish and install utility meter, meter enclosure, and associated metering conduits in accordance with the utility company's requirements.
- G. Conductors: terminated at pole-mounted transformer secondaries by utility company.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

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3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide labor, tools, equipment, and materials necessary to install panelboards in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Documents

1. Section 26 05 00 Common Work Results for Electrical
2. Section 26 05 26 Grounding and Bonding for Electrical Systems
3. Section 26 05 33 Raceways and Boxes for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American National Standards Institute (ANSI)
 - a. NSF/ANSI 49 Biosafety Cabinetry Certification
2. ASTM International (ASTM)
3. National Electrical Code (NEC)
 - a. NFPA 70 – National Electrical Code (NEC)
 - b. NEC Articles 230.VI and VII.
4. National Electrical Manufacturers Association (NEMA)
 - a. NEMA PB 1 – Panelboards
 - b. NEMA PB 1.1 – General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less
 - c. NEMA AB 1- Molded Case Circuit Breakers

5. Underwriters Laboratories (UL)
 - a. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations
 - b. UL 67 Standard for Panelboards
 - c. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
 - d. UL 869 Reference Standard for Service Equipment

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
 1. Product Data
 - a. For each type panelboard specified
 - b. Panel schedules for installation in panelboards. Submit final versions after load balancing.
 2. Shop Drawings
 3. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. Location of the main, branches, and solid neutral clearly shown. Drawing shall illustrate one line diagrams with applicable voltage systems.
- B. Certificates: materials certifications as required.
- C. Source and Field Quality Control Submittals: test reports.
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Acceptable panelboard manufacturers
1. Square D Company
 2. General Electric Co.
 3. Eaton/Cutler Hammer
 4. Siemens
 5. Or equal
- B. Substitutions must be submitted in writing 3 weeks prior to original bid date with supporting documentation demonstrating that alternate manufacturer meets all aspects of the specification.

2.02 POWER DISTRIBUTION PANELBOARDS

- A. Panelboard Interior
1. Power distribution panelboards: rated 600 VAC or 250 VDC maximum. Continuous main current ratings as indicated on associated schedules not to exceed 1200 amperes maximum. Panelboard bus current ratings: determined by heat-rise tests conducted in accordance with UL 67.
 2. Provide UL short circuit current ratings (SCCR) as indicated on associated schedules not to exceed lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards: suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230.VI and VII.
 3. Panelboard interior shall have 3 flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. Molded polyester insulators shall support and provide phase isolation to entire length of bus.
 4. Bussing: fully rated with sequentially phased branch distribution. Provide aluminum panelboard bussing rated 100 through 600 amperes. Bussing rated 800 amperes and above: plated copper. Bus bar plating shall run

entire length of bus bar. Interleaved assembly: contained between 2 U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners.

5. Interior trim: dead-front construction to shield user from energized parts. Main circuit breakers through 800 amperes: vertically mounted. Main circuit breaker and main lug interiors: field convertible for top or bottom incoming feed.
6. Provide solidly bonded equipment ground bar.
7. Equip solid neutral with full capacity bonding strap for service entrance applications. Gutter-mounted neutral is not acceptable.
8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL label, and SCCR displayed on interior or in booklet format. Provide leveling provisions for flush mounted applications.

B. Group Mounted Circuit Breakers through 1200A

1. Circuit breakers: group mounted plug-on with mechanical restraint on common pan or rail assembly.
2. Interior shall have 3 flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. Molded polyester insulators shall support and provide phase isolation to entire length of bus.
3. Circuit breakers equipped with line terminal jaws do not require additional external mounting hardware. Circuit breakers: held in mounted position by self-contained bracket secured to mounting pan by fasteners. Circuit breakers of different frame sizes: capable of being mounted across from each other.
4. Jaw type line-side circuit breaker connections.
5. Equip unused spaces, unless otherwise specified, for future devices, including all appropriate connectors and mounting hardware.

C. Electronic Trip Molded Case Standard Function 80 percent Rated Circuit Breakers

1. Electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay, and

Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and be independent of all other adjustments.

2. Circuit breaker trip system: microprocessor-based true RMS sensing designed with sensing accuracy through the 13th harmonic. Sensor ampere ratings as indicated on associated schedule or Drawings.
3. Local visual trip indication for overload, short circuit and ground fault trip occurrences.
4. Provide long time pickup indication to signal when loading approaches or exceeds adjustable ampere rating of circuit breaker.
5. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

D. Thermal Magnetic Molded Case Circuit Breakers

1. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
2. Circuit protective devices: molded case circuit breakers. Circuit breakers: standard interrupting. Ampere ratings: as shown on Drawings.

E. Enclosures

1. Type 1 Boxes
 - a. Boxes: hot zinc dipped galvanized steel constructed in accordance with UL 50. Unpainted galvanized steel is not acceptable.
 - b. Boxes shall have removable blank end walls and interior mounting studs. Provide interior support bracket for ease of interior installation.
 - c. Maximum enclosure dimensions shall be 44 inches wide and 9.5 inches deep.
2. Type 1 Trim Fronts
 - a. Trim front steel shall meet strength and rigidity requirements per UL 50 and have an NSF/ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.
 - b. Trim front: hinged 1-piece with door available in flush or surface mount as indicated on panel schedules. Trim front door shall have rounded corners and edges free of burrs. Mount clear plastic directory cardholder on inside of door.

- c. Locks: cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies: keyed alike. Provide 1 key with each lock.
3. Type 3R, 5 and 12
 - a. Enclosures: constructed in accordance with UL 50, painted with NSF/ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. Doors: gasketed and equipped with tumbler type vault lock and 2 additional quarter turn fasteners. Mount clear plastic directory cardholder on inside of door. All lock assemblies: keyed alike. Provide 1 key with each lock.
 - c. Maximum enclosure dimensions shall not exceed 44 inches wide and 14.5 inches deep.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

- A. Lighting and appliance panelboards: designed for 3 phase, 4 wire, solid neutral, 60-hertz service rated for 480/277 volt or 120/208V service as indicated. Where main circuit breakers are indicated on Drawings, provide main circuit breaker type interiors. Back-fed branch circuit breakers shall not be utilized for main circuit breakers.
- B. Panelboards: flush or surface mounted, as indicated by panel schedule, code gauge galvanized steel boxes and enameled steel fronts sized for minimum 6-inch minimum side, top and bottom gutters, or greater as required by NEC.
- C. Panel shall have door in door trim with full length piano hinge to allow for access to wireways.
- D. Panel shall have door provided with cylinder lock and latch allowing for common key access to each panel. Each panel shall have fully typed out directory indicating outlets, fixtures, devices and locations served by intended circuit. Panelboards for use as service disconnecting means conforming to UL 869.
- E. Mechanical lugs furnished with panelboards: cast copper or copper alloys of sizes suitable for conductors indicated to be connected. Panelboards shall have full capacity neutral bus, ground bus and bolt-on circuit breakers.
- F. Circuit breakers: molded-case, thermal-magnetic, quick-make, quick-break, bolt-in type. Interrupting rating of circuit breakers: as indicated. Provide with suitable handle locks where indicated. Where interrupting rating is not indicated, panels for 120/208 volts' service shall have breakers with 10,000 ampere RMS minimum interrupting rating at 240 volts, main circuit breakers where indicated shall have 25,000 ampere RMS minimum interrupting rating at 240 volts. Panels for

480/277-volt service shall have breakers with 14,000 ampere RMS minimum interrupting rating at 480 volts.

2.04 SPD DEVICES

- A. IEEE C62.41, integrally mounted, plug-in style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
- B. Minimum single-impulse current rating
 - 1. Line to Neutral: 100,000A
 - 2. Line to Ground: 100,000A
 - 3. Neutral to Ground: 50,000A
- C. Protection modes
 - 1. Line to neutral
 - 2. Line to ground
 - 3. Neutral to ground
- D. EMI/RFI noise attenuation using 50-ohm insertion loss test: 55dB at 100kHz.
- E. Accessories
 - 1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of surge diversion module.
 - 2. Audible alarm activated on failure of surge diversion module.

2.05 ENCLOSURES

- A. Reference Section 26 05 33 for approved enclosure types.

2.06 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 PANELBOARDS

- A. Install panelboards and accessory items in accordance with NEMA PB 1.1, and manufacturers' written installation instructions.

- B. Mounting heights: top of trim shall be 6 feet 2 inches above finished floor, except as indicated.
- C. Circuit directory: typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing. Number branch circuit devices to correspond to circuit directory.
- D. After substantial completion, conduct load balancing measurements and circuit changes. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in panelboard to balance phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- E. Make equipment grounding connections for panelboards as indicated.
- F. Provide ground continuity to main electrical ground bus indicated.
- G. Electrical Tests
 - 1. Include the following items performed in accordance with manufacturer's instructions.
 - a. Ground resistance test on system and equipment ground connections.
 - b. Test main and subfeed overcurrent protective devices.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.04 CLEANING

- A. Upon completion of installation, inspect all panelboards and transformers. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marks of finish to match original finish.

3.05 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide wiring devices in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 26 05 00 – Common Work Results for Electrical
 - 2. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
 - 3. Section 26 05 26 – Grounding and Bonding for Electrical Systems
 - 4. Section 26 05 34 – Raceways, Boxes & Supporting Devices

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. National Electrical Code (NEC)
 - a. NEMA FB 11 – Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations
 - b. NEMA WD 1 – General Color Requirements for Wiring Devices
 - c. NEMA WD 6 – Wiring Devices – Dimensional Specifications
 - 2. National Electrical Manufacturers Association (NEMA)
 - 3. Underwriters Laboratories (UL)
 - a. UL 20 – General-Use Snap Switches

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
- C. Certificates
 - 1. Materials Certifications
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 FLUSH WIRING DEVICES

- A. Wall Switches
 - 1. Wall Switches: specification grade, toggle operated, quiet type alternating current (AC) switches, NEMA heavy duty class, rated at 20 amperes, 120/277 v. Provide matching two pole, 3-way or 4-way switches as indicated. Switches: white in color. Comply with UL 20 and NEMA standards.
 - 2. Where two or more switches are to be installed at same location, mount in one-piece ganged switch boxes, with appropriate gang cover plate.
 - 3. Provide waterproof switches where indicated.
- B. Receptacles
 - 1. Convenience receptacles for interior use: specification grade, industrial heavy duty type, 20-ampere, 125-volt ac, 2-pole, 3-wire, back wiring, metal plaster ears, single, duplex (as indicated) grounded, conforming to NEMA FB 11, NEMA WD 1 and to 5-20R configuration in NEMA WD 6.

Receptacles: white in color. Provide waterproof in-use covers where indicated and required.

2. Ground Fault Interrupter (GFI) Receptacles: specification grade. Provide 20 ampere, feed through type ground fault circuit interrupter, with integral heavy duty NEMA 5 20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2³/₄-inch deep outlet box without adapter, grounding type, Class A, Group 1. Receptacles: be white in color. Provide waterproof in-use covers where indicated and required.
3. Locking receptacles shall conform to NEMA WD 6. Furnish one plug with each locking receptacle.
4. Receptacles shall meet requirements for retention of plugs, overload, temperature, and assembly security in accordance with NEMA WD 1.
5. Special purpose outlets: NEMA heavy duty class, grounding type with matching plug. Coordinate NEMA type with equipment manufacturer.

C. Device Plates

1. Wall plates for flush wall switches and receptacles: appropriate type and size; and match wiring devices for which they are intended. Dimensions for openings in wall plates: in accordance with NEMA WD 1.
2. Plates in process areas for receptacles, telephone: galvanized steel, smooth rolled outer edge sized to fit box.
3. Stainless steel device plates in general areas for receptacles.
4. Device Plates in finished office spaces: impact resistant plastic, white in color.

D. Weatherproof Device Plates

1. Provide weatherproof device plates where indicated and required.
2. Device plates for interior and exterior wet locations: die-cast aluminum gasket, with corrosion resistant screws to match plate cover finish. Provide weatherproof receptacles with vertical in-use covers for complete weatherproofing when plug is inserted.

2.02 CONTROL RELAYS

A. Control Relays

1. Allen Bradley Bulletin 700-H Series, Square D, or equal

2. 120V coil as required or as indicated
3. Number of poles as indicated or required
4. Electrically held, except as noted
5. NEMA-1 enclosure, except as noted

2.03 MOTOR CONTROL RELAYS/CONTACTORS

- A. Motor Control Relays/Contactors
 1. Allen Bradley, Square D, or equal
 2. 120V and 277V coils as required or as indicated
 3. Number of poles as indicated or required
 4. Horsepower rated for connected motor
 5. Electrically held, except as noted
 6. NEMA-1 enclosure, except as noted
 7. 600V rated

2.04 CONTROL STATIONS

- A. Control stations: industrial, heavy duty type, with oil-tight construction and clearly marked legend plates. Enclosures: provided based upon location in accordance with NEMA requirements and as required for area classifications as indicated and NEMA rating to meet environmental conditions of installed location.
- B. Enclosures: common or grouped mounted for devices in same location. Devices shall include front mounted nameplates identifying function.
- C. Provide control stations, subject to compliance with requirements, from:
 1. Allen Bradley Company
 2. Appleton Electric Company
 3. Crouse-Hinds Company
 4. Or equal
- D. Selector Switches

1. Selector Switches: non-illuminated, standard knob operated rated for use at 120VAC. Knob operator insert: white in color. Units: rotary type with round or oval handles and positioning device to securely hold switch in selected position. Selector switches: key type, where shown on Drawings.
 2. Provide nameplate for each selector switch, identifying intended functions: HAND/OFF/AUTO, LOCAL/OFF/REMOTE, JOG/OFF/AUTO, as indicated on Drawings.
 3. Units: 30.5mm selector switches.
- E. Pushbuttons
1. Switches: non-illuminated momentary or maintained type rated for use at 120 VAC. Switches: green in color for START pushbuttons, and red in color for STOP pushbuttons.
 2. Provide compatible nameplate for each pushbutton, identifying intended functions, STOP, START.
 3. Emergency stop operators: mushroom style, 2-position push-pull type, with number of contacts as indicated on Drawings. Stations: provided with push-pull padlocking attachment and legend plate reading: Push to Stop, Pull to Start.
 4. Units: 30.5mm pushbuttons.

2.05 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Tests and Inspections
 1. Manufacturers test reports

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Wiring Devices
 1. Wall Switches and Receptacles
 - a. Wall switches and receptacles: installed so that when device plates are applied, plates will be aligned vertically to within 1/16-inch.
 - b. Bond ground terminal of each flush-mounted receptacle to outlet box with an approved green bonding jumper.

2. Device Plates
 - a. Label device plates and receptacle cover plates for receptacles and light switches, identifying circuit number and panel name.
 - b. Identify device plates on inside of plate by circuit number and panelboard.
3. Control Stations
 - a. Mount equipment with sufficient access and working space provided for ready and safe operation and maintenance.
 - b. Securely fasten equipment to walls or other surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other surface exists.
 - c. Install in conformance with National Electrical Code.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide individually mounted enclosed switches and circuit breakers used for service disconnecting means; feeder and branch-circuit protection; and motor and equipment disconnecting means.
- B. Related Requirements
 - 1. Section 26 05 00 - Common Work Results for Electrical
 - 2. Section 26 05 26 - Grounding and Bonding for Electrical Systems
 - 3. Section 26 05 33 - Raceways and Boxes for Electrical Systems

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI/NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA AB 1 – Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
 - 2. NEMA KS 1 – Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 70 – National Electrical Code
- D. Underwriters Laboratories (UL)
 - 1. UL 98 – Enclosed and Dead-Front Switches

2. UL 486A-486B – Wire Connectors
3. UL 508A – Standard for Industrial Control Panels

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Product Data
 1. Each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings
 1. Dimensioned plans, elevations, sections, and details for each switch and circuit breaker, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - a. Enclosure types and details
 - b. Current and voltage ratings
 - c. Short-circuit current rating
 - d. UL listing for series rating of installed devices
 - e. Features, characteristics, ratings, and factory settings of individual over-current protective devices and auxiliary components.
 - f. Time-current curves, including selectable ranges for each type of circuit breaker.
 2. Wiring Diagrams
 - a. Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Manufacturer Instructions
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
 1. Maintenance Data – provide O&M Manuals for enclosed switches and circuit breakers and for components. In addition to requirements specified in Division 01 include the following:

- a. Routine maintenance requirements for components.
- b. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
- c. Time-current curves, including selectable ranges for each type of circuit breaker.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.
- B. Rate equipment for continuous operation under following conditions, unless otherwise indicated:
 1. Ambient Temperature: minimum minus 22 degrees F, minus 30 degrees C, and maximum 104 degrees F, 40 degrees C.
 2. Altitude: maximum 6600 feet

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from
 1. Square D Co.
 2. Eaton Corp.; Cutler-Hammer Products
 3. General Electric Co.; Electrical Distribution & Control Division
 4. Or equal

2.02 SWITCHES

- A. General
 1. Electrical components, devices, and accessories: listed and labeled as defined in NFPA 70, Article 100, by a testing agency, and marked for intended use.

2. Must comply with UL 98 and UL 508 and NFPA 70.
3. Product Selection for Restricted Space
 - a. Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

2.03 ENCLOSED SWITCHES

- A. Enclosed, Non-fusible Switch: NEMA KS 1; heavy duty type with lockable handle. Rating: voltage and number of poles as required for motor or equipment circuits being disconnected. Switches used for service entrance equipment shall bear a UL label and be rated for service entrance equipment.
- B. Enclosed, Fusible Switch, 800A and Smaller: NEMA KS 1; heavy duty type with clips to accommodate specified fuses; lockable handle with two padlocks; and interlocked with cover in closed position.
- C. Double Throw Safety Switches: unfused double throw with center OFF position; quick make, quick break mechanism; visible blades in the OFF position; and safety handle. Rating, voltage and number of poles as required for circuits being disconnected.

2.04 ENCLOSED CIRCUIT BREAKERS

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
- B. Thermal-Magnetic Circuit Breaker: inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable, instantaneous, magnetic trip setting for circuit-breaker frame sizes 150 Amp through 400 Amp.
- C. Molded-Case Circuit-Breaker Features and Accessories: standard frame sizes, trip ratings, and number of poles. Mechanical style lugs suitable for number, size, trip ratings, and material of conductors.
- D. Application Listing: appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
- E. Electronic Trip Unit Circuit Breakers, frame sizes 400 Amp and larger: RMS sensing; interchangeable harmonic trip unit; LED trip indicators with field-adjustable settings listed.
 1. Long-time pickup levels and adjustments (L)

2. Short-time pickup levels adjustments (S)
 3. Instantaneous trip adjustments (I)
 4. Ground fault pickup level, time delay, I2t response and adjustments (G)
- F. Circuit breaker operating handle: externally operable with operating mechanism being an integral part of box, not cover. Provisions for padlocking circuit breaker in OFF position shall be provided. Enclosures shall have a dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON, and prevent turning circuit breaker ON when enclosure cover is open. Cover interlock mechanism will have an externally operated override but not permanently disable interlock mechanism. Tool used to override cover interlock mechanism is not required to enter enclosure in order to override interlock.

2.05 DOUBLE THROW SAFETY SWITCHES

- A. Unfused, double throw with center OFF position; quick make, quick break mechanism, visible blades in OFF position; and safety handle. Rating, voltage and number of poles as required for circuits being disconnected.

2.06 ENCLOSURES

- A. Enclosures: NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location. Reference Section 26 05 33.
1. Outdoor locations: NEMA Type 3R
 2. Corrosive locations: NEMA Type 4X, stainless steel
 3. Wet or damp locations: NEMA Type 4
 4. Indoor dry locations: NEMA Type 1
 5. Indoor dusty locations: NEMA Type 12

2.07 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: manufacturer's standard grey paint applied to factory-assembled and tested enclosures before shipping.

2.08 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- C. Securely fasten equipment to walls or other structural surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other structural surface exists.
- D. Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install in conformance with National Electrical Code.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified.
- B. Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
- C. Identify source of each service for double throw switches.

3.04 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring between switches and circuit breakers, and control and indication devices.

- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Site/Field Tests and Inspections
 - 1. Demonstrate product capability and compliance with requirements after installing enclosed switches and circuit breakers and after electrical circuitry has been energized.
 - 2. Perform visual and mechanical inspections and electrical tests indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 4. Submit written test reports and include test procedures used; test results that comply with requirements; and results of failed tests and corrective action taken to achieve results that comply with requirements.
- C. Manufacturer's field service report.

3.06 CLEANING

- A. Inspect interior and exterior of enclosures upon completion of installation. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.07 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

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SECTION 31 00 00

EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Excavating, filling, backfilling, stockpiling, bedding, compacting, grading, hauling, disposal of on-Site soils, processing of on-Site soils for reuse, testing of soils, engaging an independent Geotechnical Testing Agency to perform required quality assurance/quality control inspection and testing, protection and other Work necessary for construction of pipelines, structures, subsurface structures, foundations, pavements, earthen embankments and appurtenant Work in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Section 01 57 05 – Temporary Dewatering
2. Section 01 57 13 – Temporary Erosion and Sedimentation Controls
3. Section 31 10 00 – Site Clearing
4. Section 31 05 19.13 – Geotextiles for Earthwork
5. Section 31 25 00 – Erosion and Sedimentation Controls
6. Section 31 50 00 – Excavation Support and Protection

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. AASHTO M85 Standard Specification for Portland Cement
 - b. AASHTO T11 Standard Specification for Materials Finer Than 75-Micrometer (No. 200) Sieve in Mineral Aggregates by Washing

- c. AASHTO T27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
2. ASTM International (ASTM)
 - a. ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
 - b. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
 - c. ASTM D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - d. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
 - e. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
 - f. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - g. ASTM D2922 Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
 - h. ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
 - i. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
 - j. ASTM D3740 Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - k. ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 - l. ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
 - m. ASTM C131 / AASHTO T-96 (Los Angeles Abrasion Test)
3. MassDOT Standard Specifications and Supplements and Construction Details

B. Definitions

1. Unsuitable material: soft clay or silt, organic clays or silts, peats, debris, concrete, pavement, stones or boulders over 6 inches in diameter, wet or frozen material, and material deemed unsuitable by Owner or Engineer

that will not provide suitable foundation or structural support for pipe and associated drainage structures, buildings, or other structures, and is unsuitable for use in backfill.

2. On-Site material: suitable material from on-Site excavation. Supply additional material as required to completely backfill trenches and other areas shown on Drawings.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1. Pre-installation conference: conduct at Project Site at least 30 days prior to start of Work.
 - a. Required attendees: Owner and Engineer, Owner's independent testing firm and geotechnical consultant, Contractor's Superintendent, Support of Excavation (SOE) Installer, Dewatering Installer and Contractor's independent testing firm
 - b. Review methods and procedures related to earthmoving including, but not limited to, the following.
 - 1) Work hours
 - 2) Personnel and equipment needed to maintain proposed construction schedule and avoid delays
 - 3) Work procedures
 - 4) Establishing and maintaining Site access
 - 5) Coordination of Work with utility locator service
 - 6) Stockpiling area and temporary access points
 - 7) Site logistics for hauling and stockpiling
 - 8) Coordination of Work and equipment movement with support of excavation systems installation
 - 9) Construction phasing, anticipated daily and weekly progress and conformance to construction schedule
 - 10) Methodology for field quality control
2. Make provisions for observations and testing of Work by Owner's independent testing and inspection agency and geotechnical consultant.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 - 1. Provide for each on-Site and borrow soil material or aggregate
 - a. Name of each material Supplier, specific type and source of each material
 - b. Bills of Lading documenting materials source, including Supplier name and relationship to source, location where materials were obtained; including street, town, lot and block, country and state. Include present and past usage of source Site
 - c. Supplier's statement that material is not contaminated and is free of extraneous debris or solid waste, and description of steps taken to confirm
 - d. Product weight shipping tickets certified by Supplier
- C. Samples and Mockups: as specified in Article 1.06.
- D. Certificates
 - 1. Certification stating materials are virgin materials from a commercial or non-commercial source.
- E. Design Data/Submittals
 - 1. Materials gradation
- F. Source and Field Quality Control Submittals
 - 1. Field compaction testing
 - 2. Material testing reports for each on-Site and borrow soil material proposed for fill and backfill in accordance with ASTM D2487
 - 3. Laboratory compaction curve in accordance with ASTM D1557
 - 4. Backfill moisture-density relationships

5. Submit daily field reports documenting all earthwork activity and field-testing for each day. At minimum, reports shall include
 - a. Description of day's activities
 - b. Results of in-place density testing including in-place dry density, moisture content, percent compaction, elevation of test and description of soil
 - c. Sketch indicating extent of each day's Work and location of testing
6. Daily records of over-excavated volumes including
 - a. Beginning and end station of over-excavation
 - b. Proposed elevation of subgrade
 - c. Actual elevation of subgrade
 - d. Calculated volume of additional excavation in bank cubic yards (BCY)
- G. Qualification Statements
 1. Contractor's Independent Testing Agency: qualified for testing specified in ASTM E329 and ASTM D3740.
- H. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements.
 1. Geotechnical testing agency to monitor earthwork: qualified per ASTM E329 and ASTM D3740.
- C. Independent Testing
 1. Minimum of 50 pounds of material in an airtight container to testing laboratory.
- D. Samples
 1. Each type of soil or aggregate proposed for use on Project, a minimum of 14 days prior to Work.

2. Submit additional material Samples at least every 500 cubic yards throughout course of Work, if requested by Engineer to evaluate consistency of source or process.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Waste Management and Disposal
 1. Legally dispose of excess or unsuitable material.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General
 1. Obtain approval of Owner and Engineer for changes in material sources.
 2. Off-Site sources of materials and testing of materials to verify compliance with Specifications may be inspected by Owner.
- B. $\frac{3}{4}$ -inch sized Crushed Stone: Durable, clean angular rock fragments obtained by breaking and crushing rock material meeting MassDOT M2.01.4 criteria, free of ice, snow, sand, silt, clay, loam, shale, or other deleterious matter.

Sieve analysis by weight

Sieve Size	Percent Passing by Weight
1-inch	100
3/4-inch	90-100
1/2-inch	10- 50
3/8-inch	0- 20
#4	0-5

- C. Sand: clean inert, hard, durable grains of quartz or other hard durable rock, free from loam or clay, surface coatings and deleterious materials.

Sieve analysis by weight

Sieve Size	Percent Passing by Weight
3/8-inch	100
#4	95-100
#16	50-85
#50	10-30
#100	2-10
#200	0-3

- D. Suitable backfill: well-graded granular material. Retain at least 25 percent by weight on #4 sieve and contain less than 35 percent finer than a #200 sieve by weight, predominantly free from organic matter, man-made materials, ice, snow or other deleterious material.
- E. Gravel borrow for trench backfill: hard, durable stone and coarse sand inert material, free from loam and clay, surface coatings and deleterious material, MassDOT Division III, subsection M1.03.0, Type b. Gradation requirements: AASHTO T11 and T27.

Sieve analysis by weight

Sieve Size	Percent Passing by Weight
1/2 inch	50-85
#4	40-75
#50	8-28
#200	0-10

Type b: maximum stone size = 3-inches in largest dimension

- F. Gravel borrow for roadway subbase: processed gravel for backfill per MassDOT Section M1.03.1, consisting of hard, durable stone and coarse sand inert material, free from loam and clay, surface coatings and deleterious materials. Coarse aggregate percentage of wear: maximum 50 by ASTM C131 / AASHTO T-96 (Los Angeles Abrasion Test).

Sieve analysis by weight

Sieve Size	Percent Passing by Weight
3 inch	100
1-1/2 inch	70-100
3/4 inch	50-85
#4	30-60
#200	0-10

- G. Dense graded crushed stone: crusher-run coarse aggregates of crushed stone and fine aggregates of natural sand or stone screenings, uniformly pre-mixed with a predetermined quantity of water.

Sieve analysis by weight

Sieve Size	Percent Passing by Weight
2 inch	100
1/2 inch	70-100
3/4 inch	50-85
#4	30-55
#50	8-29
#200	3-10

- H. Refill material: 3/4-inch crushed stone for below grade or rock excavation unless otherwise directed.
- I. Common fill: friable material with no objects greater than 6 inches in diameter, no more than 30 percent by weight finer than No. 200 sieve, free from ice, snow, roots, sod, rubbish and other deleterious or organic matter. Excavated material from on-Site sources meeting these Specifications may be used for common fill.
- J. Select backfill: as specified for gravel borrow with stones maximum 3 inches in diameter.
- K. Compacted structural fill: suitable bank run sand and gravel, free of clay, organic material, snow, ice, or other unsuitable materials, well-graded.

Sieve Designation	Percent Passing by Weight
3 inch	100
#4	30-90
#40	10-50
#200	0-8

- L. Drainage stone: 1-1/2-inch crushed stone per MassDOT Section M2.01.1 of durable, clean angular rock fragments obtained by breaking and crushing rock material.

Sieve Size	Percent Passing by Weight
2 inch	100
1-1/2 inch	95 - 100
1 inch	35 - 70
3/4 inch	0 - 25

- M. Controlled density fill (CDF) (flowable fill): excavatable and used to limit settlement, lateral movement, undermining, washout and other hazards created by earthwork operations as shown on Drawings and when excavating around structures, utilities, sidewalks, pavements, and other facilities. Batch CDF at concrete plant.

1. Portland cement: AASHTO M85.
2. Fly ash: AASHTO M295. Class F
3. Sand: MassDOT M4.02.02.
4. Water: MassDOT M4.02.04.
5. Air entraining admixture: MassDOT M4.02.05.
6. Compressive strength: 28 day = 30-80 psi, 90 day = 100 psi.
7. Slump: 10 - 12 inches.

- N. Riprap stone: sound, durable rock that will not disintegrate due to exposure to water or weather, angular in shape such as rough, unhewn quarry stone or fragments obtained by blasting, breaking or crushing natural rock) Do not use rounded boulders or cobbles, or flat, platy stones, shale or slate rock with its largest length dimension 3 times greater than its shortest dimension.

- O. Riprap gradation: stone size corresponding to inch dimension indicated on Drawings. D₅₀ stone size represents 50 percent of stone passing D₅₀ dimension sieve screen. D₂₀ stone size, 20 percent passing: 1/2 D₅₀ dimension. Maximum size limit: D₁₀₀: twice the D₅₀ stone size dimension.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions
 - 1. Check and verify governing dimensions and elevations before starting Work. Survey condition of adjoining properties with Engineer. Take digital video recording of any prior settlement or cracking of structures, pavements and other improvements. Provide list of damages, verified and signed by Contractor and Engineer.
 - 2. Coordinate survey. Establish exact elevations at fixed points to act as benchmarks. Identify benchmarks and record existing elevations. Locate datum level used to establish benchmark elevations so it will not be affected by excavation operations.

3.02 PROTECTION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost. Remove temporary protection before continuing Work.
- D. Prevent surface water and groundwater from entering excavations, ponding on prepared subgrades, and flooding Project Site and surrounding area.
- E. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Excavation will occur below water level. Complete Work in-the-dry to maintain undisturbed condition of bearing soil.
 - 2. Reroute surface water runoff away from excavated area. Do not allow water to accumulate in excavations to ensure bottoms and sides of excavations remain firm and stable throughout construction operations. Do not use excavated trenches as temporary drainage ditches.
 - 3. Install a dewatering system in accordance with Section 01 57 05 to keep subgrades dry and convey groundwater away from excavations. Maintain until dewatering is no longer required.

4. Recharge water from excavations on-Site avoiding injury to public health, public and private property, existing Work, Work to be completed or in progress, roads, walks, and streets, or causing any interference with by the public.
5. Do not place concrete or fill in excavations containing free water.

3.03 GENERAL EXCAVATION

- A. Ensure sequence of excavation operations provides efficient use of excavated materials into embankments and minimum use of borrow.
- B. Dispose of excavated materials including unsatisfactory soil materials, cobbles, boulders, and obstructions and replace with suitable backfill materials. Urban fill may be screened to remove unsatisfactory material, and used requirements of suitable backfill are met.
- C. Remove and legally dispose of pavements, curbing and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation. Legally dispose of surplus materials resulting from excavation not needed for use on Project as determined by Engineer. Obtain necessary permits for legal disposal of surplus material.
- D. Unclassified excavation: excavating to subgrade elevations regardless of surface and subsurface conditions.
- E. Classified excavation: excavating to subgrade elevations. Material excavated: classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Engineer.
 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions.
 - a. 24 inches outside of concrete forms other than at footings
 - b. 12 inches outside of concrete forms at footings
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments

- 1) 6 inches beneath bottom of concrete slabs-on-grade
 - 2) 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide
- F. Remove materials encountered to limits shown on Drawings, as specified or required.
- G. Do not perform excavation below normal grade to remove and replace unsuitable materials until approved by Engineer.
- H. Unauthorized excavation: removal of materials beyond indicated subgrade elevations or dimensions without specific direction.
1. Refilling Unauthorized Excavation
 - a. Trenches: use 3/4-inch crushed stone or compacted structural fill and stabilization fabric as separator material as directed.
 - b. Backfill and compact unauthorized excavations as specified for authorized excavations, of same classification, unless otherwise directed.
 - c. Excavation below normal grade
 - 1) Notify Engineer to observe conditions when excavation has reached required subgrade elevations. Carry excavations deeper and replace excavated material with compacted structural fill or crushed stone if unsuitable materials are encountered at required subgrade elevations as directed.
 2. Excavation above normal grade
 - a. Remove from Site and dispose of legally if unsuitable materials are encountered above normal grade. Do not use unsuitable materials as backfill on any portion of Project unless approved.
 - b. Use approved suitable stockpiled material to replace unsuitable material to backfill trenches to dimensions for pipe and structure bedding and backfill as shown on Drawings. Use gravel borrow to complete trench backfills to elevation shown for pipe and structure backfill if suitable stockpile material is not sufficient to backfill trenches to required dimensions.

- I. Site Clearing
 - 1. Clear site in accordance with Section 31 10 00 – Site Clearing.
- J. Material Storage
 - 1. Stockpile and maintain suitable surplus excavated materials for re-use as specified in Section 31 14 13.16.

3.04 EXCAVATION IN ASPHALT PAVEMENT AREAS

- A. Saw cut or mill to full depth through existing pavement for pipe or structure placement prior to excavation. Minimize disturbance of remaining pavement.
- B. Use shoring and bracing where sides of excavation will not stand without undermining pavement.
- C. Remove and legally dispose of existing pavements during course of Work. Avoid mixing existing pavement material with excavation material intended for backfill.

3.05 EXCAVATION FOR TRENCHES

- A. Excavate to widths shown on Drawings.
- B. Produce an evenly graded flat trench bottom at subgrade elevation required for installation of pipe and bedding material.
- C. Load excavated material directly into trucks unless otherwise approved.
- D. Place backfill material directly into trench or excavation. Do not stockpile material to be used as backfill in traffic areas.

3.06 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within tolerance of plus or minus 1 inch. Extend excavations sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and inspections.
 - 1. Excavate footings, foundations, and structures to final grade by hand just before concrete reinforcement placement. Do not disturb bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive other Work.
 - 2. Do not excavate to final subgrade level until geotextile and compacted structural fill or crushed stone layer can be placed immediately to avoid softening or deterioration of formation. Leave a minimum depth of 3 feet

overlying the final subgrade level in place where geotextile and compacted structural fill or crushed stone layer are not immediately placed.

3. Do not allow trafficking on final subgrade or upper surface of crushed stone layer without prior placement of approved sacrificial haulage layer.

B. Approval of Subgrade

1. Notify Engineer when excavations have reached required subgrade. Remove last 6 inches just prior to inspection.
2. Clear subgrade of soft, spongy or other material unsuitable for founding. Continue excavation and replace with compacted structural fill as directed if independent inspection and testing agency or geotechnical consultant determines presence of unsatisfactory soil.
3. Finished subgrade tolerance: plus or minus 1 inch.
4. Seal subgrade and protect from degradation.
5. Re-compact exposed surfaces prior to placing compacted structural fill or constructing foundations in accordance with Section 3.11 with a minimum 4 passes with double-drum vibratory roller compactor following excavation to foundation bearing levels in natural soils using Bomag BW-60 S or equivalent. Engineer may waive re-compaction if integrity of subgrade soils is compromised. Do not proof-roll wet or saturated subgrades.
6. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water or construction activities affecting final subgrade.
7. Seal formations within 4 hours of inspection with specified geotextile and compacted structural or crushed stone fill.
8. Install geotextiles in accordance with Section 31 05 19.13 – Geotextiles.
9. Protect formations from loosening by trafficking or resulting from high groundwater table.

- C. Provide monitoring of geotechnical instrumentation against predefined target performance values.

3.07 PROCESSING OF ON-SITE URBAN FILL USED FOR BACKFILL

- A. Excavate urban fill where encountered in Work to designated depths and stockpile until processed.
- B. Pass on-Site cohesionless soils excavated from trench through mechanical screen to remove particles larger than 3 inches.
- C. Reuse only processed urban fill containing maximum of 5 percent by dry weight of roots, plants, sod, clay lumps or other cohesive soils.

3.08 ROCK REMOVAL

- A. Notify Engineer immediately of change in classification. Expose bedrock surface to allow Engineer to perform an elevation survey and take cross-sectional measurements if bedrock is encountered above trench bottom grade or above subgrade elevation.
- B. Perform rock excavation by mechanical methods only. Do not blast.
- C. Remove or partially remove boulders exposed on sides or bottom of excavations as directed. Remove boulders to:
 - 1. minimum 2 feet outside structure walls
 - 2. minimum 12 inches outside footings
 - 3. minimum 6 inches below under-slab subgrade
 - 4. minimum lateral trench width line limits indicated
 - 5. minimum 12 inches below underside of pipes.
- D. Refill depressions resulting from removal of boulders and rock with approved compacted bedding.
- E. Refill unauthorized rock excavations, or excavations made beyond or below indicated or directed excavation limits, with compacted bedding.
- F. Remove and dispose of unused rock and boulders off-Site.
- G. Remove and dispose of residual solids to limits shown on Drawings, as specified, or needed to complete Project in accordance with Laws and Regulations.

3.09 SHORING AND BRACING

- A. Provide in accordance with Section 31 50 00.

3.10 BACKFILL AND FILL

A. General

1. Suspend operations when weather conditions are unsatisfactory for placing backfill and avoid disturbing placed material and approved excavations.
2. Remove and replace excavation or material previously placed that have softened or eroded, soft and yielding material, or other unsuitable or damaged areas with compacted backfill as specified.
3. Do not backfill excavations and trenches until new utilities and structures have been inspected and tested satisfactorily for conformance with Drawings and Specifications unless directed. Place soil material in layers to required elevations as shown on Drawings or specified. Fill, backfill, and compact in accordance with this Section to produce minimum subsequent settlement of material. Provide support for surface treatment or structure to be placed on material. Place material in approximately horizontal layers beginning at lowest area, maintaining drainage. Replace frozen or saturated fill in stockpiles with suitable off-Site fill.

B. Provide compacted structural fill or backfill for structure, placed beneath the structures' foundations and slabs-on-grade where unsuitable soil has been over excavated below design subgrades, and against below grade walls.

C. Do not reuse excess excavated on-Site soils as compacted structural fill below foundations.

D. Ground Surface Preparation

1. Remove asphalt and concrete pavements, granular base course, existing sandy and gravelly fills, existing organic silty clay soils, organic peat, vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface to excavation subgrade prior to placement of fills.
2. When existing ground surface has a density less than specified for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

E. Placement

1. Place backfill and fill materials in layers of maximum 6 inches in loose depth for material compacted by heavy compaction equipment or hand-operated tampers. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

2. Place backfill and fill materials evenly, adjacent to structures, to required elevations. Prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.
3. Do not allow heavy machinery within 5 feet of structure during backfilling and compacting.

F. Backfilling Excavations

1. Backfill excavations promptly as Work permits and after completion of the following.
 - a. Inspection and recording locations of underground utilities and structures
 - b. Removal of concrete formwork
 - c. Removal of shoring and bracing, and backfilling of voids with satisfactory materials
 - d. Removal of trash and debris
2. Backfill under existing utility pipes crossed by new utility pipes with CDF. Extend CDF continuously from bedding of new pipe to utility pipe crossed including a 6-inch thick envelope around existing utility pipes.
3. Backfill with CDF when clearance between proposed structure and existing structure is 18 inches or less and sufficient clearance is not provided to obtain suitable compaction.
4. Backfill with CDF for trenches within impervious surfaces with pipes containing less than 3 feet of cover.
5. Provide that 3/4 inch crushed stone backfill stands at its own angle of repose. Do not haunch or form with common fill.

G. Backfilling Trenches

1. Place pipe and structure bedding, and gravel bedding to extent and dimensions shown on Drawings so pipes and structures have complete and uniform bearing.
2. Grade, compact, and shape pipe and structure bedding so full length of pipe barrel has complete and uniform bearing. Dig bell holes and depressions for joints after bedding has been graded and compacted, at proper clearance for jointing pipes.

3. Carefully hand place and compact additional approved bedding to limits shown on Drawings following inspection and approval of pipe installation by Engineer. Perform hand or mechanical tamping on sides of pipe.
4. Place 6 inches of suitable backfill having stones a maximum 3 inches in diameter in trenches above pipe crown; 6 inches above crown of highest pipe around structures and up to underside of pavement. Spread in layers of maximum 6 inches in loose thickness and compact in accordance with Section 3.11 and each layer by minimum 4 passes with approved vibratory compactor. Avoid disturbance of Work and existing structures. Adjust moisture content of backfill for proper compaction.
5. Bed pipe in 3/4-inch crushed stone pipe and structure bedding as shown on Drawings. Remaining trench backfill: as shown on Drawings.
6. Restore surface of trenches in cross-country runs to pre-existing conditions as shown on Drawings, mounding trench 6 inches above existing grade or as directed.

H. Earthen Embankment Fill

1. Strip organic topsoil, trees, shrubs and roots of other vegetation along length and breadth of areas having fill material placed on top. Fill depressions left by grubbing and stripping with same type material and compacted to a density at least equal to surrounding foundation material.
2. Replace unsuitable soil with compacted fill material if independent inspection and testing agency or Engineer have determined its presence.
3. Proof roll subgrades as directed prior to placement of fill. Excavate soft areas and replace with appropriate compacted fill.
4. Do not place embankment over porous, wet, frozen, or spongy subgrade or previous embankment surfaces. Excavate and remove unsuitable material if present prior to placing additional fill.
5. Dewater to maintain groundwater levels a minimum of 1 foot below bottom of excavations or subgrades. Place fill in-the-dry.
6. Bench existing slopes prior to placing horizontal fill layers on existing slopes greater than 6H:1V.
7. Place materials in continuous horizontal layers in loose lift thickness of maximum 8 inches.

8. Compact soil materials in accordance with Section 3.11 of this Specification in accordance with ASTM D1557, with water content of plus or minus 2 percent moisture content. Remove and replace with drier fill if wet fill cannot be compacted as specified.
9. Uniformly water fill that is too dry for proper compaction with sufficient water to allow compaction to required density.
10. Compact impervious and semi pervious materials with more than 15 percent passing the #200 sieve, with a tamping sheep-foot roller or rubber-tired roller. Scarify surface before placement of next lift if compaction results in smooth surface on top of lift.
11. Remove and replace fill that is disturbed after compaction and re-compact to specified degree of compaction.
12. Place and compact soil material on embankment in a direction parallel to embankment top.

3.11 COMPACTION

- A. Use approved methods that produce required degree of compaction throughout entire depth of material placed without damage to new or existing facilities. Adjust moisture content of soil as required. Remove and replace material that is too wet to compact to required density. Compact each layer as Work progresses.
- B. Place compacted structural fill for support of footings and foundations and against below grade walls in loose lift thicknesses not exceeding 10 inches. Compact to minimum 95 percent maximum dry density in accordance with ASTM D1557.
- C. Place backfill in open areas with self-propelled vibratory rollers, and hand-guided equipment in confined areas. Loose lift thickness: maximum 6 inches.
- D. Perform a minimum 4 systematic passes to compact each lift with specified compaction equipment.
- E. Place backfill and fill soil materials evenly on sides of structures to required elevations, and uniformly along full length of each structure.

Compaction Method	Maximum Stone Size	Maximum Loose Lift Thickness		Minimum Number of Passes	
		Below Pavement	Less Critical Areas	Below Pavement	Less Critical Areas
Hand-operated vibratory plate or light roller in confined areas	4 inches	6 inches	8	4	4
Hand-operated vibratory drum rollers weighing at least 1,000 pounds in confined areas	6 inches	10 inches	12 inches	4	4
Light vibratory drum roller minimum weight at drum 5,000 pounds, minimum compaction force 10,000 pounds	8 inches	6 inches	18 inches	4	4
Medium vibratory drum roller min. weight at drum 10,000 pounds, minimum compaction force 20,000 pounds	8 inches	6 inches	24 inches	6	6

F. Degree of Compaction

Fill and Backfill Location	Minimum Density
Top 3 feet under pavement grade	95 percent of maximum
Below slabs and foundations	95 percent of maximum
Below top 3 feet under pavement grade	92 percent of maximum
Pipe Bedding	92 percent of maximum
Beside structure foundation walls	95 percent of maximum
Maximum density	ASTM D698, modified
Field density tests	ASTM D1556 (sand cone) or ASTM D6938 (nuclear methods)

G. Disc harrow or dry fill material that is too wet for compaction to specified moisture content and to required density. Remove and replace with drier fill that cannot be dried within 48 hours of placement.

3.12 GRADING

- A. Uniformly grade areas, including adjacent transition areas. Smooth finished surface within specified tolerances. Compact with uniform levels or slopes between points where elevations are shown, or between points where elevations are shown and existing grades.
- B. Grade areas adjacent to structure lines to drain away from structures and prevent ponding.
- C. Finish surfaces: free from irregular surface changes and as follows.
 - 1. Finish lawn or other unpaved areas to receive topsoil to within a maximum 0.10 feet above or below required subgrade elevations.
 - 2. Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than plus or minus 1 inch above or below required subgrade elevation.

3.13 RIPRAP

- A. Place riprap to full depth of $1.5D_{50}$ in one operation without special handwork, measured perpendicular to face of slope to obtain uniform appearance true to line and grade. Place larger stones at bottom of slope. Place stones in close contact with interlocking of face stones and backing stones. Fill openings between stones with smaller stones. Embed, re-orient or discard loose stones or excessively large stones projecting above surface.

3.14 EROSION CONTROL

- A. Provide erosion control measures in accordance with Section 01 57 13 and Section 31 25 00.

3.15 PROTECTION

- A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- B. Scarify surface, re-shape, and compact to required density prior to further construction where completed compacted areas are disturbed by subsequent construction operations or adverse weather. Immediately repair any subsequent settling and provide maintenance for remainder of Work.
- C. Remove soft or unsuitable material and replace with suitable backfill material prior to paving on sub-grade. Bring low sections, holes, or depressions to required grade with approved material. Shape sub-grade to line, grade, and cross section, and thoroughly compact.

- D. Keep roads free of debris. Use watertight vehicles for hauling wet materials over roads and streets. Promptly clean materials dropped or spread by vehicles or when directed by Engineer.

3.16 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Owner may engage a qualified special inspector to perform the following special inspections in addition to the Contractor's independent testing.
 - 1. Confirm specified fill and backfill are used.
 - 2. Confirm preparation of Site.
 - 3. Observe removal of existing unsuitable foundation materials from footing and slab areas and confirm character of material encountered at bearing levels.
 - 4. Confirm compliance of fill material and maximum lift thickness.
 - 5. Confirm compliance of in-place density of compacted fill with required frequency.
 - 6. Observe preparation of footing bearing surfaces.
 - 7. Confirm suitability of excavated soils for reuse as fill, including reuse of on-Site soils as common fill.
- C. Perform at least 1 test of each soil stratum at foundation subgrades to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on visual comparison of subgrade with tested subgrade when approved.
- D. Engage an independent testing agency to test compaction of soils in place in accordance with ASTM D1556, ASTM D2167, ASTM D2922, and ASTM D2937.
 - 1. Tests
 - a. Paved and structure areas: at subgrade and each compacted fill and backfill layer, at least 1 test for every 2000 square feet or less of paved area or concrete slab, with minimum 3 tests.
 - b. Foundation walls backfill: at each compacted backfill layer, at least 1 test for every 100 feet or less of wall length, with minimum 2 tests.

- c. Trench backfill: at each compacted initial and final backfill layer, at least 1 test for every 150 feet less of trench length, with minimum 2 tests.
2. Scarify and moisten or aerate, or remove and replace soil materials to depth required when testing agency reports subgrades, fills, or backfills have not achieved degree of compaction specified. Re-compact and re-test until specified compaction is obtained.
3. Determine actual in-place densities using field tests as directed.
4. Perform additional Work to obtain proper compaction if in-place densities do not meet specified densities. Retest if directed by Engineer.
5. Tests for Pipe Backfill
 - a. Suitable backfill: compact backfill in maximum loose lifts per table above. Conduct 1 field density test every 50 linear feet for each lift for utility lines.
 - b. Pavement sub-base: minimum 1 field density test of sub base for every 50 linear feet of paved area.

3.17 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.
- B. Complete site finishes as required in the contract documents including planting, seeding, mulching, paving, etc.

END OF SECTION

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SECTION 31 05 19.13

GEOTEXTILES FOR EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide and install permanent geotextile fabrics in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 REFERENCES

- A. Reference Standards
 - 1. ASTM International (ASTM)
 - a. ASTM D4354 Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products(RECPs) for Testing
 - b. ASTM D4355 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
 - c. ASTM D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity
 - d. ASTM D4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles
 - e. ASTM D4595 Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
 - f. ASTM D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 - g. ASTM D4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile
 - h. ASTM D4759 Standard Practice for Determining the Specification Conformance of Geosynthetics

- i. ASTM D4873 Standard Guide for Identification, Storage, and Handling of Geosynthetics Rolls and Samples
- j. ASTM D4884 Standard Test Method for Strength of Sewn or Bonded Seams of Geotextiles
- k. ASTM D5321 Standard Test Method for Determining the Shear Strength of Soil-Geosynthetics and Geosynthetic-Geosynthetic Interfaces by Direct Shear
- l. ASTM D6241 Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data: manufacturer's product specifications.
- C. Samples and Mockups: as specified in Article 1.06.
- D. Manufacturer's Instructions: for storage, handling, and installation of geotextiles.
- E. Source and Field Quality Control Submittals
 1. Submit signed, certified manufacturing quality control certificates for representative rolls of each lot of material delivered to Site.
- F. Qualification statements of manufacturer.
- G. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements for Geotextile Manufacturer and as follows
 1. Well-established firm with more than 2 years' experience in the manufacture of geotextile fabrics.
- C. Samples
 1. Swatch of each geotextile fabric

1.07 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Deliver geotextile materials including manufacturer's name, product identification, style number, roll number, roll weight, roll dimensions and geotextile type in accordance with ASTM D4873.
 - 2. Store off ground out of direct sunlight. Protect from mud, dirt, dust, and moisture. Store on surface that does not cause distortion of roll or wraps, or impedes installation. Do not stack rolls higher than manufacturers recommendation.
 - 3. Load and unload rolls with equipment recommended by manufacturer. Move rolls with a single tooth pipe forklift capable of supporting the roll in cantilever using structural steel insert pipe placed within core tube of roll. Attach lifting slings or chains to pipe only to support the roll. Prevent damage with use of a spreader bar.

1.08 SITE CONDITIONS

- A. Existing conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GEOTEXTILES

- A. Furnish stock materials with minimum average roll values (MARV) that meet or exceed specified criteria. Strength properties specified are for the weaker principle direction.
- B. Acceptable level of quality for Non-Woven Geotextile: equivalent to TenCate Mirafi 1100N.
- C. Acceptable level of quality for Woven Geotextile: equivalent to TenCate Mirafi RS580i.

D. Requirements

1. Non-woven Geotextile

PROPERTY	TEST METHOD	STANDARD	SPECIFIED VALUE
Material	--	--	Polypropylene
AOS	ASTM D4751	maximum	0.15 mm
Grab Tensile Strength	ASTM D4632	MARV	250 lbs/in
CBR Puncture Strength	ASTM D6241	MARV	700 lbs.
Trapezoidal Tear Strength	ASTM D4533	MARV	100 lbs.
Permittivity	ASTM D4491	MARV	0.8 sec ⁻¹

2. Woven Geotextile

PROPERTY	TEST METHOD	STANDARD	SPECIFIED VALUE
Material	--	--	Polypropylene
Tensile Modulus @ 2% strain	ASTM D4595	MARV	90,000 lbs/ft
Tensile Modulus @ 5% strain	ASTM D4595	MARV	87,600 lbs/ft
Flow Rate	ASTM D4491	MARV	75 gal/min/ft ²
Permittivity	ASTM D4491	MARV	1.0 sec ⁻¹
Interaction Coefficient	ASTM D5321	MARV	0.9

INDEX PROPERTY	TEST METHOD	STANDARD	SPECIFIED VALUE
Material	--	--	Polypropylene
Apparent Opening Size	ASTM D4751	MARV	#40 U.S. Sieve
Factory Seam Strength	ASTM D4884	MARV	3,000 lbs/ft
UV Resistance	ASTM D4355	MARV	90%

3. Stabilization Fabric

PROPERTY	TEST METHOD	STANDARD	SPECIFIED VALUE
Material	--	--	Polypropylene
AOS	ASTM D4751	maximum	0.15 mm
Grab Tensile Strength	ASTM D4632	MARV	315 lbs/in
CBR Puncture Strength	ASTM D6241	MARV	900 lbs.
Trapezoidal Tear Strength	ASTM D4533	MARV	113 lbs.
Permittivity	ASTM D4491	MARV	0.05 sec ⁻¹

INDEX PROPERTY	TEST METHOD	STANDARD	SPECIFIED VALUE
Material	--	--	Polypropylene
Apparent Opening Size	ASTM D4751	MARV	40 mm

2.02 SEWING THREAD FOR SEAMING

- A. Type: polyester with chemical and UV light resistance properties, equal to or greater than the fabric itself. Color: contrasting to color of fabric.

2.03 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Provide for sampling and testing of geotextile specified by manufacturer a minimum of once every 100,000 square feet of production to demonstrate material conforms to requirements.
- C. Obtain quality control certificate including roll number identification, sampling procedures used, and results of quality control testing including descriptions of test methods used.
- D. Manufacturer to perform additional testing if geotextile sample fails to meet Specifications, including the following.
 - 1. Sample and test each roll manufactured in same lot or same time as failing roll.
 - 2. Continue sampling and testing of rolls until a pattern of acceptable tests results is established.
 - 3. Additional testing of individual rolls may be performed by manufacturer to more closely identify the non-complying rolls and to qualify individual rolls.

PART 3 – EXECUTION

3.01 INDEPENDENT TESTING

- A. Prior to installation, Samples of geotextiles will be taken by Engineer and sent to an independent laboratory for testing in accordance with this Specification and ASTM D4354, Procedure A.
 - 1. Sample size: 3 feet by full roll width, after first 3 feet of roll have been discarded. Immediately rewrap sampled rolls and return to storage.

2. One sample will be collected for every 100,000 square feet of material. At a minimum, each lot of material defined as a group of consecutively numbered rolls manufactured from same production line, will have one sample collected and tested for conformance.
 3. Materials delivered to Site without testing certification will be rejected.
- B. Perform the following conformance tests, at a minimum, on each geotextile sample.
1. Grab strength: ASTM D4632.
 2. Trapezoidal tear strength: ASTM D4533.
 3. CBR puncture: ASTM D6241.
- C. Re-sampling: in accordance with ASTM D4759 if testing fails.

3.02 INSTALLATION

- A. Install as shown on Drawings in accordance with manufacturer's instructions.
- B. Provide smooth graded surface, free of large stones, tree roots and limbs, or other debris prior to placement of geotextiles. Notify Engineer when areas are ready for geotextile placement.
- C. Deployment and Covering
1. Unroll fabric in area to be used, in down-slope direction.
 2. Minimize wrinkles and folds in geotextile. Straighten to smooth out creases or irregularities in sections. Place geotextile in close contact with adjacent materials. Overlap adjacent fabric sides and ends a minimum of 12 inches. Do not allow gaps and tears. Place overlaps so uphill panel is shingled over downhill panel. Replace damaged geotextile.
 3. Begin placement at base of slope and proceed up-slope for overlying stone. Work in direction of fabric overlap for overlying stone placement on flat areas. Ensure fabric overlap remains intact. Install in a relaxed condition free of tension or stress. Do not stretch geotextile to fit.
- D. Protection
1. Secure geotextile from wind damage.
 2. Do not allow construction equipment to travel directly over any in-place geotextiles. Maintain 1-foot minimum cover above fabrics for low ground pressure tracked vehicles; contact pressure 8-psi or less, and 3-foot

minimum cover for wheeled vehicles or heavy tracked vehicles; contact pressure above 8-psi.

3. Do not allow more than 14 days to elapse between the day when reinforcing geotextile is unrolled and when a subsequent layer is placed to cover it. Do not allow more than 30 days to elapse between the day when cushioning geotextile is unrolled and when a subsequent layer is placed to cover it. Replace material exposed to sunlight or weather for longer duration.

E. Patching

1. Patch rips and tears with a minimum 3-foot overlap in each direction from perimeter of damaged area. Heat bond repair patch to underlying geotextile.
2. For damaged areas greater than 1/2 the width of fabric roll, cut out entire roll-width of damaged area and place a new section laced over area with minimum 3-foot overlap at each end. Place up-slope end of patch under existing up-slope fabric and place down-slope end of patch over down-slope fabric.

3.03 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 31 09 00

GEOTECHNICAL INSTRUMENTATION AND MONITORING OF EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide design, installation, monitoring, and maintenance of geotechnical instrumentation and data collection, storage, and reporting in accordance with this Section and applicable reference standards listed in Article 1.03.
2. Provide instrumentation engineer to perform the following.
 - a. Supervise preparation and review Contractor submittals related to geotechnical instrument installations and data collection system.
 - b. Prepare detailed step-by-step procedures and data flow chart specified for instruments and data collection system.
 - c. Provide on-Site supervision of installation for each instrument.
 - d. Conduct pre-installation and post-installation acceptance tests for each instrument.
 - e. Review data to ensure validity.
 - f. Manage repair and replacement of damaged instruments.
 - g. Demonstrate startup and operation of data collection system.
 - h. Supervise data collection, reduction, plotting and reporting.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM International (ASTM)
 - a. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - b. ASTM C150 – Standard Specification for Portland Cement
 - c. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

2. Mainland Zone (Fipszone 2001)
 - a. North American Datum 1983 (NAD 83)
3. National Institute of Standards and Technology (NIST)
4. North American Vertical Datum 1988 (NAVD 88)

B. Definitions

1. Instrumentation engineer: registered engineer to perform geotechnical instrumentation installation and monitoring.
2. Baseline readings: initial readings obtained at each instrument location within 24 hours of instrument installation and minimum of 1 week prior to start of construction.
3. Threshold level: geotechnical instrument reading that triggers a set of review and mitigation actions to ensure limit level is not exceeded.
4. Limit level: maximum permissible geotechnical instrument reading corresponding to a potential temporary work stoppage to prevent damage to a structure, excavation, work area, personnel, or the public.
5. Geotechnical Instrumentation: devices measuring surface, utility, and structure movements. Includes measurement devices and appurtenant equipment, sensors, cabling, readout devices, and data collection systems; including ancillary facilities required for their operation, such as housings, and covers.
6. Structure Monitoring Point (SMP): A system for monitoring horizontal and vertical movements (settlement or heave) at an existing above ground structure or a temporary structure using optical surveying methods.
7. Support of Excavation Monitoring Point (SOEMP): A system for monitoring horizontal and vertical movements (settlement or heave) of the top of the temporary support of excavation systems.
8. Electronic distance meter (EDM): surveying instrument for measuring distance electronically between two points through electromagnetic waves.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.
- B. Conduct a pre-installation conference at Project Site at least 30 days prior to installation of geotechnical instrumentation, attended by Engineer, Contractor, instrumentation engineer and excavation support and protection systems' installer.

1. Verify availability of instrumentation engineer's personnel and equipment needed to maintain progress and avoid delays.
2. Review condition of Site for installation of geotechnical instrumentation, including coordination with temporary erosion-control measures and temporary controls and protections.
3. Review geotechnical report.
4. Review geotechnical instrumentation monitoring requirements.
5. Review proposed Site clearing and excavation schedule.
6. Coordinate geotechnical instrumentation installation and monitoring work with work for installation of excavation support and protection systems, excavation and backfilling.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Qualification Statements and resumes for individuals specified in Paragraph 1.06.B to verify details of relevant experience.
- C. Product Data
 1. Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions.
 2. Manufacturers' product data sheets describing instruments to be installed, including requests for consideration of substitutes.
- D. Design Data/Submittals
 1. Geotechnical Instrumentation and Monitoring Plan
 - a. Include monitoring locations as shown on Geotechnical Instrumentation Monitoring Drawings attached to this Specification.
 - b. Step-by-step procedure for installation, with a sample installation record sheet for each instrument.
 - c. Provide method for surveying and monitoring top of SOE systems.
 - d. Submit plan showing proposed physical locations of instrumentation indicating layout, nearby existing subsurface utilities and details.
 - e. Provide step-by-step procedures for conducting measurements, including baseline measurements and measurements during

construction to specified accuracies, including survey instruments, measurement devices, data reduction procedures, summary, and data plotting procedures. Provide sample summary plots.

- f. Provide schedule indicating proposed instrument installation sequence and proposed monitoring and reporting frequencies for specified instruments.
 - g. Provide database with example data showing how data from monitoring points will be displayed and reported.
- E. Source and Field Quality Control Submittals
1. Provide instrumentation installation records, readings or weekly summaries containing the following.
 - a. Project name
 - b. Contract name and number
 - c. Instrument type, ID, and serial number
 - d. Dates of installation, reading or summary
 - e. Time of installation of reading
 - f. As-built location coordinates
 - g. Responsible personnel
 - h. Relevant comments or remarks at time of readings
 - i. Weather at time of installation
 2. Submit installation record sheet, factory calibration, and manufacturer's equipment certification within 3 workdays of installation. Include the following.
 - a. Existing ground level at time of installation
 - b. Planned location in plan and elevation, including elevation referenced to Project datum
 - c. Equipment used for instrumentation installation
 - d. Spaces for necessary measurements or readings required during installation, including acceptance tests
 - e. As-built location in plan and elevation, including elevation referenced to the North American Vertical Datum 1988 (NAVD 88), and horizontal position referenced Massachusetts State Plane Coordinate System – North American Datum 1983 (NAD 83). Units are feet.
 - f. As-built orientation

- g. Weather conditions during installation
 - h. Space for notes including problems encountered, delays, unusual features of installation, and any events that may have a bearing on instrument behavior
 - i. Any color coding used
 - j. Baseline readings obtained
 - k. Certification indicating test equipment is calibrated in accordance with NIST
 3. Submit installation report of installed instruments minimum of 3 days prior to start of Work within 100 feet of monitoring point. Include general description of Site and Work, types of installed instruments, copy of installation record sheets, and as-built location plan with surveyed coordinates including plan and vertical coordinates of installed instrument locations, including benchmark locations and baseline readings.
 4. Report measured readings during construction in database format within 24 hours of obtaining measurements. Immediately notify Engineer if threshold or limit values have been exceeded. Provide a formal weekly summary monitoring report within 2 days of end of each week being reported, including the following.
 - a. Description of monitoring works which have been in operation during the preceding week
 - b. Information on reading anomalies or corrections, and factors which may influence measured data
 - c. Observations or remarks
 - d. Plan showing installed locations of instruments, taken from installation report
 - e. Provide data tabulations or plots of instrument readings listed below. Provide instrumentation engineer with software for generating required plots and tabulations. Show horizontal axis (X-axis) in date and time. Plots and tabulations presented each week: an update of previous plots and tabulations, giving a complete record starting from time of installation.
 - 1) SMPs: horizontal and vertical movement vs. time (tabulation and plot)
- F. SOEMPs: horizontal and vertical movement vs. time (tabulation and plot) Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
 1. Within 1 week of final completion, obtain final readings at each instrument installed. Within 1 week of obtaining final measurements, provide final

monitoring report summarizing all monitoring performed throughout construction and end-of-construction measurements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements and as follows.
 - 1. Geotechnical monitoring contractor
 - a. Minimum 10 years' continuous experience within the past 10 years in Work specified.
 - 2. Instrumentation engineer
 - a. Minimum Bachelor of Science Degree in Civil Engineering and previous successful experience (three (3) years) with operation and maintenance of surveying and instrumentation system specified.
 - b. Instrumentation engineer with minimum 5 years of direct field experience with instrumentation specified, responsible for furnishing, installing, monitoring, maintaining, and reporting of geotechnical instrumentation and measurements.
 - 3. Licensed professional land surveyor registered in the state where Project is located to supervise surveying activities and survey party chief with experience in measurements of types and accuracies specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Storage and Protection
 - 1. Repair or replace monitoring instrument within 48 hours if damaged or inoperative due to inadequate protection. Provide Engineer with minimum 24 hours' notice. Engineer will be sole judge of whether repair or replacement is required. Engineer may impose a Work stoppage in vicinity of damaged or inoperative instrument until operational.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide new, or like new, condition instrumentation materials and equipment.

2.02 STRUCTURE MONITORING POINTS

- A. Acceptable level of quality for stainless steel bolt or adhesive-backed target: equivalent to Leica TPS1200 Series, model numbers #635 317, #635 318, or #635 319.

2.03 SUPPORT OF EXCAVATION MONITORING POINT

- A. Provide a permanent marker (painted or torch-cut notch) and/or an adhesive-backed target, Leica Models #763-532 (20mm square), #763-533 (40 mm square), or #763-534 (60mm square), or acceptable equivalent.

2.04 SURVEY INSTRUMENTS

- A. Provide instruments for vertical movement monitoring with minimum accuracy of plus or minus 1.5 mm, and minimum setting accuracy of plus or minus 1.0 arc seconds. Leveling staffs: non-telescopic design. Plumb leveling rod with bullseye bubble level.
- B. Provide instruments for horizontal movement monitoring with minimum accuracy of plus or minus 3.0 arc seconds, and minimum display reading less than or equal to accuracy. Measure distances greater than 30 feet with EDM. Perform electronic pointing to minimize possible misalignment error of EDM axis and telescope. Accomplish centering using high precision optical plummets or mechanical centering devices.

2.05 IDENTIFICATION TAGS

- A. Provide each SMP with a stainless steel indented name tag designating its ID.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install instruments in accordance with approved geotechnical instrumentation and monitoring plan. Installation: monitored by instrumentation engineer and personnel. Consult with Engineer on suitability of planned locations. Install SMPs at locations shown on Geotechnical Instrumentation Monitoring Drawings. Install SOEMPs at top of temporary support of excavation system at distance no greater than 25 feet along its entire length. Locations of SOEMPs shall be determined in the field based on the as-built layout of the temporary support of excavation system and are not included on the Geotechnical Instrumentation Monitoring Drawings for clarity.
- B. Instrumentation engineer or personnel shall survey as-built location after installation of each instrument to define vertical and horizontal positions of exposed parts.
- C. Notify Engineer at least 24 hours prior to installing drilled or excavated instruments.
- D. Flag and protect locations. Repair or replace damaged instrumentation as determined by Engineer. It may be necessary to stop work until a damaged instrument has been repaired or replaced.

3.02 PRE-INSTALLATION EQUIPMENT VERIFICATION

- A. Provide that instrumentation engineers' personnel perform pre-installation equipment verification upon receipt at Site to ensure functionality prior to installation.
 - 1. Factory calibration curve and tabulated data to verify completeness.
 - 2. Manufacturer's final quality assurance inspection check list.
 - 3. Verify model, dimensions, materials and quantities.
 - 4. Verify components fit together in correct configuration.
 - 5. Check components for damage.
 - 6. Complete a pre-installation acceptance test record form.

7. Repair instruments that fail test, to be able to pass a subsequent test, or replace with identical instrument.

3.03 INSTALLATION OF MOVEMENT DETECTION INSTRUMENTS

A. Structure Monitoring Points (SMP)

1. Install SMPs on each side of building or structure locations shown on Geotechnical Instrumentation Monitoring Drawings.
2. Determine as-built survey coordinates for horizontal position to an accuracy of plus or minus 0.01 foot, and elevation to accuracy of plus or minus 0.01 foot, after installation completion.
3. Establish baseline reading for SMP consisting of 3 readings, with minimum 24 hours between readings, after installation completion and prior to installation of support of excavation system and performance of excavation activities.

B. Support of Excavation Monitoring Points (SOEMP)

1. Complete installation of SOEMPs prior to start of excavation for construction of subsurface structures. Provide monitoring of horizontal movement during construction.
2. Space SOE monitoring points at distance no greater than 25 feet along its entire length.
3. Establish baseline reading for SOEMPs consisting of 3 readings after installation completion and prior to performance of excavation activities.

C. Monitoring Geotechnical Instrumentation

1. Provide SMPs for monitoring horizontal and vertical movements at existing above ground structure or temporary structure at location shown on Geotechnical Instrumentation Monitoring Drawings.
2. Perform monitoring of geotechnical instrumentation continuously throughout duration of Work, at intervals and frequency specified. Obtain baseline readings for each type of monitoring prior to start of Work.

3.04 MONITORING OF INSTRUMENT AND POINTS

- A. Establish deep benchmarks and control points bonded into stable ground and sleeved for movement monitoring at 1,000 foot intervals outside zones expected to be influenced by construction being monitored. Confirm elevations and coordinates of control points on a weekly basis, or any time movement is suspected.

Measurement rounds shall incorporate 2 benchmarks or control points for level runs or traverses. Use similar benchmarks for each monitoring point.

- B. Perform initial survey of SMPs a minimum of 48 hours after completion of each installation.
- C. Perform initial survey of SOEMPs a minimum of 4 hours prior to start of excavation.
- D. Perform a minimum of 3 independent rounds of survey readings for both SMPs and SOEMPs to establish a single initial elevation or plan location and standard deviation for measurement. Address methods to achieve required accuracy and repeat measurements if error at 1 standard deviation exceeds 0.01-foot vertical or 0.015-foot horizontal for initialization rounds. Monitoring points: monitored from same benchmarks during re-surveys. Locate monitoring points within a horizontal accuracy of plus or minus 0.015 feet, and elevation accuracy of plus or minus 0.01 feet at 1 standard deviation.
- E. Where instruments are installed during construction, perform 3 sets of readings in quick succession and compare results.
- F. Obtain daily instrument measurements during underground work activities, including trench excavation, excavation support installation and protection systems, excavation in accordance with the following guidelines.
 - 1. Obtain daily measurements at all SMPs and SOEMPs when within 100 feet of construction activities associated with trenching, dewatering and utility line installation.
 - 2. At discretion of Owner, Engineer, or utility owner, data collection may be carried out more frequently than specified based on evaluation of collected data.
 - 3. Reduce traverses via least squares adjustments.
 - 4. Check benchmark elevations being used for monitoring purposes weekly compared to other benchmarks set along alignment.
 - 5. Whenever sets of data are measured, compare to previous sets of data. If anomalous readings are present which differ from expected value or trend, take further readings immediately and inform Engineer. If anomalous values persist, inform Engineer and conduct an investigation to determine reasons for anomalous readings.
 - 6. Inform Engineer within 1 day after monitoring if there are anomalies or sudden significant changes in results.

7. Provide instrument data to Engineer within 1 working day of reading.

3.05 DATABASE FOR MONITORING DATA

- A. Prepare online database with monitoring data. Provide logins for involved parties to review. Provide collected data within 24 hours. Compare data to threshold and limiting values.

3.06 THRESHOLD AND LIMIT VALUES

- A. Threshold and limit levels.

Instrument	Threshold level	Limit Level
Structure Monitoring Points	0.25 in.	0.5 in.
SOE Monitoring Points	0.75 in.	1.5 in.

- B. If threshold level is reached on any monitoring point, immediately notify Engineer and utility owner, if any, and increase frequency of movement monitoring as required. Review and modify Work operations and procedures as needed to minimize additional movements and prevent reaching limit level. Modify the Work as approved by Engineer prior to implementation.
- C. If limit level is reached, immediately halt Work activities, except those needed to prevent instability, and notify Engineer or utility owner, if any. Review and modify Work operations and procedures, and structure and utility support requirements as needed. Submit mitigation and repair action plan for approval by Engineer, and owner of the impacted utility, if any, prior to implementation.

3.07 DISPOSITION OF INSTRUMENTS

- A. Remove salvageable instruments only when directed by Engineer. Salvaged instruments become property of Contractor.
- B. Restore disturbed or damaged surfaces to existing condition prior to installation.

3.08 IDENTIFICATION TAGS

- A. Mount tags that cannot be attached directly on associated structure as close as practicable to allow for clear reading. Mount using nails or bolts where possible. Only use epoxy as a last resort.

3.09 DEWATERING

- A. Provide in accordance with Section 01 57 05.

3.10 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.11 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.12 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

3.13 ATTACHMENTS

- A. Geotechnical Instrumentation Monitoring Drawings

END OF SECTION

8 7 6 5 4 3 2 1

NOTES:

1. BASE PLAN ADAPTED FROM AUTOCAD FILE "228340-C-401 - C-404 FM" DATED JANUARY 11, 2017 RECEIVED FROM WOODWARD & CURRAN
2. GROUND SURFACE ELEVATIONS WERE ESTIMATED FROM TOPOGRAPHIC INFORMATION OBTAINED FROM THE BASE PLAN PREPARED BY WSP.
3. ELEVATIONS ARE IN FEET AND REFER TO THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM NAD83.
4. SMP LOCATIONS SHOWN ON PLAN ARE APPROXIMATE. ACTUAL LOCATIONS FOR SMPs ON EACH STRUCTURE ARE TO BE DETERMINED IN FIELD BASED ON SITE CONDITIONS.
5. SMPs SHALL BE INSTALLED ON FACE OF STRUCTURE WHICH IS CLOSEST TO THE PROPOSED WORK.
6. SUPPORT OF EXCAVATION MONITORING POINTS ARE NOT SHOWN ON PLANS. THESE POINTS ARE TO BE INSTALLED IN ACCORDANCE WITH PROJECT SPECIFICATIONS.

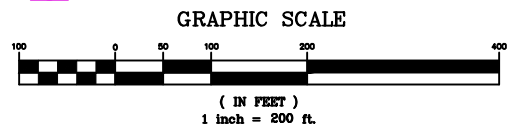


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G
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B
A



LEGEND

SMP-1
 STRUCTURE MONITORING POINT



NOT FOR CONSTRUCTION

INSTRUMENTATION LOCATION PLAN

CANAL STREET FLOOD
 MITIGATION PROJECT
 PHASE II - CONTRACT A

DATE:	01/13/17
DRAWN	RL
DESIGN	DD
CHECKED	MC

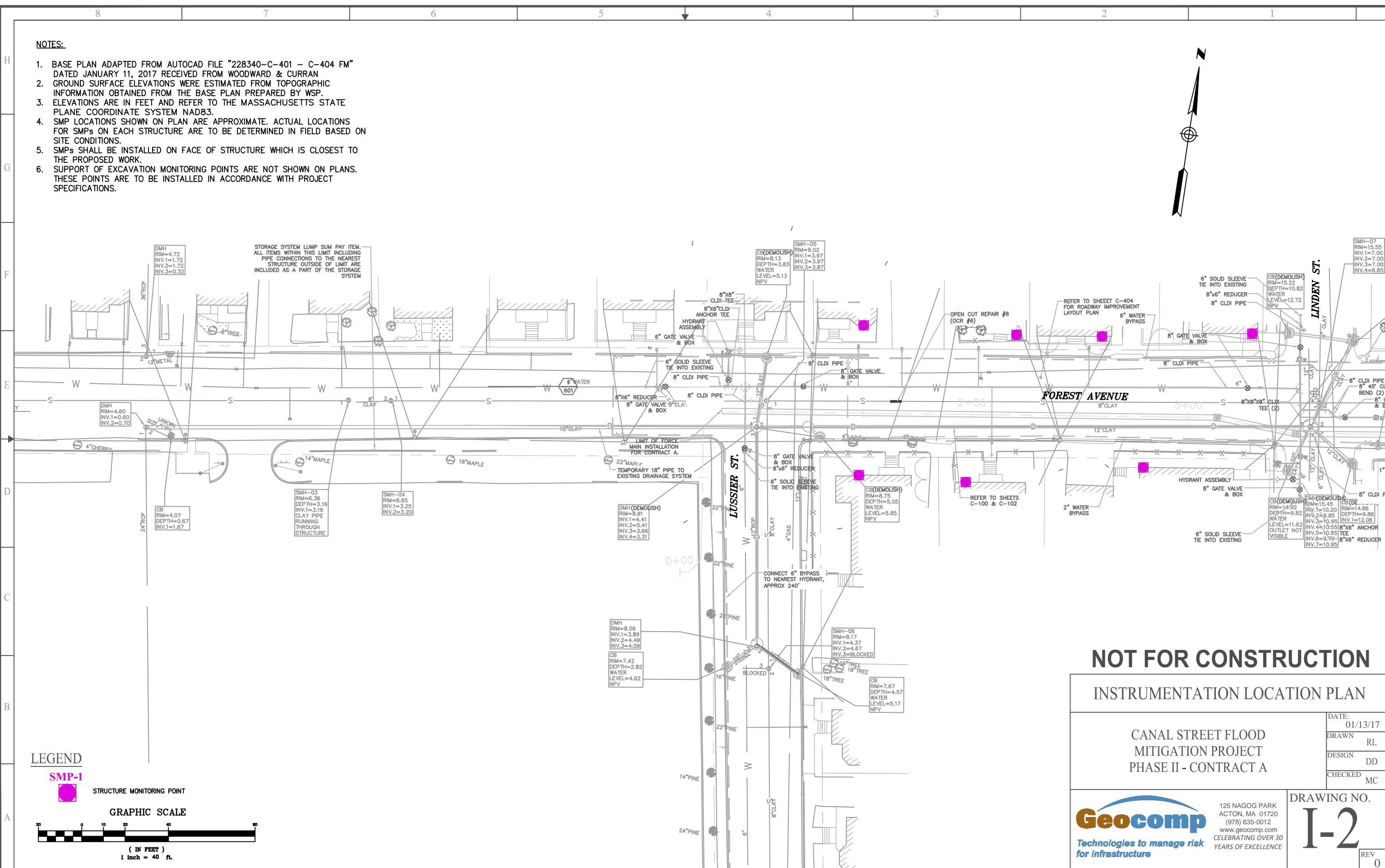
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4. SMP LOCATIONS SHOWN ON PLAN ARE APPROXIMATE. ACTUAL LOCATIONS FOR SMPs ON EACH STRUCTURE ARE TO BE DETERMINED IN FIELD BASED ON SITE CONDITIONS.
5. SMPs SHALL BE INSTALLED ON FACE OF STRUCTURE WHICH IS CLOSEST TO THE PROPOSED WORK.
6. SUPPORT OF EXCAVATION MONITORING POINTS ARE NOT SHOWN ON PLANS. THESE POINTS ARE TO BE INSTALLED IN ACCORDANCE WITH PROJECT SPECIFICATIONS.



LEGEND

SMP-1
 STRUCTURE MONITORING POINT

GRAPHIC SCALE

 (IN FEET)
 1 inch = 40 ft.

NOT FOR CONSTRUCTION

INSTRUMENTATION LOCATION PLAN

CANAL STREET FLOOD MITIGATION PROJECT PHASE II - CONTRACT A		DATE: 01/13/17
DRAWN	RL	
DESIGN	DD	
CHECKED	MC	

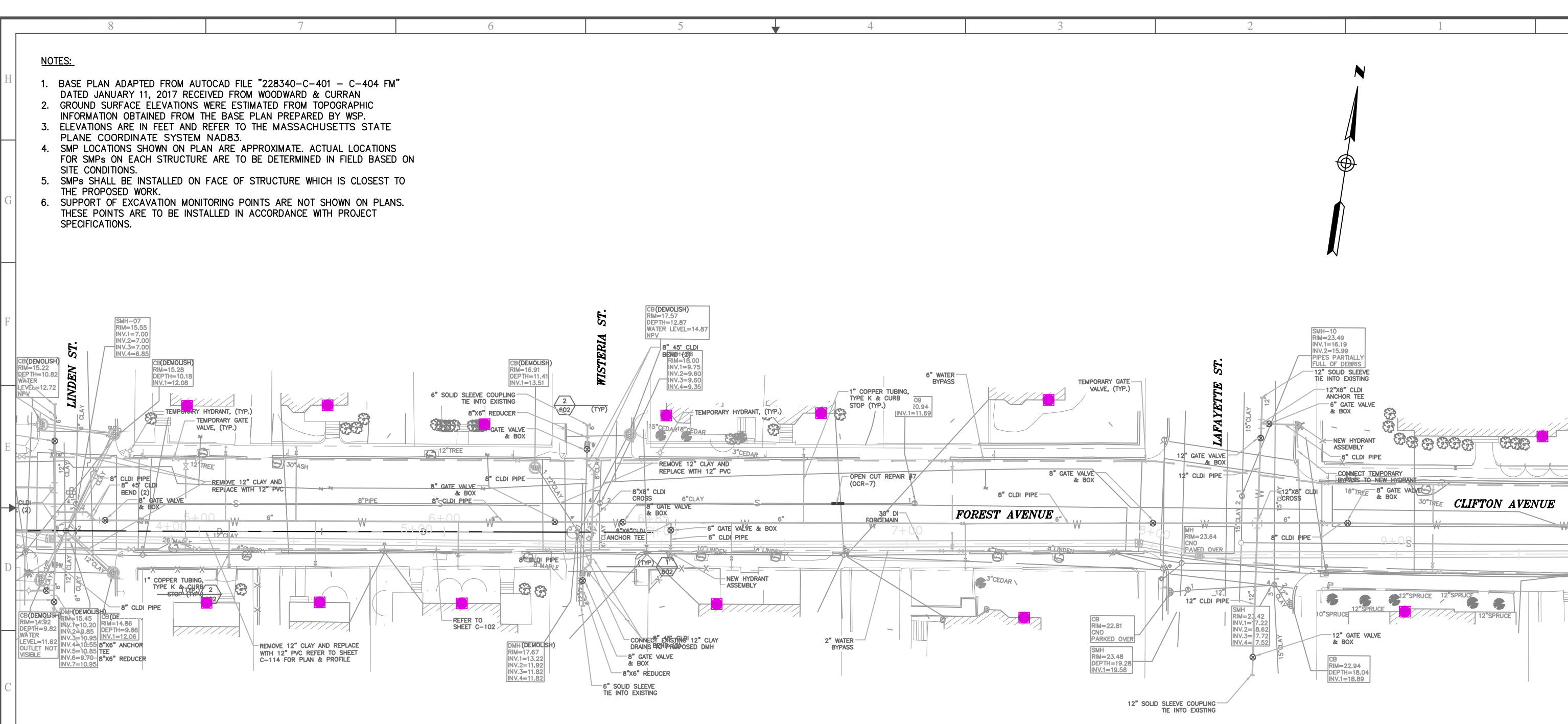
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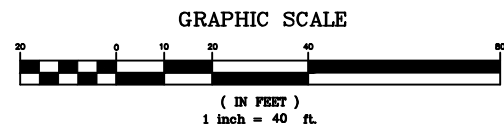
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1. BASE PLAN ADAPTED FROM AUTOCAD FILE "228340-C-401 - C-404 FM" DATED JANUARY 11, 2017 RECEIVED FROM WOODWARD & CURRAN
2. GROUND SURFACE ELEVATIONS WERE ESTIMATED FROM TOPOGRAPHIC INFORMATION OBTAINED FROM THE BASE PLAN PREPARED BY WSP.
3. ELEVATIONS ARE IN FEET AND REFER TO THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM NAD83.
4. SMP LOCATIONS SHOWN ON PLAN ARE APPROXIMATE. ACTUAL LOCATIONS FOR SMPs ON EACH STRUCTURE ARE TO BE DETERMINED IN FIELD BASED ON SITE CONDITIONS.
5. SMPs SHALL BE INSTALLED ON FACE OF STRUCTURE WHICH IS CLOSEST TO THE PROPOSED WORK.
6. SUPPORT OF EXCAVATION MONITORING POINTS ARE NOT SHOWN ON PLANS. THESE POINTS ARE TO BE INSTALLED IN ACCORDANCE WITH PROJECT SPECIFICATIONS.



LEGEND

SMP-1
 STRUCTURE MONITORING POINT



NOT FOR CONSTRUCTION

INSTRUMENTATION LOCATION PLAN

CANAL STREET FLOOD
 MITIGATION PROJECT
 PHASE II - CONTRACT A

DATE:	01/13/17
DRAWN:	RL
DESIGN:	DD
CHECKED:	MC

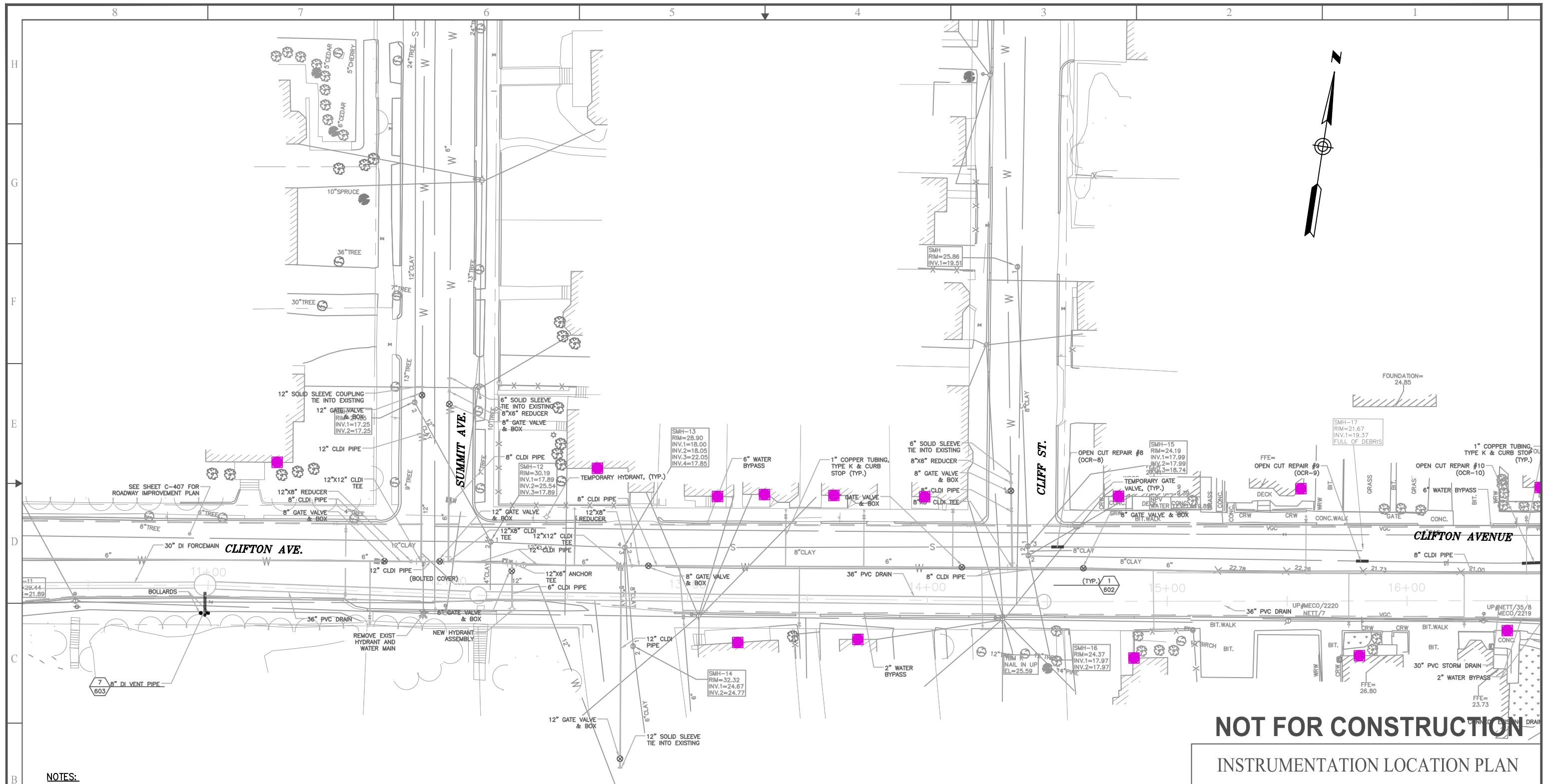


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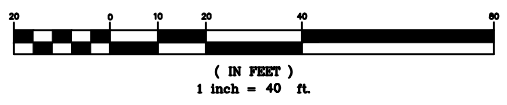


- NOTES:**
1. BASE PLAN ADAPTED FROM AUTOCAD FILE "228340-C-401 - C-404 FM" DATED JANUARY 11, 2017 RECEIVED FROM WOODWARD & CURRAN
 2. GROUND SURFACE ELEVATIONS WERE ESTIMATED FROM TOPOGRAPHIC INFORMATION OBTAINED FROM THE BASE PLAN PREPARED BY WSP.
 3. ELEVATIONS ARE IN FEET AND REFER TO THE MASSACHUSETTS STATE PLANE COORDINATE SYSTEM NAD83.
 4. SMP LOCATIONS SHOWN ON PLAN ARE APPROXIMATE. ACTUAL LOCATIONS FOR SMPs ON EACH STRUCTURE ARE TO BE DETERMINED IN FIELD BASED ON SITE CONDITIONS.
 5. SMPs SHALL BE INSTALLED ON FACE OF STRUCTURE WHICH IS CLOSEST TO THE PROPOSED WORK.
 6. SUPPORT OF EXCAVATION MONITORING POINTS ARE NOT SHOWN ON PLANS. THESE POINTS ARE TO BE INSTALLED IN ACCORDANCE WITH PROJECT SPECIFICATIONS.

LEGEND



GRAPHIC SCALE



NOT FOR CONSTRUCTION

INSTRUMENTATION LOCATION PLAN

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 MITIGATION PROJECT
 PHASE II - CONTRACT A

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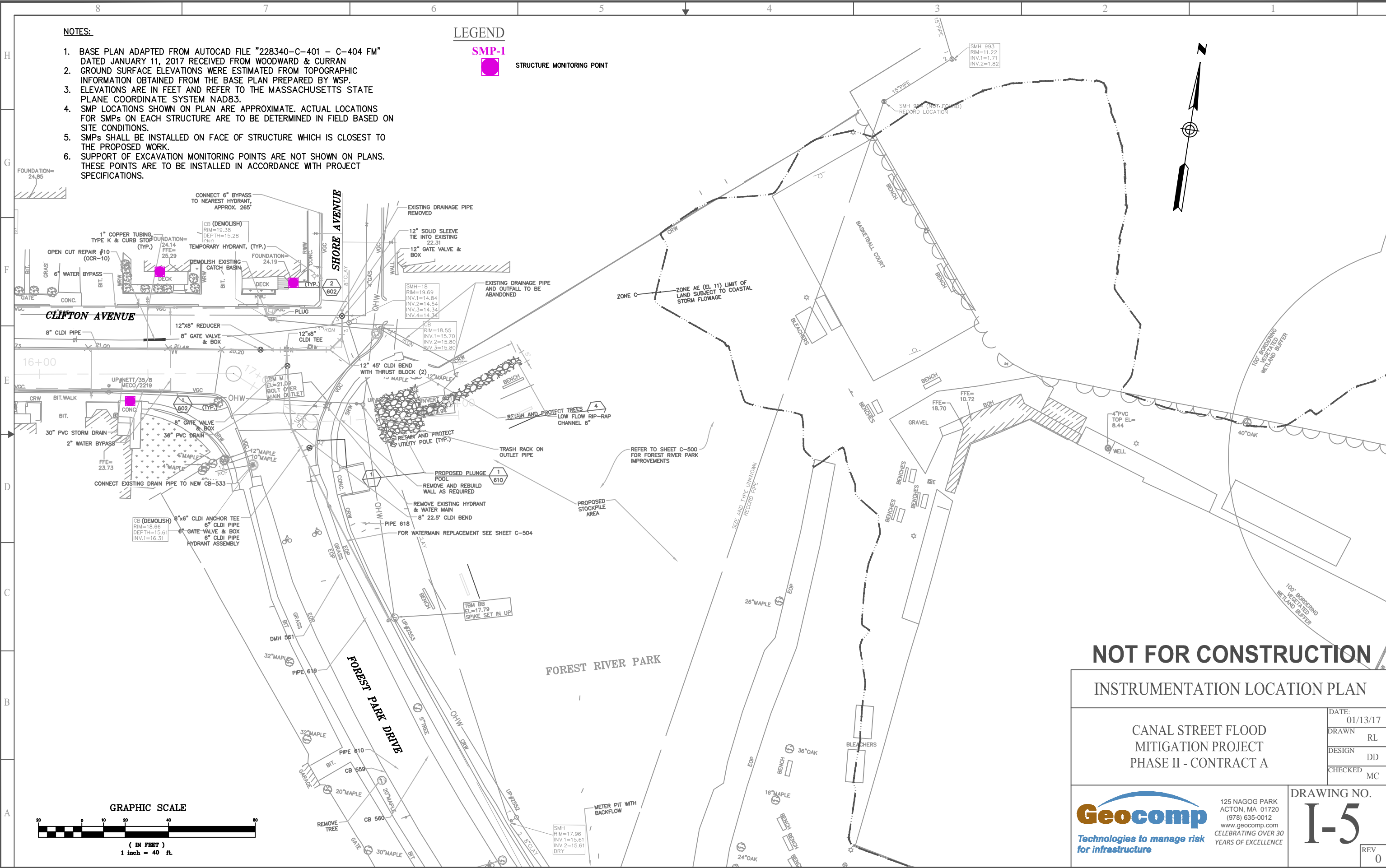
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NOTES:

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2. GROUND SURFACE ELEVATIONS WERE ESTIMATED FROM TOPOGRAPHIC INFORMATION OBTAINED FROM THE BASE PLAN PREPARED BY WSP.
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LEGEND

SMP-1
 **STRUCTURE MONITORING POINT**

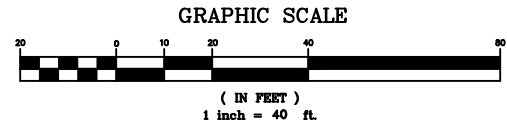


NOT FOR CONSTRUCTION

INSTRUMENTATION LOCATION PLAN

CANAL STREET FLOOD
 MITIGATION PROJECT
 PHASE II - CONTRACT A

DATE:	01/13/17
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SECTION 31 10 00

SITE CLEARING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide Site clearing and grubbing in accordance with this Section.
- B. Related Requirements
 - 1. Section 32 90 00 – Planting

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Definitions
 - 1. Clearing: cutting and disposing of trees, downed timber, stubs, brush, bushes, snags, rubbish, debris, and other objectionable matter and materials, and removal and storage of fences, signs, walks, guard rails, curbs and items to be restored.
 - 2. Grubbing: removal and disposal of stumps, roots, duff, foundations and other objectionable matter, and materials to a minimum of 6 inches below original ground surface.
 - 3. Topsoil: friable loam surface soil found in a depth of not less than 4 inches from original ground surface. Satisfactory topsoil: reasonably free of subsoil, clay lumps, stones, and objects over 2 inches in diameter, and free of weeds, roots, and other objectionable material.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Store trees, plants and shrubs in protected areas and provide water to keep them in thriving condition for replanting.
- C. Store slate and flagstone walk sections, granite and stone curbs, fences, signs, guard rails and other items removed for reinstallation at approved locations.
- D. Do not obstruct roads, driveways, sidewalks, gutters and drainage ditches, swales and channels with stored materials.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions
 1. Verify Site conditions. Trees, plantings, vegetation, sidewalks, curbs and other living and nonliving item locations shown on Drawings were determined by actual surveys and conditions may have changed.
 2. Verify limiting boundaries, such as permanent and temporary easements, property lines, rights-of-way and grading limits, have been located and marked.
 3. Verify pipeline routings and other items of Work have been located and marked.

3.02 PREPARATION

- A. Mark trees, plantings and other items to be removed, trimmed, cut, or removed and preserved. Inspect items with Engineer prior to start of Work. Do not remove or trim unmarked items unless approved by Engineer.
- B. Protect existing trees and vegetation indicated to remain in place against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering by

stockpiling construction or excavated materials within drip line, excess foot or vehicular traffic, or vehicle parking within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

- C. Protect existing objects. Avoid interference with use of, and passage to and from adjacent buildings, facilities, driveways, walks, drainage systems and road.
- D. Remove highway signs, guard rails and other control, safety, and warning devices just prior to installation of Work.
- E. Notify affected property owners at least 4 days in advance of fence removal. Do not remove fencing more than 48 hours in advance unless written permission is received from property owner.
- F. Leave items affecting traffic, safety, containment of humans and animals, and essential to protection of property or operation of a business, in place until Work is ready to be installed. Restore items immediately after installation.

3.03 IMPLEMENTATION

- A. General
 - 1. Use of explosives for clearing and grubbing operations is not allowed.
 - 2. Limit clearing and grubbing to preserve plantings and natural vegetation. Perform Work so present growth will blend with limits of construction and attain natural appearance.
 - 3. Confine clearing and grubbing operations within grading limits as shown on Drawings, and within Owner easements and property lines.
 - 4. Provide measures to avoid erosion.
 - 5. Do not disturb property markers unless absolutely necessary. If necessary to disturb or remove a property marker, employ a professional land surveyor licensed in the state where the Project is located to establish property marker location; mark area, and replace property marker immediately, in compliance with Division 01 General Requirements.
- B. Stripping Topsoil
 - 1. Strip topsoil within limits indicated on Drawings, or as required to prevent mixing with underlying subsoil or objectionable material.
 - 2. Prevent damage to main root system of trees indicated to be left standing.

3. Stockpile topsoil in areas shown on Drawings, or where directed, and provide for drainage of surface water. Protect stockpiles to prevent windblown dust and erosion.
 4. Stockpile surplus material on-Site. Surplus loam and topsoil not required for completion of Work will remain on Owner's property. Maintain and protect until Work is complete.
- C. Trees and Plantings
1. Remove only items marked for removal in grassed, planted and open areas.
 2. Trees
 - a. Notify property owners one (1) month in advance of tree trimming or removal to allow property owner to cut and remove trees and retain debris, unless otherwise directed.
 - b. Remove or trim trees in wooded areas only as required. Minimize damage to trees left standing. Immediately remove and legally dispose of debris.
 - c. Take possession of timber and wood removed.
 - d. Trim trees evenly to achieve neat appearance with least possible damage to trees.
 - e. Apply wet burlap to prevent drying where roots are cut or damaged.
- D. Pavements, Walks, Curbs and Guard Rails
1. Remove existing pavements, walks, and curbs to limits shown on Drawings, or if not shown, to minimum extent possible to complete the work.
 2. Saw-cut pavements to be removed, including highways, driveways and walks. Remove when Work is ready to be installed.
 3. Remove slate and flag stone walks, granite and stone curbs, and guard rails to minimum extent possible. Terminate removals at joint or guard rail post. Store and protect for reuse.
- E. Walls, Fences, and Other Obstructions
1. Remove walls, fences, signs, sheds and other obstructions and store for replacement after verification with Owner and Engineer.
 2. Protect existing structures during Work.
- F. Remove and legally dispose of materials not specified to be stored or reused. Do not burn debris unless approved and required permits obtained.

- G. Comply with Section 32 90 00 for replanting and restoring surfaces.
- H. Replace and restore items and materials removed to original conditions.
- I. Replace items damaged during removal, storage or re-installation.

3.04 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 31 14 13.16

SOIL STOCKPILING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide labor, equipment and materials associated with soil stockpiling in accordance with this Section.
- B. Related Requirements
 - 1. Section 01 57 13 – Temporary Erosion and Sediment Control
 - 2. Section 31 00 00 – Earthwork
 - 3. Section 31 10 00 – Site Clearing
 - 4. Section 31 50 00 – Excavation Support and Protection

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.05 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.07 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Provide minimum 6 mil fire retardant polyethylene sheeting.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 SOIL STOCKPILING

- A.
- B. Locate soil stockpiles in area approved by Engineer. Transport soils from generation area to stockpile areas along designated transport roadways approved by Engineer, preventing soil spillage, mud and soil tracking, and release of other materials to transport roadway throughout construction.
- C. Arrange location, clearing, removal and salvage of overburden soils, and other Site preparation for temporary stockpiles. Location: approved by Engineer.
- D. Cover soil stockpiles with minimum 6 mil polyethylene sheeting at all times, except during active loading or removal, if directed by Engineer. Keep stockpiles in neat and well drained condition.
- E. Identify stockpiles, including classification of soil or other excavated spoils. Maintain an updated inventory of all stockpiled material.

3.02 SOIL REUSE

- A. Utilize on-Site soils for backfill before use of imported soil, as directed by Engineer.
- B. Transportation and legal disposal of surplus native soils is allowed.

3.03 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

3.05 PROTECTION

- A. Protect structures, utilities, facilities and pavements from damage caused by settlement, lateral movement, washout, and other hazards created by stockpiling of soil.

END OF SECTION

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SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide and install permanent devices to control erosion, siltation, and sedimentation in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. MassDEP – Massachusetts Erosion & Sedimentation Control Guidelines for Urban and Suburban Areas
2. MassDOT Standard Specifications and Supplements and Construction Details
 - a. Section 767 – Mulching, Seed for Erosion Control
 - b. M6.04.2 Straw Mulch
3. Order of Conditions

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data: for permanent erosion control matting.
- C. Manufacturer's Instructions
- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements

PART 2 – PRODUCTS

2.01 MATERIALS

A. Permanent Erosion Control Blanket

1. Provide as shown on Drawings or as directed by Engineer in compliance with the Order of Conditions to prevent slope erosion. If sequence of operations is such that only portions of slopes have been completed, preserve those portions by seeding and installation of erosion control blanket when directed, prior to completion of remaining portions of slope.
2. Provide soft pine wood wedges and stakes of biodegradable materials as recommended by manufacturer.
3. Coir log: coconut fiber mats woven into a matrix in compliance with the following.

PROPERTY	Test Method	Parameter
Weight	ASTM D 3776	17.8 oz/SY (600 g/m ²)
Wide width tensile strength Wet Machine direction Cross direction	ASTM D 4595	910 lbs/ft (13.3 kN/m) 870 lbs/foot (12.7 kN/m)
Wide width tensile strength Dry Machine direction Cross direction	ASTM D 4595	1130 lbs/foot (16.5 kN/m) 1040 lbs/foot (15.2 kN/m)
Elongation at failure Wet Machine direction Cross direction	ASTM D 4595	32 percent 26 percent
Open area	Calculated	58 percent
Thickness	ASTM D 177	0.35 inch (9 mm)
Recommended shear stress		4 lbs./sq. ft. (192 N/sq.m.)
Recommended flow		10 fps (3 m/s)
Recommend slope		2:1

- B. Straw mulch: MassDOT M6.04.2, long fibered straw, 100 percent certified weed free, free from foreign matter detrimental to plant life, and in dry condition.
- C. Tackifier: biodegradable and non-toxic bonding adhesive agent during hydraulic seeding or straw mulching to minimize wind and water effects.

PART 3 – EXECUTION

3.01 GENERAL

- A. Prevent erosion of soil and to prevent silting of drainage ditches, storm sewers, rivers, streams, and lakes.
- B. Limit duration of exposure of soils on embankments, excavations, and graded areas.
- C. Install erosion control measures in any ditch, swale or channel before runoff flows to waterways.

3.02 PREPARATION

- A. Protection
 - 1. Provide pollution prevention measures, erosion and sedimentation control, before, during and after soils are exposed. Implement and maintain erosion and sedimentation control measures as necessary until Site is permanently stabilized.
 - 2. Stabilize areas shown on Drawings with permanent erosion control practices immediately, and within 14 days after construction activity on a particular portion of Site has permanently ceased, except where construction activities will resume on the particular portion of Site within 21 days, and where snow cover precludes initiation of stabilization measures.
- B. Conform to grades and cross sections for slopes and ditches shown on Drawings.
- C. Finish to a smooth and even condition. Rake out and remove debris, roots, stones, and lumps.
- D. Loosen soil surface to permit bedding of matting.
- E. Apply seed prior to placement.
- F. Dewater trenches and swales to install materials in the dry.

3.03 INSTALLATION

- A. Install erosion control blanket and straw mulch in accordance with manufacturer's instructions, the following, and as shown on Drawings or directed by Engineer. Submit manufacturer's instructions to Engineer prior to installation. Place immediately following seeding.
- B. Install erosion control blanket onto slopes that have been graded, seeded, completed to required line and where grades are steeper than or equal to 3:1 as shown on Drawings and directed by Engineer.
- C. Place strips lengthwise in direction of flow of water.
- D. Overlap ends at least 6 inches in a shingle fashion.
- E. Turn down up-slope end of each strip of matting and bury to a depth of not less than 6 inches with soil firmly tamped against it.
- F. Engineer may require that any edge exposed to more than normal flow of water be buried in a similar manner.
- G. Build check slots at right angles to direction of flow of water. Space so one check slot or one end occurs within each 50 feet of slope length. Construct by placing a tight fold of matting at least 6 inches vertically into ground, and tamp same as up-slope ends.
- H. When directed by Engineer, spread additional seed over matting, particularly at locations disturbed by building the slots. Press matting onto ground with a light lawn roller or similar means.
- I. Use pine wedges to fasten coir to ground. Metal staples are not allowed. Pound vertically flush to surrounding surface, not protruding above finished grade. Place pine wedges in same locations as recommended by manufacturer for staples.
- J. On grades 4:1 or steeper, place pine wedges in same 3 rows, but spaced 2 feet apart.
- K. On overlapping or butting edges, double pine wedges, with spacing halved. Secure ends of matting and required check slots spaced every foot.
- L. Apply weed free straw mulch in combination with erosion control blanket on side slopes steeper than 3:1.
- M. Place mulch according to MassDOT Section 767. Do not use short fibered material or material so wet or decayed that it cannot be properly spread. Apply tackifier as needed.
- N. Maintain areas mulched or matted, until Project acceptance.

- O. Maintain swales by removing silt that reaches a depth of over one foot, until Project acceptance.

3.04 REPAIR/RESTORATION

- A. Repair matting immediately if any pine anchors become loosened or raised, or if any matting becomes loose, torn, or undermined.

3.05 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Site/Field Tests and Inspections
 - 1. Inspections of disturbed soil areas, material storage areas exposed to precipitation and erosion control measures will be conducted by both Contractor and Engineer a minimum of once every 14 days and also within 24 hours after any storm event greater than 0.5 inches of rainfall. Immediately correct deficiencies identified.
 - 2. Inspect erosion control blanket immediately after each rainfall and at least daily during prolonged rainfall or snowmelt for damage. Make appropriate repairs or replacement until acceptance by Engineer.

3.06 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 – SUMMARY

- A. Section Includes
 - 1. Provide excavation support and protection in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 31 00 00 - Earthwork
 - 2. Section 31 09 00 - Geotechnical Instrumentation and Monitoring of Earthwork

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Institute of Steel Construction (AISC)
 - a. Steel Construction Manual
 - 2. ASTM International (ASTM)
 - a. ASTM A36 Standard Specification for Carbon Structural Steel
 - b. ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
 - c. ASTM A328 Standard Specification for Steel Sheet Piling
 - d. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 - e. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - f. ASTM A690 Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments
 - g. ASTM A992 Standard Specification for Structural Steel Shapes

3. American Welding Society (AWS)
 - a. D1.1 - Structural Welding Code, Steel

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.
- B. Pre-installation Conference
 1. Review geotechnical report, existing utilities and subsurface conditions.
 2. Review coordination for interruption, shutoff, capping, and continuation of utility services.
 3. Review instrumentation and monitoring program, and dewatering program. Confirm coordination with instrumentation and monitoring, and dewatering activities.
 4. Review proposed excavations and equipment, monitoring of excavation support and protection system and abandonment or removal of excavation support and protection system.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
 1. Do not begin excavation requiring support until submittals are approved.
- B. Product Data
 1. Include construction details, material descriptions, performance properties, dimensions of individual components and profiles, and calculations for excavation support and protection system for each type of product.
- C. Shop Drawings
 1. Plans, elevations, sections, and details for excavation support and protection system, by professional engineer licensed in the state where Project is located
 2. Arrangement, locations, and details of soldier piles, sheet piling, lagging, tiebacks, bracing, and other components of excavation support and protection system
 3. Written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation

- D. Calculations and analysis data for excavation support and protection system by professional engineer licensed in the state where Project is located
- E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
 - 1. Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions on record documents.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements for Installer and professional engineer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.
- B. Review geotechnical report and determine need to perform additional test borings and conduct other exploratory operations necessary for excavation support and protection.
- C. Verify dimensions and elevations before starting Work. Survey condition of adjoining properties with Engineer. Take photographs, recording any prior settlement or cracking of structures, pavements, and other improvements. Prepare list of existing damages, verified by dated photographs, signed by Contractor, Engineer and others conducting the investigation.
- D. Survey adjacent structures and improvements, establishing exact elevations at fixed points to act as benchmarks. Identify benchmarks and record existing elevations. Locate datum level where it will not be affected by excavation operations.
- E. During excavation, re-survey benchmarks weekly. Maintain log of surveyed elevations for comparison with original elevations. Notify Engineer if changes in elevations occur, or if cracks, sags or other damage is evident.

- F. Interruption of Existing Utilities
 - 1. Do not interrupt any utility serving facilities without Owner's written permission. Provide temporary utility if required.
 - 2. Provide minimum 5 days' advance notice of proposed interruption of utility.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Provide shoring and bracing materials, in serviceable condition and adequate for intended purpose.
- B. Steel sheet piling and shapes: continuous interlocking type; section modulus, type of section specified, in accordance with ASTM A328, ASTM A572, and ASTM A690, with continuous interlocks.
- C. Provide movable box where shoring system is required, and where sheet piling is not specified.
- D. Bracing members: wood timbers or steel members in accordance with ASTM A36.
- E. Provide bolts in accordance with ASTM A307.
- F. Provide structural steel in accordance with ASTM A36, ASTM A690, and ASTM A992.
- G. Wood lagging: lumber, mixed hardwood, pressure-treated.
- H. Provide reinforcing bars in accordance with ASTM A 615, Grade 60, deformed.

2.02 DESIGN CRITERIA

- A. Provide services by professional engineer licensed in the state where Project is located, including preparation of Shop Drawings.
- B. Design excavation support system in accordance with earth pressures and other criteria indicated, for construction of permanent structures without excessive movement or settlement of adjacent buildings, roadways, structures, or utilities, as shown on Drawings and as specified. Include analysis by professional engineer licensed in the state where Project is located.
- C. Earth support design: coordinated dewatering design incorporating lowest anticipated excavation depths and full differential water head during dewatering.
- D. Consult official records of both surface and subsurface existing utilities and connections to verify existing conditions and limitations as they apply to this Work

and its relation to other construction work. Proceed with caution in areas of utility facilities. Excavate by hand, or other methods acceptable to utility owner. Protect existing utilities to remain within and adjacent to Work area in accordance with requirements of authorities having jurisdiction.

2.03 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Anchor and brace system to resist earth and hydrostatic pressures, including surcharges from surface loads. Support excavation to prevent undermining or disturbance to foundations of existing structures and utilities, or of ongoing or previously completed Work. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or adjacent occupied or used facilities without approval. Provide alternate routes around closed or obstructed traffic ways if required.
- C. Maintain shoring and bracing while excavation is open.
- D. Check base stability.
- E. Prevent surface water from entering excavations.
- F. Monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes to prevent damage to permanent structures in accordance with Section 31 09 00.

3.02 STEEL SHEET PILING

- A. Install 1-piece sheet piling lengths and interlock vertical edges to form a continuous barrier before starting excavation.
- B. Place piling using templates and guide frame unless otherwise specified by sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line, and not more than 1:120 out of vertical alignment.
- C. Cut off sheet piling to be left in place at least 5 feet below finish grade. Indicate location of sheet piling cut off and left in place on record documents.

- D. Remove steel sheet piling following completion of Work where shown on Drawings or directed by Engineer. Obtain approval for steel sheet piling to be left in place.

3.03 BRACING

- A. Locate bracing to clear columns, floor framing construction, and other permanent Work. Install new bracing before removing original brace if moved. Do not place bracing where it will be cast into permanent concrete Work unless approved by Engineer.
- B. Install internal bracing if required to prevent spreading or distortion of braced frames.
- C. Maintain bracing until structural elements are supported by other bracing, or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.04 REPAIR/RESTORATION

- A. Remove excavation support and protection systems in stages to avoid disturbing underlying soils and rock, or damaging structures, pavements, facilities, and utilities.
- B. Fill voids immediately with approved backfill compacted to density specified in accordance with Section 31 00 00.
- C. Repair or replace adjacent Work damaged or displaced by removing excavation support and protection systems.

3.05 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Resurvey benchmarks twice weekly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Owner if changes in elevations or positions occur, or if cracks, sags, or other damage is evident in adjacent construction.
- C. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- D. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

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Issue Date: January 2017

Contract A
Canal Street Flood Mitigation Project – Phase II
Salem, Massachusetts

3.06 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 32 01 90.16

AMENDING SOILS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide labor, equipment, materials and construction methods necessary to supply and place planting soils for the little league baseball athletic field in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 31 00 00 – Earthwork
 - 2. Section 33 46 16 – Subdrainage Piping
 - 3. Section 32 18 23.16 – Natural Baseball Field Surfacing

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. AASHTO
 - a. AASHTO T 180 Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
 - 2. American Society of Agronomy (ASA)
 - a. Methods of Soil Analysis
 - 3. AOAC International (AOAC)
 - 4. ASTM International (ASTM)
 - a. ASTM D75 Standard Practice for Sampling Aggregates
 - b. ASTM D422 Standard Test Method for Particle-Size Analysis of Soils

- c. ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
 - d. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone
 - e. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
 - f. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - g. ASTM D2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 - h. ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
 - i. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
 - j. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - k. ASTM D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity
 - l. ASTM D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 - m. ASTM D4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile
 - n. ASTM D4759 Standard Practice for Determining the Specification Conformance of Geosynthetics
 - o. ASTM D6938-10 Standard Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
 - p. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
- 5. Solvita Compost Manual
 - 6. USDA Soil Classification System

B. Definitions

1. Subgrade: soil material and levels resulting from approved filling and rough grading work
2. Subgrade soil: existing soil or other materials, either undisturbed or placed, from approved rough grading Work, located in athletic field planting areas
3. Existing subsoil: on-Site soils below existing topsoil in athletic field areas
4. Amended athletic field root zone mix: existing amended topsoil taken from top 6 inches of existing athletic field outfield lawn area, mixed and batched with imported sand and compost materials for use on athletic field areas only
5. Existing topsoil: on-Site topsoil from athletic field lawn area only
6. Stripped topsoil: top 6 inches of existing outfield
7. Sand blanket: granular, free-draining sand, or sand and gravel, for placement beneath athletic field root zone mix and on top of flat drain drainage composite

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.
1. Coordinate activities to prevent soil disturbance from traffic or other construction activities subsequent to placement of athletic field root zone mix.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
1. Manufacturer's current catalog cuts or Specifications and granular analysis demonstrating compatibility with the following
 - a. Fertilizer
 - b. Soil amendment
 - c. Organic matter amendment
 - d. Agricultural chemicals
 2. Provide analyses of soil mix components no more than 90 days old. Ensure materials delivered to Site are consistent with submittals.

- C. Samples and Mockups: as specified in Article 1.06.
- D. Sample Test Reports and Evaluations
 - 1. Submit Samples, certifications, product data and certified test results at least 30 days prior to ordering materials.
- E. Manufacturer Instructions
- F. Source and Field Quality Control Submittals
 - 1. Soil blending plan covering intended area for soil blending, Plans and provisions for protection of stockpiles, control from erosion, and methodology for blending and testing of soils
 - 2. Landscape soil, soil mix, and backfill mix installation certification for compliance with approved soils testing reports
 - 3. Testing laboratory results and recommendations
 - 4. Subgrade elevation report confirming 6-inch to 12-inch sand blanket thickness and 12-inch thickness of athletic field root zone mix across field area
 - 5. As-built survey data plotted on a 20-scale plan of final field surface, prepared by a surveyor licensed in the state where the Project is located.
- G. Qualification Statements
- H. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements and as follows for soil testing.
 - 1. Nutrient content: determined by a laboratory equivalent to University of Massachusetts Soil Testing Laboratory to evaluate required soil amendments for mixed soils.
 - 2. Stability tests: conducted by a laboratory equivalent to Woods End Research Laboratory, Mt. Vernon, Maine.
 - 3. Organic content: determined by a laboratory equivalent to West Experiment Station at University of Massachusetts, Amherst.

- C. Independent Testing
 - 1. Obtain recommendations from soil testing lab for amending sub soil and top soil and amending soil mix.
 - 2. Provide alternate material for material that fails testing or amendment procedure and repeat testing.
- D. Samples
 - 1. Compost: two 2-pound Samples
 - 2. Uniformly graded medium to coarse sand: two 1-gallon Samples
 - 3. Pilot batch of athletic field root zone mix for textural and organic content analysis
 - 4. Full scale soil blend
 - 5. Soil Samples
 - a. Provide Samples representative of material to be brought to Site.
 - b. Provide composite Samples, consisting of 5 separate sub-Samples taken from a minimum of 5 different locations at each source and mixed together to make the test sample. Submit Samples for the following items
 - 1) Stripped topsoil: 2 composite Samples
 - 2) Amended athletic field root zone mix pilot batch Samples: 2 composite Samples
 - 3) Amended athletic field root zone mix full scale Samples: 2 composite Samples
 - 4) Amended athletic field root zone mix full scale composite sample submitted to testing laboratory and analyzed for Standard Proctor.
 - 6. Loam Samples: furnished to Site and stockpiled from on-Site stripping

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
 - 1. Do not order or deliver materials until submittals are approved.

- B. Packing, Shipping, Handling, and Unloading
 - 1. Deliver fertilizer in original, unopened containers bearing manufacturer's certificate of compliance covering analysis.
 - 2. Deliver acidulants in unopened containers labeled with manufacturer name, material, analysis and net weight on container.
- C. Storage and Protection
 - 1. Protect landscape Work and materials from damage. Maintain protection during installation until acceptance.
 - 2. Cover materials that sit on-Site for more than 24 hours with tarpaulin or another soil erosion system acceptable to Engineer, surrounded by silt fence.
 - 3. Apply filter fabric covering and planking, or other engineering controls over soil to minimize compaction and collection of dust and debris in Work areas after installation of athletic field root zone mix.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Retain qualified soil testing laboratories to conduct soil testing and amending Work and provide recommendations for each of the following, including existing stockpiled or imported topsoil and amended athletic field root zone mix prior to placement. Provide laboratories with copies of Section 32 18 23.16 and this Section. Perform tests per AOAC standards.
 - 1. Mechanical gradation sieve analysis: performed and compared to USDA Soil Classification System
 - 2. Silt and clay content: hydrometer test of soil passing #270 sieve
 - 3. Percent of organics: ash burn test
 - 4. Chemical analysis for nitrate nitrogen, ammonium nitrogen, phosphorus, potassium, calcium, aluminum, magnesium, iron, manganese, lead, soluble salts, cation exchange capacity, soil reaction (pH), and buffer pH

5. Soil analysis tests including recommendations for tested soils for additives to correct soils deficiencies as necessary to perform for new lawns. Provide rates of application for additives per both 1,000 square feet and per cubic yard.
6. Submit sample for ASTM D698 Standard Proctor Test after approval of full scale blended athletic field soil.

2.02 AMENDED TOPSOIL FOR LAWNS AND ATHLETIC FIELD ROOT ZONE

- A. Screen and amend existing topsoil from top 6 inches of existing baseball athletic field outfield area with compost, uniformly graded sand and other amendments per approved soils tests.
- B. Excavate and handle existing topsoil so underlying subsoils are not incorporated and comingled. If topsoil is not stripped properly and degraded due to admixture of subsoil or being handled in wet conditions, amend topsoil to original condition as directed by Engineer or purchase new topsoil to replace degraded topsoil.

2.03 ORGANIC AMENDMENTS (COMPOST)

- A. Use the following additives determined by recommendation of soil testing reports.
 1. Compost for amending planting media: stable, humus-like material produced from aerobic decomposition of organic lawn and leaf waste residues, composted a minimum of 12 months, dark brown to black in color, capable of supporting plant growth with appropriate management practices in conjunction with addition of fertilizer and other amendments with no visible free water, dust, plastics, metal, concrete or other debris, stones larger than 1/2 inch, large branches or roots, no unpleasant odor, meeting the following criteria as reported by producer.
 - a. Carbon to nitrogen ratio: range of 12:1 to 25:1
 - b. Assess stability by Solvita Compost Maturity Test. Compost must achieve a maturity index of 6 or more as measured by Solvita scale by testing laboratory.
 - c. Pathogens/Metals/Vector Attraction reduction: 40 CFR Part 503 rule, Table 3, page 9392, Vol. 58 No. 32 and local environmental Regulations.
 - d. Organic content: at least 20 percent dry weight. One hundred percent of material shall pass a 3/8-inch or smaller screen. Debris such as metal, glass, plastic, wood, asphalt or masonry may not be visible and not exceed 1 percent dry weight. Organic content as determined by weight loss on ignition for particles passing a #10 sieve according to testing laboratory procedures. Organic matter is calculated as loss on ignition

- e. pH: between 6.5 to 7.2 as determined from a 1:1 soil-distilled water suspension using glass electrode pH meter per ASA Methods of Soil Analysis
- f. Salinity: electrical conductivity of a 1 to 5 soil to water ratio extract not to exceed 2.0 mmhos/cm (dS/m)
- g. Provide compost with texture suitable for incorporation without causing loss of hydraulic conductivity of soil mix. Screen compost to 3/8-inch maximum particle size. Compost may not contain more than 3 percent material finer than 0.002mm, determined by hydrometer test on ashed material.

2.04 SAND

- A. Provide uniformly graded coarse sand consisting of clean, inert, rounded grains of quartz or other durable rock, free from loam or clay, surface coatings, mica, or other deleterious materials with the following gradation as required for mixing with topsoil and flat drain composite drainage sand blanket, in accordance with Section 31 00 00, Section 33 46 16, and as specified. Based on percentage passing the #10 sieve.

Percent Passing

U.S. Sieve Size Number	Minimum	Maximum
10	100	-
18	65	90
35	25	45
60	8	20
140	0	8
270	0	3
0.002mm	0	0.3

- B. Maximum size: 1/2-inch largest dimension. Maximum retained on #10 sieve: 15 percent by weight of total sample.
- C. Ratio of particle size for 70 percent passing (D70) to particle size for 20 percent passing (D20): 3.0 or less. (D70/D20 less than 3.0)
- D. Complete test by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
- E. pH: less than 7.5

2.05 MIX DESIGN FOR ATHLETIC FIELD ROOT ZONE MIX

- A. Provide topsoil collected from top 6 inches of existing outfield lawn area for use in fabricating amended athletic field root zone, consisting of a blend of approximately 1-part by volume existing stripped topsoil loam to 2-1/2 parts by volume coarse uniform sand to 1-part by volume compost organic amendment for a ratio of 1T:2.5S:1C.
- B. Provide final mix with organic content between 3.5 and 5.0 percent conforming to the following gradation requirements for material passing a #10 sieve.

Percent Passing

U.S. Sieve Size Number	Minimum	Maximum
10	100	-
18	65	80
35	37	57
60	24	32
140	17	23
270	11	15
0.002mm	1.5	3

- C. Maximum size: 1-inch largest dimension. Maximum retained on #10 sieve: 20 percent by weight of total sample
- D. Ratio of particle size for 70 percent passing (D70) to the particle size for 20 percent passing (D20): 4.5 or less (D70/D20 less than 4.5)
- E. Complete test by combined hydrometer and wet sieving in accordance with ASTM D422 after destruction of organic matter by ignition.
- F. Saturated hydraulic conductivity of mix: not less than 4 inches per hour when compacted to a minimum of 88 percent in accordance with ASTM D698.

2.06 SOIL ADDITIVES

- A. Use to counteract soil deficiencies recommended by soil analysis and as supplements for lawn construction as specified.
- B. Acidulant for adjustment of athletic field root zone mix pH: unadulterated commercial grade flours of sulfur, ferrous sulfate, or aluminum sulfate
- C. Provide ground limestone for adjustment of athletic field root zone mix pH containing no less than 85 percent total carbonates, ground so 40 percent will pass through No. 100 mesh sieve and 95 percent will pass through No. 20 mesh sieve. Meet testing lab recommendations for amended topsoil.

- D. Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$): agricultural grade, granular form. Conform gradation to the following.

Sieve Designation	Percent Passing by Weight
No. 8	100
No. 16	97
No. 30	82
No. 50	46
No. 100	21

- E. Provide commercial fertilizer complying with local, State and United States Laws for fertilizer, meeting soil analysis recommendation.
1. Fertilizer for planting: formulated for top-dressing soil surface application to plants, designed and certified to provide controlled release of fertilizer continuously for 9 months. Nitrogen content: 100 percent derived from organic materials, coated to ensure slow release. Fertilizer weight percentages and ingredients to meet soil testing and analysis specified in Section 32 18 23.16.

2.07 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Strip on-Site topsoil and stockpile on Owner’s property outside of athletic field areas as specified in Section 31 00 00.

3.02 FILLING AND COMPACTION

- A. Remove topsoil within proposed athletic field limits. Re-use only top 6 inches of stripped topsoil for blending into amended athletic field root zone mix. Fill area within athletic field limits with suitable backfill to subgrade elevation and slope toward subsurface drain lines as indicated on Drawings.
- B. Clear subgrade of construction debris, trash, rubble and any foreign material. If fuels, oils, concrete washout, or other material harmful to plants have been spilled into subgrade material, excavate soil to remove harmful material. Fill over excavation with approved suitable fill and compact to required subgrade compaction levels.

- C. Install sand blanket over flat drain drainage composite with drain lines installed at finished subgrades in accordance with Section 33 46 16 and as shown on Drawings. Sand blanket will vary in thickness from 6 inches to 12 inches to provide positive pitch to collector pipe and provide consistent 12-inch-thick athletic field root zone layer across sodded field area.
- D. Install gravel borrow over approved 3/4-inch stone backfilled collector pipe trenches as a filter layer between athletic field root zone mix and 3/4-inch crushed stone in accordance with Section 31 00 00 and as shown on Drawings.
- E. Protect sedimentation of 3/4-inch crushed stone with sand blanket material or any other finer soil materials prior to gravel borrow installation. Clean, excavate, and re-install portions of collector pipe trench stone contaminated with sand and soils.
- F. Protect adjacent walls, walks and utilities from damage or staining by athletic field root zone mix. Use 1/2-inch plywood and or plastic sheeting as directed to cover existing concrete, metal and masonry work, and other items as directed.

3.03 SOIL MOISTURE CONTENT

- A. Apply water, or allow to dry, to bring soil moisture between 60 percent of optimum moisture content and optimum moisture content in accordance with ASTM D698 prior to compaction, grading or planting. Do not move, blend or grade soil when free moisture content is apparent, dust forms in dry conditions, clods do not readily break, or when frozen.
- B. Field soil moisture test is for general soil moving and placement only, not for compaction of soils or a replacement for testing procedure specified.
 - 1. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.
 - 2. If soil will not retain shape, it is too dry and should not be worked.
 - 3. If soil retains shape and does not crumble, it is too wet and should not be worked.
 - 4. If soil glistens or free water is observed when sample is patted, it is too wet and should not be worked

3.04 MIXING OF PLANTING SOIL MIXES

- A. Blend components with earthwork equipment or by alternately passing soil components through a screener prior to placement. Mix components or ratios may be modified dependent on results of soil analyses. Blending to occur over a minimum of 3 handlings. Transport mix to approved stockpile or Work area.

- B. Protect material components and amended soil mix stockpiles from wind and rain. Do not store materials in standing water.
- C. Keep stockpiles area clean and orderly. Do not allow commingling of material components with final soil blend.
- D. Blend a 10 cubic yard pilot batch of athletic field root zone mix using approved equipment and submit Samples for approval.
- E. Upon approval of final mix ratio for blended soils, blend stripped topsoil full scale at approved ratios and submit sample of full scale soil blend for final analysis and acceptance by Engineer.
- F. Submit a representative composite sample of amended athletic field root zone mix soil for Standard Proctor test in accordance with ASTM D698 to obtain optimum moisture content and maximum dry density values once full scale soil blend is accepted for horticultural parameters.

3.05 FINE GRADING

- A. Clean subgrade of debris and stones greater than 2 inches and remove from Site. Do not rake to edges and bury. Obtain Engineer's approval prior to installation of flat drains, dumping and spreading sand blanket.
- B. Do not handle, place, plant, or sod any athletic field root zone mix if wet or frozen.

3.06 PLACEMENT OF ATHLETIC FIELD ROOT ZONE MIX

- A. Engineer to review flat drain and sand blanket installation prior to athletic field root zone mix application. Spread over area minimizing traversing sand blanket and compress material with 2 perpendicular passes of bulldozer tracks, or equivalent to a density of 86 - 88 percent Standard Proctor maximum dry density. Vibratory compaction of subgrade or planting medium is not allowed. Rubber-tired or heavy equipment is not allowed except for a small bulldozer passing over soils after they have been prepared or planting medium spread. Rototill, re-compact, and re-survey areas of athletic field root zone mix that become heavily compacted after placement.
- B. Spread athletic field root zone mix to a depth greater than required so after settlement, finished grade conforms to lines, grades and elevations shown on Drawings. Ensure proper drainage in an uninterrupted pattern, free of hollows and pockets.
- C. Remove and legally dispose of clods, lumps, brush, roots, stumps, litter, other foreign material, and stones over 1-inch in diameter.

- D. Spread soil additives and incorporate into athletic field root zone mix by harrowing or other methods approved by Engineer. Incorporate the following soil additives.
1. Ground limestone or acidulants required by soil analysis to achieve required pH as specified. Spread limestone at rate required by soil analysis up to a limit of 200 pounds per 1,000 square feet. If recommendations of soil analysis require greater rates of application, apply surface application of limestone during season, up to a limit of 50 pounds per 1,000 square feet to established lawn.
 2. Spread fertilizer at rate recommended by soil analysis.
 3. Provide other soil amendments required by soil analysis.
- E. Prepare root zone by scarifying, harrowing, or tilling loam to integrate soil additives into top 6 inches of loam after athletic field root zone mix and required additive applications. Remove clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove stones over 1 inch in diameter and smaller stones in excessive quantities from unscreened soils from top 6 inches of loam bed.
- F. Set sufficient quantity of grade stakes in bottom of swales and top of slopes to check finished grades. Deviation from indicated elevations greater than 1/4 inch over 10 feet is not acceptable. Connect contours and spot elevations with an even slope. Finish grades: smooth and continuous with no abrupt changes at top or bottom of slopes.
- G. During compaction process, fill depressions caused by settlement or compaction with additional athletic field root zone mix and re-grade surface to a smooth, even finish to required grades.
- H. In addition to range specified above, compact each lift to reduce settling, but not enough to prevent movement of water and feeder roots through the soil. Athletic field root zone mix in each lift should feel firm to the foot in all areas and only make slight heel prints. At completion of amended soil installation, soil should offer a firm, even resistance when a soil sampling tube or compaction probe is inserted from lift to lift. Perform percolation tests to determine if soil has been over compacted using the following procedures.
1. Dig hole in installed soil a minimum of 4 inches in diameter and 4 inches deep. Do not penetrate through soil layer being tested.
 2. Fill hole with water and let drain completely. Immediately refill hole with water and measure rate of fall in water level.
 3. If water drains at a rate less than 2 inches per hour, till soil to depth required to break over-compaction.

4. Perform minimum of 1 soil percolation test per 10,000 square foot area of athletic turf area.
- I. Select equipment and phase installation of athletic field root zone mix to ensure wheeled equipment does not travel over subsoil, placed fills or ordinary borrow, or installed soil. Movement of tracked equipment over soils to be approved by Engineer. If wheeled equipment must travel over installed soil, provide a written description of sequencing of Work ensuring compacted soil is loosened and uncompacted as Work progresses, or place 1-inch thick steel plate ballast or equivalent ballast approved by Engineer over length and width of any travel way to cover athletic field root zone mix and protect it from compaction. Use of haul roads is acceptable provided haul road is re-worked to meet requirements of this section. Treat, repair or replace damaged athletic field root zone mix installation work immediately.
- J. Grade smooth disturbed areas outside limit of athletic field Work and spread with athletic field root zone mix or topsoil as necessary to meet finished grades. Extend athletic field root zone mix and sand blanket materials up to perimeter collector pipe located in outfield.
- K. Prepare surface with rock hound or other approved agricultural device with low ground pressure tires to scarify and loosen upper 1/2 to 1-inch of seed bed for acceptance of sod immediately prior to sod installation.
- L. Maintain stockpiles until final placement of existing on-Site topsoil and athletic field root zone mix has been approved by Engineer in writing. Provide survey data and Plans showing volume of existing on-Site topsoil stockpiles for review and analysis by Engineer. Upon Engineer's written approval, use remaining on-Site topsoil, or remove excess from Site.

3.07 ACCEPTANCE

- A. Confirm final grade of athletic field root zone mix is at finish grade elevations and not over-compacted. Adjust grade as required to meet contours and spot elevations noted on Drawings. Proceed with remaining Work after Engineer's written approval of final grade.

3.08 POST-INSTALLATION TESTING

- A. In-place density testing is required in all areas. Placed athletic field root zone mix must be inspected for compaction level in accordance with ASTM D6938-10, after ASTM D698. Conduct density testing at minimum of 1 test every 1,000 square feet.

3.09 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.10 CLEANING

- A. During installation, keep pavements clean and Work area in an orderly condition.
- B. Keep trash and debris in a central collection container. Do not bury trash and debris in backfill.
- C. Remove any excess soil from pavements or embedded in fixtures at completion.

3.11 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 32 12 16

ASPHALT PAVING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Furnish and install tack prime coat, hot mix asphalt pavement base and surface courses, temporary trench paving, permanent trench paving, pavement reclaim, structure protection & adjustments, sidewalks, driveways, bituminous concrete berm and curb, and miscellaneous patching in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. AASHTO T166 Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
 - b. AASHTO T209 Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA)
 - c. AASHTO TP 68 Standard Method of Test for Density of In-Place Hot-Mix Asphalt (HMA) Pavement by Electronic Surface Contact Devices
2. MassDOT Standard Specifications and Supplements and Construction Details

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
 - 1. Product Data
 - a. Product weight shipping tickets certified by Supplier
 - 2. Manufacturer Instructions
- B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 BITUMEN FOR TACK PRIME COAT

- A. Provide in accordance with MassDOT Section 460 and Construction Standard Details.

2.02 HOT POURED RUBBERIZED ASPHALT SEALANT

- A. Provide in accordance with MassDOT Section 460 and Construction Standard Details.

2.03 HOT MIX ASPHALT SURFACE COURSE STANDARD TOP

- A. Provide in accordance with MassDOT Section 460, M3.11.03 and Construction Standard Details.

2.04 HOT MIX ASPHALT BASE COURSE

- A. Provide in accordance with MassDOT Section 460, M3.11.03 and Construction Standard Details.

2.05 BITUMINOUS CONCRETE BERM

- A. Provide in accordance with MassDOT Section 460 and Construction Standard Details.

2.06 HOT MIX ASPHALT FOR MISCELLANEOUS WORK

- A. Provide in accordance with MassDOT Section 472 and Construction Standard Details.

2.07 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Minimize area of pavement removed to suitable width for installation of Work. Legally dispose of existing pavements. Removal and replacement of pavement for Contractor's convenience shall be at no additional cost to Owner.
- B. Place hot mix asphalt between April 1 and November 15, unless otherwise specified by Owner.
- C. Do not place hot mix asphalt mixture unless breakdown and intermediate rolling can be completed by time material has cooled to 175 degrees F, and provided density of completed pavement attains at least 92.5 percent of maximum theoretical density as determined by AASHTO T209.
- D. Do not place mix on wet or damp surfaces, or when ambient temperatures are 40 degrees F and falling, unless otherwise specified by Owner.
- E. When air temperature falls below 50 degrees F, take extra precaution drying aggregates, controlling temperatures of materials, placing, and compacting mixtures.
- F. Use straightedge to check compacted surfaces and obtain approval of Engineer.
- G. Utilize an approved dial type thermometer, and infrared piston thermometer for each paving machine. Retain thermometer upon completion of Project.
 - 1. Fahrenheit or Celsius selectable
 - 2. Portable and battery operated
 - 3. Repeatability of plus or minus 5 degrees F

4. LCD display to nearest 1 degrees
5. Accuracy of plus or minus 2 percent
6. Emissivity present at 0.95
7. Temperature operation range: 0 degrees F to 750 degrees F.

3.02 INSTALLATION

- A. Place hot mix asphalt base and top courses on roadways, sidewalks and other areas to maintain traffic access and egress to properties abutting Work, and for safe passage of pedestrian and vehicular traffic in accordance with MassDOT Section 460 and Construction Standard Details.
1. Provide minimum compacted thickness depth of hot mix asphalt base course indicated on Drawings or as directed by Engineer to achieve necessary base course grade in support of finish grade pavement elevations.
 2. Apply bitumen for prime and tack coat at a rate of 7/10 gallons per square yard over milled areas immediately prior to installation of top course, as shown on Drawings or directed by Engineer. Clean surface of sand and foreign matter, and dry before applying prime coat.
 3. Apply bitumen for prime and tack coat at a rate of 1/10 to 1/20 gallons per square yard over hot mix asphalt base course immediately prior to installation of top course, as shown on Drawings or as directed by Engineer. Clean surface of sand and foreign matter, and dry before applying prime coat.
 4. Provide minimum compacted thickness depth of hot mix asphalt surface course indicated on Drawings or as directed by Engineer to achieve finish grades.
 5. Apply hot poured rubberized asphalt sealant to longitudinal and transverse joints.
 6. Remove and replace defective mix not conforming to specified mix formula within stipulated tolerances on basis of testing. Samples of mixture in use will be taken as many times daily as necessary, and mixtures maintained uniform as specified. Owner may suspend further approval of plant mixtures in related Work if mixtures are not uniformly furnished as specified, until necessary changes have been made so mixtures conform to specified requirements.
 7. Irregularities which may develop before completion of rolling and while material is still workable, may be remedied by loosening surface mixture

and removing or adding material as necessary. Should any irregularities or surface defects remain after final compaction, defective Work will be corrected by minor surface projections, joints, and minor honeycombed surfaces ironed out smoothly to grade, and as directed.

8. If any soft, imperfect places or spots develop on surface before final acceptance of Work, remove and replace with new materials and compact until edges of new Work seamlessly connect with old Work.
- B. Install hot poured rubberized asphalt sealer on roadway cracks less than or equal to 1-inch in width. Prior to placing sealer, thoroughly clean and dry crack to be sealed to a minimum depth of twice the crack width with a high pressure air blast. Apply sealer per manufacturer's recommendations.
- C. Install hot mix asphalt for miscellaneous work and handwork on roadway surfaces that cannot be installed mechanically, or as directed by Engineer, in accordance with MassDOT Standard Specifications for Highways and Bridges, Supplements Section 472 and MassDOT Construction Standard Details.
- D. Set manhole covers and water gate boxes flush with finish grade of top course of resurfaced streets.
- E. Vehicular traffic or loads will not be permitted on newly completed pavement until adequate stability has been attained and material has cooled sufficiently to prevent distortion or loss of fines. If climatic or other conditions warrant it, the period of time before opening to traffic may be extended at discretion of Owner.

3.03 RECLAIM OF ROADWAY WITH PAVING

- A. Prior to scarifying and pulverizing existing pavement, locate and protect existing drainage and utility structures, and underground pipes, culverts, conduits and other appurtenances. If upper sections of utilities are removed to facilitate scarifying and pulverizing existing pavement, immediately cover remaining part of structure with a steel plate capable of withstanding a 36.5 ton truckload with impact. Protect, remove or replace existing utility structures and boxes as part of the Work.
- B. Reclamation of paving includes scarifying and pulverizing in-place pavement and underlying material, mixing or blending material in depths specified on Drawings, followed by placing Type I-1 binder course in depths specified on Drawings and Type I-1 top course in depths specified on Drawings.
- C. Remove unsuitable material in sub-grade to lines and depths established by Owner and replace with gravel borrow conforming to requirements of MassDOT subsection M1.03.0, Type B.
- D. Placement: established within limits of Work.

3.04 BITUMINOUS CONCRETE BERM

- A. Provide foundation for bituminous concrete berms as shown on Drawings or as directed, conforming to requirements for the particular type of berm.
- B. Place mixture and compact with machine approved by Owner for type of berm required.

3.05 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Perform testing of in-place density of applicable hot mix asphalt pavement courses using 6-inch diameter cores in accordance with AASHTO T166 or AASHTO TP 68. Do not obtain cores from bridge protective course or bridge surface course. Determine degree of compaction from each core by comparing bulk density of core pavement layer to average maximum theoretical density of same day's production.
- C. Test plane of finished surfaces of base and binder courses and top course of compacted mixtures with a 16-foot straightedge. A 10-foot straight edge may be used on vertical curves. Apply straightedge immediately after first compaction by rolling, and from then on, as necessary until and after final compaction of material in place. Hold straightedge in successive positions parallel to road centerline and in contact with road surface, and check entire area from one side of pavement to the other. Correct irregularities which vary 1/4 inch from true surface in base or binder course.

3.06 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 32 16 14

GRANITE CURBS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Remove and reset, or provide new granite curbs in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. ASTM International (ASTM)
 - a. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
 - b. ASTM C150 Standard Specification for Portland Cement
 - c. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes
 - d. ASTM C615 Standard Specification for Granite Dimension Stone
 - 2. MassDOT Standard Specifications for Highways and Bridges
 - a. MassDOT Supplemental Specifications Section 501
 - b. MassDOT Supplemental Specifications Section 580
 - 3. MassDOT Construction Standard Details

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
 - 1. Product Data
 - 2. Manufacturer Instructions
- B. Certificates: manufacturer's certification that products meet Specification requirements.
- C. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Storage and Protection
 - 1. Protect curb against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected.
 - 2. Store granite curbing pallets on pavement or other hard, durable surface that will not compact from the weight. Prevent pallet steel strapping from rusting and staining pavement. Remove and replace pavement stained by rusting steel strapping.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GRANITE CURBS

- A. Provide Type VA-4 in accordance with MassDOT Supplemental Specifications Section 501 and MassDOT Construction Details.

2.02 MORTAR

- A. Provide mortar composed of 1 part Type II portland cement in accordance with ASTM C150, 2 parts sand in accordance with ASTM C144, well graded with no

grain larger than will pass #8 sieve, and 20 percent hydrated lime conforming to ASTM C207, Type S.

2.03 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Verify that earthwork is completed to correct line and grade.
- B. Check that subgrade is smooth, compacted, and free of frost or excessive moisture.

3.02 REMOVAL AND RESETTING

- A. Remove and reset curbs, curb inlets and curb corners at locations where required in accordance with MassDOT Supplemental Specifications Section 580, and MassDOT Construction Details. Incorporate existing curbs, curb inlets and curb corners before installation of new curb.
- B. Remove existing curb in areas indicating remove, stack and reuse, and reinstall prior to installation of curb delivered to Site.

3.03 INSTALLATION

- A. Install new curbs in accordance with MassDOT Supplemental Specifications Section 501, and Drawings.
- B. Install ends of curbs vertically forming a flush joint when 2 curb stones are placed adjacent to each other.
 - 1. Maximum joint space: not to exceed 3/4 inches.
 - 2. Top 6-inches of curb stone: uniform thickness and surface finish.
 - 3. Radii of curved curb stone: per Drawings.

3.04 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

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- B. Deliver excess curbing to City DPW yard. Dispose of legally if Owner does not want excess curbing.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide pavement markings in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. MassDOT Standard Specifications and Supplements and Construction Details
 - a. MassDOT Section 860 Reflectorized Pavement Markings

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
 - 1. Product Data
 - 2. Manufacturer Instructions
- B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 PAVEMENT MARKINGS

- A. Provide in accordance with MassDOT Section 860.
- B. Provide thermoplastic reflectorized type conforming to M7.01.03 (white) and M7.01.04 (yellow).

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Apply and install pavement markings in accordance MassDOT Section 860, MUTCD and Mass Amendments, and Drawings.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.03 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 32 18 23.13

BASEBALL FIELD SURFACING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Furnish and install the baseball field infield mix, warning track mix, and mound clay for athletic field in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. ASTM International (ASTM)
 - a. ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
 - b. ASTM F2107-08 Standard Guide for Construction and Maintenance of Skinned Areas on Baseball and Softball Fields
 - c. ASTM F2270-12 Standard Guide for Construction and Maintenance of Warning Track Areas on Athletic Fields
 - 2. United States Department of Agriculture (USDA)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Samples and Mockups: as specified in Article 1.06
- C. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Samples
 - 1. Submit Samples for approval prior to testing. Engineer retains the right to reject all Samples prior to or after testing is complete. Testing lab to be approved by Engineer. Provide testing, and retesting of failed Samples.
 - 2. Submit representative Samples of infield mix, warning track mix, and mound clay with certified report from approved soil testing laboratory stating results of analysis of same material. Include particle size distribution analysis per ASTM D422, USDA soil classification including breakdown by sand, silt, and clay percentages, silt to clay ratio, organic content, and Standard Proctor compaction test, providing optimum moisture content and maximum dry density.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Acceptance at Site
 - 1. Each batch delivered is subject to approval of Engineer.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 INFIELD MIX

- A. Provide infield mix consisting of tan or red clay silt, blended with sand, nominal ratio of 25 to 30 percent silt and clay to 70 to 75 percent sand, free of stone, allowing no separation of ingredients, manufactured specifically for use on baseball and softball fields. Mix to provide firm traction, drainage, retention of moisture and compaction, conforming to the following requirements.
 - 1. Mechanical Analysis
 - a. Sand: 70 to 75 percent (with medium sand, greater than 50 percent of total mix).
 - b. Silt and clay: 25 to 30 percent.
 - c. Silt to clay ratio (silt divided by clay): 0.5 - 1.0.

2. Sieve Analysis

Screen Size	Percent Passing
#4	100 percent
#10	89-95 percent
#20	75-85 percent
#40	55-65 percent
#60	35-45 percent
#100	25-32 percent
#200	24 percent

3. Provide baseball field infield mix pre-conditioned with 15 percent by volume calcined clay conditioner. Acceptable level of quality: equivalent to Turface MVP or Southern Athletic Fields MuleMix 816. Install conditioner into infield mix during construction in accordance with the manufacturer's installation requirements.

2.02 WARNING TRACK MIX

- A. Provide warning track mix consisting of tan or red sand, silt, and clay, with 100 percent finer than 5/16 inch, free of stone, allowing no separation of ingredients. Mix to provide firm traction, drainage, retention of moisture and compaction. Acceptable level of quality: equivalent to Warning Track Mix from New England Specialty Soils, Leominster, MA

2.03 MOUND CLAY

- A. Provide mound clay consisting of high density tan or red clay material, screened at 1/2 inch, free of stone, allowing no separation of ingredients. Acceptable level of quality: equivalent to Southern Athletic Fields Mar Mound Clay from New England Specialty Soils, Leominster, MA

2.04 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Form edges interfacing with infield mix, warning track mix, or mound clay with temporary wood or plastic edge, staked and supported to achieve a uniform and smooth edge as approved by Engineer.
- B. Spread infield mix over prepared sand blanket in 2 lifts, each approximately 2 inches thick. Dampen, compact, and lightly scarify first lift prior to installation of second lift. Final compacted thickness may not be less than 4 inches.

- C. Spread warning track mix over prepared sand blanket and non-woven geotextile fabric in a single lift, 3 inches thick. Final compacted thickness may not be less than 3 inches.
- D. Install mound clay in area of pitcher's mound circle and in home plate at batter's boxes to a depth no less than 4 inches thick. Batter's box areas can be top-dressed with approximately 1/2 inch of infield mix over top of mound clay. Bags or bricks of clay are acceptable.
- E. Plane and fine grade infield mix, warning track mix, and mound clay surfaces to eliminate standing water and provide positive storm runoff to adjacent areas. Correct areas of standing water.
- F. Install infield mix higher than grass at edges between grass and infield areas to allow water to run off of infield mix areas onto grass areas. Lips between infield mix and grass areas are not allowed.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.03 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 32 18 23.16

NATURAL BASEBALL FIELD SURFACING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Provide natural baseball field surfacing in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 31 00 00 – Earthwork
 - 2. Section 32 01 90.16 – Amending Soils
 - 3. Section 32 80 00 - Irrigation

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. ASTM International (ASTM)
 - a. ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
 - 2. Turfgrass Producers International (TPI)
 - a. Guideline Specifications to Turfgrass Sodding
 - 1) Specifications for Turfgrass Sod Materials
 - 2) Specifications for Turfgrass Sod Transplanting and Installation

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.
 - 1. Pre-installation conference: at Project Site with Engineer, Owner and supervisor or foreman responsible for soil preparation, mixes, and placement specified in Section 32 01 90.16, prior to commencement of landscape planting Work. Provide a minimum 7 days' notice of conference date. Review planting installation, Project and plant installation schedules, Specification criteria, material sources procedures, outstanding submittals and approvals, and other topics necessary for coordination of Work. Establish follow up meetings as necessary.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
- C. Samples and Mockups: as specified in Article 1.06.
- D. Certificates
 - 1. Certification of Grass Seed and Sod
 - a. Certification for each grass-seed monostand or mixture stating botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include year of production and packaging date.
 - b. Certification of each seed mixture for turfgrass sod, identifying source, including name and telephone number of Supplier.
 - 2. Product Certificates
 - a. Soil amendments, herbicides and fertilizers, signed by product manufacturer.
 - b. USDA Soil Classification of sod farm growing medium.
- E. Source and Field Quality Control Submittals
 - 1. Planting schedule indicating anticipated planting dates for each type of planting.
 - 2. Maintenance instructions: recommended procedures to be established by Owner for lawn maintenance during a calendar year. Submit before expiration of required maintenance periods.

3. Fertilization requirements: invoice copies to prove mycorrhizal inoculant and biostimulant purchase to cover Project at rates recommended by manufacturer. Include Project name, date, purchase location and contact information.

F. Qualification Statements

G. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for landscape installer and as follows.

1. Provide experienced landscape installer who has completed landscaping and soil supply, seeding and sod installation work similar in material, design, and to extent indicated with a record of successful landscape establishment.
 - a. Installer's field supervisor: English speaking, experienced in seeded, sodded, and hydroseeded lawn installation and maintenance.
 - b. Provide names of projects, locations, client contact names and phone numbers for a minimum of 5 projects of similar size and scope, for Engineer review.
 - c. Supervisor: full-time on-Site during lawn installation or maintenance.
 - d. Personnel using herbicides: qualified for such work.
 - e. Provide number and personnel type utilized to meet lawn installation schedule.

C. Samples

1. Submit a 12 inch by 12 inch square of proposed turfgrass sod including typical soil section, root mat and turf grass within 24 hours of harvesting.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Packing, Shipping, Handling, and Unloading

1. Notify Engineer of confirmed source of sod materials 14 days prior to shipping to Site.

2. Deliver packaged materials in unopened standard size bags or containers bearing name, guarantee, and trademark of producer, material composition, manufacturers' certified analysis, and weight.
 3. Deliver seed in original sealed, labeled, and undamaged containers.
 4. Harvest, deliver, store, and handle sod in accordance with TPI Specifications for Turfgrass Sod Materials and Specifications for Turfgrass Sod Transplanting and Installation in its Guideline Specifications to Turfgrass Sodding.
- C. Storage and Protection
1. Store and cover materials off of ground to prevent materials from getting wet or damp, impairing material effectiveness.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.
1. Determine locations of existing trees remaining and protected areas extending to their existing drip lines. Exercise care when planting around existing trees and tree protection areas to not damage existing roots.
 2. Determine location of existing and proposed above grade and underground utilities and perform Work to avoid damage. Hand excavate as required.
 3. Notify Engineer if conditions detrimental to plant growth are encountered such as rubble fill, adverse drainage conditions, or obstructions, before planting.
 4. Coordinate Site water availability. Furnish water, water tank trucks, spray heads, hoses and other equipment required.

PART 2 – PRODUCTS

2.01 TURFGRASS SOD

- A. Install certified, approved, Number 1 quality, premium turfgrass sod, including limitations on thatch, weeds, diseases, nematodes, and insects, in accordance with TPI's Specifications for Turfgrass Sod.
1. Furnish sod with uniform density, color, and texture, strongly rooted and capable of vigorous growth and development when planted.
 2. Thatch layer not to exceed 1/2 inch.

3. Provide sod grown in a sand-based growing medium consistent with the following grain size distribution. Sod grown in fine grained, low permeability soil is not acceptable.

Percent Passing

U.S. Sieve Size Number	Minimum	Maximum
10	100 percent	-
18	85 percent	100 percent
35	60 percent	85 percent
60	25 percent	40 percent
140	6 percent	18 percent
270	4 percent	12 percent
0.002mm	2 percent	5 percent

- a. Maximum retained on number 10 sieve: 15 percent by weight of total Sample.
 - b. Organic content: between 3.0 and 8.0 percent.
- B. Turfgrass species: suitable for athletic field play with no less than 95 percent germination, no less than 85 percent pure seed, and no more than 0.5 percent weed seed to match seeding requirements.
1. Athletic field sod: seed blend with minimum of 3 cultivars of Kentucky Blue Grass (KBG) and remaining portions 25 percent perennial ryegrass and 25 percent tall fescue.

2.02 ATHLETIC FIELD ROOTZONE MIX

- A. Provide as specified in Section 32 01 90.16.

2.03 SOIL ADDITIVES

- A. Provide as specified in Section 32 01 90.16.

2.04 ORGANIC SOIL AMENDMENTS

- A. Provide as specified in Section 32 01 90.16.

2.05 FERTILIZER

- A. Commercial fertilizer for installed topsoil prior to lawn installation: neutral character, consisting of fast and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition.
 - 1. Nitrogen, phosphorous, potassium and other supplemental nutrients in amounts recommended in soil reports from a qualified soil-testing agency.
- B. Superphosphate: commercial, phosphate mixture, soluble with a minimum of 20 percent available phosphoric acid.
- C. Commercial fertilizer for post-installation: granular or pelleted fertilizer consisting of minimum 50 percent controlled release nitrogen, phosphorus, potassium, magnesium, and iron in the following composition.
 - 1. Composition: 1 pound per 1000 square feet of actual nitrogen, 6 percent phosphorous, 4 percent potassium, 2 percent magnesium, 1 percent iron by weight.
 - 2. Acceptable level of quality: equivalent to Greenskeeper 10-6-4, manufactured by Lebanon Turf Products, in accordance with the following analysis.

Guaranteed Analysis	Nutrient Sources
Total Nitrogen (N): 10 percent	
3 percent Water Insoluble Nitrogen	Methylene Ureas
4.2 percent Ammoniacal Nitrogen	Ammonium Phosphate and Ammonium Sulfate
2.8 percent Water Soluble Nitrogen	Urea and Methylene Ureas
Available Phosphate (P ₂ O ₅): 6 percent	Ammonium Phosphate
Soluble Potash (K ₂ O): 4 percent	Muriate of Potash
Magnesium (Mg): 2 percent	Dolomite
Total Iron (Fe): 1 percent	Ferrous Sulfate

2.06 BIOSTIMULANT

- A. Biostimulant: liquid concentrate of manure extract and bio stimulants that include cold water kelp extract, humic acid and fulvic acid, combined with chelated iron and surfactant.

- B. Acceptable level of quality: equivalent to Launch 0-0-1 Biostimulant manufactured by PBI-Gordon Corporation. Comply with the following.
 - 1. Guaranteed Analysis
 - a. Soluble potash (K₂O): 1.00 percent.
 - b. Iron (Fe): 0.36% chelated iron derived from potassium hydroxide, ferrous EDTA (ethylene diamine tetraacetic acid).
 - 2. Non-plant Food Ingredients
 - a. Manure extract: 74.30 percent.
 - b. Humic and fulvic acids: 9.00 percent.
 - c. Kelp extract: 1.20 percent.
 - d. Siloxane surfactant: 0.36 percent.

2.07 PLANTING ACCESSORIES

- A. Water: potable, clean, fresh, and free from harmful materials deleterious to plant growth, furnished and applied as necessary for lawn installation and maintenance.
- B. Fungicides and pesticides: type recommended by manufacturer for application, EPA registered and approved for type and rate of application, and approved by agencies with jurisdiction.
- C. Selective herbicides: type recommended by manufacturer for application, EPA registered and approved.

2.08 MULCHES

- A. Straw mulch: air-dried, clean, mildew and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Fiber mulch: biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic, free of plant-growth or germination inhibitors with maximum moisture content of 15 percent and pH range of 4.5 to 6.5.
- C. Non-asphaltic tackifier: colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.09 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Conduct tests on turfgrass sod by combined hydrometer and wet sieving in accordance with ASTM D422 after destruction of organic matter by ignition.
- C. Engineer may observe sod at place of growth for compliance with requirements for species, variety, color, uniformity of texture, and quality. Engineer may observe sod further for condition of root systems, insects, fungus, mold, mildew, thatch and diseases, and to reject unsatisfactory or defective material at any time during progress of Work. Remove rejected sod immediately from Project Site.

PART 3 – EXECUTION

3.01 GENERAL

- A. Coordinate Work of this Section with the following other Work of the Project.
 - 1. Subsurface utilities
 - 2. Concealed conditions
 - 3. Irrigation System Testing and Operation
 - 4. Sequence of exterior planting installation
 - 5. Other construction activities requiring access to lawn and athletic field areas
- B. Sequence athletic surface planting and athletic field root zone mix installation to avoid driving or operating any mechanical equipment over any installed athletic field root zone mix material. Rototill athletic field root zone mix material that has been driven over, re-compact and re-survey, or remove from Site and legally dispose of.
- C. Environmental Requirements and Planting Schedule
 - 1. Proceed with planting as specified, and only when existing and forecasted weather conditions permit.
 - 2. Do not install plant life when ambient temperatures may drop below 40 degrees F or rise above 80 degrees F, or wind velocity exceeds 30 mph. Do not plant when the ground is frozen, excessively wet, or soil is otherwise in unsatisfactory condition for planting.

3. Plant during one of the planting seasons outlines in Section 01 15 30, weather permitting. Coordinate planting periods with maintenance periods to provide required maintenance. Deviations from the following dates must be approved in writing.

3.02 EXAMINATION

- A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Prior to installation of lawns, determine location of surface and subsurface utilities.
 1. Do not disturb or damage sub-surface elements. Repair damaged utilities or subsurface elements, with no modification to the schedule.
 2. If subsurface elements are uncovered for plant items, notify Engineer immediately for approved relocation of items.
- C. Verify irrigation system in plant areas are in place, tested and ready for use.

3.03 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations. Protect adjacent and adjoining areas from hydro seeding overspray.
- B. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.04 INSTALLED TOPSOIL AND ATHLETIC FIELD ROOT ZONE MIX PREPARATION AT LAWN AND FIELD AREAS

- A. Apply commercial fertilizer as recommended by soil testing laboratory. Work fertilizer into top 4 inches of topsoil.
- B. Apply mycorrhizal inoculant as directed by manufacturer.
- C. Grade planting areas to smooth, uniform surface plane with loose, uniformly fine texture to within plus or minus 1/4 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting.
- E. Restore areas if eroded or disturbed after finish grading and before planting.

3.05 ATHLETIC FIELD AREA SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across angle of slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer, but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within 2 hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.06 SATISFACTORY LAWNS

- A. Satisfactory sodded field at end of maintenance period: healthy, well-rooted, even-colored, viable lawn or field surface, established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.07 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Provide installed athletic field root zone testing and quality assurance in accordance with Section 32 01 90.16.
- C. Engineer may observe sod at Site prior to planting for compliance with requirements for species, variety, color, uniformity of texture, and quality. Engineer may observe sod further for condition of root systems, insects, fungus, mold, mildew, thatch and diseases, and reject unsatisfactory or defective material at any time during progress of Work. Remove rejected sod immediately from Project Site.
- D. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

3.08 CLEANING

- A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving Site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Provide that barricades erected around grass ring paver unit areas are accessible by emergency and fire equipment during and after installation.
- C. Remove erosion-control measures after grass establishment period.

3.09 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

3.10 MAINTENANCE

- A. Begin maintenance immediately after each area is planted and continue until acceptable field surface is established, but for not less than the following periods. If full maintenance period has not elapsed before end of planting season, or if field is not fully established, continue maintenance during next planting season.
 - 1. Sodded athletic field – Until Final Completion or 180 days, whichever is longer.
- B. Maintain and establish field surface by watering, fertilizing, weeding, applications of pre-emergent and post-emergent herbicides, pesticides, and fungicides, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and re-mulch, if seeded, to produce a uniformly smooth turf surface. Adhere to all local, state and federal Regulations during turfgrass maintenance applications.
 - 1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.
- C. Coordinate irrigation system with planting Work of this Section. If irrigation system is not functional or does not extend to all plantings, provide and maintain temporary piping, hoses, and lawn-watering equipment to keep field surface uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of sod, seed, or mulch. Provide temporary watering system. Prevent walking on muddy or newly planted areas.
 - 2. Water field surface at a minimum rate of 1 inch per week.
- D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowing's. Do

not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowing's to maintain the following grass height.

1. Mow grass 2 inches in height for baseball field surface. Never mow greater than 1/3 of grass blade length per mowing.

E. Lawn Post Installation Fertilization Applications

1. Apply in 2 applications
 - a. Apply commercial fertilizer application with actual nitrogen of at least 0.5 pounds per 1,000 square feet to lawn area after initial mowing and when grass is dry. Water in fertilizer within 2 hours of application.
 - b. Apply commercial fertilizer application with actual nitrogen of at least 0.5 pounds per 1,000 square feet to lawn area 30 days after initial mowing when grass is dry. Water in fertilizer within 2 hours of application.

F. Lawn Biostimulant Applications

1. Apply in 2 applications
 - a. Apply biostimulant to lawn area 14 days after installation at a rate of 32 fluid ounces per 1,000 square feet and water into lawn as directed by manufacturer.
 - b. Apply biostimulant to lawn area 30 days after installation at a rate of 32 fluid ounces per 1,000 square feet and water into lawn as directed by manufacturer.

END OF SECTION

SECTION 32 18 23.43

RECREATIONAL COURT SURFACING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide recreational court surfacing in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 31 00 00 – Earthwork
 - 2. Section 32 12 16 – Asphalt Paving

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Sports Builders Association (ASBA)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 - 1. Technical data and tested physical and performance properties
 - 2. Product color chart
- C. Certificates
 - 1. Material certificates from producer, material Supplier, and Contractor certifying that each material item complies with specified requirements.

- D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements for manufacturer and as follows.
 - 1. Manufacturer: registered with American Sports Builders Association (ASBA)
 - 2. Installer: company specializing in installation of asphaltic concrete with 3 years' experience and minimum 2 similar projects.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Storage and Protection
 - 1. Prevent products from freezing during storage. If product may have been exposed to freezing temperatures, consult Supplier for proper handling instructions.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Surfacing system: acrylic.
- B. Allow Owner to choose color during submittal review process.

2.02 MATERIALS

- A. Acceptable level of quality: equivalent to DecoColor by DecoTurf.
 - 1. Crack filler
 - 2. Court patch binder
 - 3. Acrylic resurfacer
 - 4. Acrylic texture course

- 5. Acrylic color course
- 6. White line paint

2.03 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

- A. Prepare newly placed hot-mix asphalt surface, and allow recommended cure time prior to installation of surfacing system.
- B. Surface: smooth, free of dirt, loose or flaking paint, oily materials or chemical residues, vegetation and other debris or foreign matter preventing proper product adhesion.
- C. Flood surface to receive system treatment, allowing time to drain prior to installation.
- D. Complete earthwork and asphalt paving in accordance with Section 31 00 00 and 32 12 16 respectively, as required.

3.02 INSTALLATION

- A. Surfacing products are limited to application on hot-mix asphalt and Portland cement concrete recreational surfaces.
- B. Apply surface treatment in accordance with manufacturer’s instructions.
- C. Acrylic Resurfacer
 - 1. Apply 1 to 2 coats of acrylic resurfacer prior to application of surfacing system. Undiluted coverage rate for acrylic resurfacer is approximately 0.06 gallons per square yard, per application. Determine final volume required.
 - 2. Amend mix based on actual field conditions. Determine final volume required.

Acrylic resurfacer	55 gallons	30 gallons
Silica sand (60 - 80 mesh)	600 - 900 pounds	325 - 400 pounds
Clean potable water	20-40 gallons	11- 22 gallons

3. Do not use sand containing clay, silt, ferrous metals or salt.
 4. Mix thoroughly with mechanical mixer and stir until homogeneous. Mix periodically as Work progresses to ensure consistent application. Add more water in very warm conditions.
 5. Apply acrylic resurfacer mix using a 50-70 durometer flexible rubber squeegee parallel to 1 side of surface area. Do not leave ridges where adjoining applications overlap. In hot conditions, keep surface damp with fine mist water spray to improve application. Do not allow water to pool on surface.
 6. Allow acrylic resurfacer to cure a minimum of 2 hours before applying additional coatings, assuming 70 degrees F temperatures and 50 percent relative humidity.
- D. Color surfacing system: 2 components; acrylic texture coating and color coating.
1. Texture Course
 - a. Texture course is supplied as unpigmented concentrate intended to be tinted with color course. Undiluted coverage rate for texture course: approximately 0.05 gallons per square yard, per application.
 - b. Provide the following mixes for average surface conditions. Amend based on actual field conditions. Determine final volume required.

Texture course	55 gallons
Color Course	15 gallons
Clean potable water	23 gallons

- c. Mix thoroughly with mechanical mixer and stir until homogeneous. Mix periodically as job progresses to ensure consistent application. More water may be added in very warm conditions.
- d. Apply texture course using a 50 durometer flexible rubber squeegee parallel to 1 side of area to be coated. Do not leave ridges where adjoining applications overlap. In hot conditions, keep surface damp with fine mist water spray to improve application. Install additional applications at 90 degrees to previous application.

- e. Allow texture course to dry 4 hours between coating applications, assuming 70 degrees F temperatures and 50 percent relative humidity.

2. Color Course

- a. Undiluted coverage rate for color finish course: approximately 0.04 gallons per square yard, per application. Determine final volume required.
- b. Provide the following mixes for average surface conditions. Amend based on actual field conditions. Determine final volume required.

Color Course	55 gallons	30 gallons
Clean potable water	38 gallons	20 gallons

- c. Thorough mixing is required. Mechanical mixer is recommended. Stir mixture until homogeneous. Mix periodically as job progresses to ensure consistent application. More water may be added in very warm conditions.
- d. Apply color course using a 50 durometer flexible rubber squeegee parallel to 1 side of area to be coated. Do not leave ridges where adjoining applications overlap. In hot conditions, keep surface damp with fine mist water spray to improve application. Pooling water on surface is not acceptable. Install additional applications at 90 degrees to previous application. Apply broom finish following squeegee application.
- e. Allow color course to dry for 4 hours between coating applications, assuming 70 degrees F temperatures and 50 percent relative humidity.

E. White Line Painting

- 1. White line paint comes ready to apply. Do not dilute.
- 2. Consult ASBA Specifications for proper line striping layouts for basketball court surface.
- 3. Apply white striping paint suitable for exterior athletic surfaces to clean, dry, color coated surface by brush, roller, airless spray or special marking equipment. Apply tape to both sides of area to be striped. Apply primer coat, or final acrylic color coating over inside edges of the tape.
- 4. Allow white striping paint to dry for 4 hours between coating applications. Allow 24 hours after Project completion before releasing for use.

3.03 PRODUCT INSTALLATION LIMITATIONS

- A. Do not install products during rainfall, or when rainfall is imminent. Air temperature: minimum 60 degrees F and rising; maximum 140 degrees F.
- B. Make allowances for drying times retarded by high humidity, cool temperatures or lack of air movement.

3.04 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide chain link fences and gates in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. ASTM International (ASTM)
 - a. ASTM F1043 – Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
 - b. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - c. ASTM A116 Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
 - d. ASTM A120 Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and seamless, for Ordinary Uses
 - e. ASTM A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - f. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - g. ASTM A392 Zinc-Coated Steel Chain-Link Fence Fabric
 - h. ASTM A428 Weight of Coating on Aluminum-Coated Iron or Steel Articles
 - i. ASTM A491 Aluminum-Coated Steel Chain Link Fence Fabric
 - j. ASTM A536 Standard Specification for Ductile Iron Castings
 - k. ASTM C569 Steel, Carbon (0.15) Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality
 - l. ASTM F668 Polyvinyl Chloride (PVC) Coated Steel Chain Link Fence Fabric

- m. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- n. American Welding Society (AWS)
- o. Chain Link Fence Manufacturers Institute (CLFMI)
- p. CLFMI Product Manual
- q. Underwriters Laboratories
 - 1) UL 325 Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems
- r. US Army Corps of Engineers (USACE)
 - 1) CRD-C 621 Non-Metallic, Multi-Purpose, Cementitious, Non-Shrink Grout

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data and catalog cut sheets of fencing products.
- C. Foundry certificate for stainless steel 18-8 dowels.
- D. Welding certifications for welding procedures and personnel
- E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide vinyl coated chain link fences and gate units fabricated by single manufacturer, including erection accessories, fittings, and fastenings as indicated on Drawings with black coating on all fence component surfaces in accordance with ASTM F668.
- B. Shop welding: performed by AWS certified welders per AWS standards.
 - 1. Spot prime welds immediately after welding with a protective zinc rich metal primer.
 - 2. Grind smooth.

2.02 ACCEPTABLE MANUFACTURERS

- A. Allied Tube and Conduit Corporation
- B. Anchor Fence Co., Inc.
- C. United States Steel Corp.
- D. Acme Fence Company
- E. Master Halco
- F. Or equal

2.03 FENCING

- A. Fabric: one-piece fabric widths for fencing.
 - 1. Chain link fence: No. 9 gage finished size galvanized steel wires.
 - 2. Baseball field fencing: No. 6 gage finished size galvanized steel wires.
 - 3. Baseball backstop: wire fabric gage as indicated on Drawings for 2-inch mesh, with both top and bottom salvages twisted and knuckled, heights as indicated on Drawings, finished with a black vinyl coating.
 - 4. Manufactured in accordance with ASTM A491
- B. Steel end, corner, and pull posts: galvanized with exposed portions finished, with a black vinyl coating.

1. Minimum sizes and weights: 2.875 inch outside diameter (OD) pipe, 5.79 pounds per linear foot, or 3.5-inch by 3.5-inch roll-formed sections, 4.85 pounds per linear foot.
- C. Steel line post: galvanized with exposed portions finished with a black vinyl coating.
 1. Minimum sizes and weights: 2.375 inch OD steel pipe, 3.65 pounds per linear foot.
- D. Top rail: galvanized steel, manufacturer's longest lengths, with exposed portions finished with black vinyl coating.
 1. Minimum sizes and weights: 1.66 inch OD pipe, 2.27 pounds per linear foot or 1.625 inch by 1.25-inch roll-formed sections, 1.35 pounds per linear foot.
- E. Bottom Rail: galvanized steel, manufacturer's longest lengths, with exposed portions finished with black vinyl coating.
 1. Minimum sizes and weights: 1.66 inch OD pipe, 2.27 pounds per linear foot or 1.625 inch by 1.25-inch roll-formed sections, 1.35 pounds per linear foot.
- F. Expansion type couplings: approximately 6 inches long for each joint.
- G. Galvanized steel sleeves: not less than 6 inches long with inside diameter not less than 1/2 inch greater than outside diameter of pipe, with exposed portions finished with black vinyl coating pipe. Steel plate closure: welded to bottom of sleeve of width and length not less than 1 inch greater than OD of sleeve.
- H. Steel wire ties: 11 gage galvanized of sufficient length to be twisted a minimum of two full turns.
- I. Post brace assembly: manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375-inch diameter rod and adjustable tightener.
- J. Steel post tops: galvanized, weather-tight closure cap with exposed portions finished with black vinyl coating, for each tubular post, furnished with caps with openings to permit passage of top rail. Corner, end, and gate post caps: smooth top caps firmly affixed to post.
- K. Stretcher bars: galvanized steel with exposed portions finished with black vinyl coating in one-piece lengths equal to full height of fabric, with minimum cross-section of 3/16 inch by 3/4 inch. Provide 1 stretch bar for each gate and end post, and 2 for each corner and pull post. Stretch bar bands: manufacturer's standard.

- L. Pipe posts and rails: ASTM F1083 and ASTM A53, Schedule 40 galvanized steel, delivered in condition for erection without field fitting or cutting.
 - 1. Stainless steel 18-8 dowels: ASTM A536, fabricated ductile iron grade 65-45-12 castings, Type A finials for pipe rail fence and Type C cast ductile iron posts for pipe rail fence. Acceptable level of quality: equivalent to Wemco Castings.

2.04 PEDESTRIAN GATES

- A. Fabricate pedestrian gate frames of 2 inch OD pipe. Metal and finish to match framework. Provide horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.
- B. Assemble gate frames by welding or with special fittings and rivets for rigid connections. Use same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to gate frame at not more than 15 inch on center. Attach hardware to provide security against removal or breakage. Install diagonal cross bracing consisting of 3/8-inch diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist, if required. Top and bottom rails required.
- C. Provide forked or plunger-bar type latch for each gate to permit operation from either side with padlock eye as integral part of latch.

2.05 FINISH

- A. Provide galvanized fabric finish in accordance with ASTM A392, Class I, with not less than 1.2-ounce zinc per square foot of surface.
- B. Provide galvanized steel framing in accordance with ASTM A120 or A123, with not less than 1.8-ounce zinc per square foot of surface.
- C. Provide galvanized hardware and accessories in accordance with ASTM A153, Table 1, with zinc weights.
- D. Do not apply lacquer, urethane, or other coatings to pipe.
- E. Ensure surfaces to be coated are clean, dry, and free of grease, dust, rust, and debris. Apply phosphating and chromating treatments to parts prior to coating.
- F. Apply polyvinyl chloride (PVC) powder coating to galvanized steel or iron by fluid bed method, to a cleaned, primed, preheated base prior to submersion in vinyl. Apply a firm thickness of 10 to 15 mils without voids, tears or cuts that reveal substrate, adhering to metal without peeling when scratched with a pick device or knife blade point.

2.06 ACCESSORIES

- A. Portland cement: ASTM C150.
- B. Aggregates: ASTM C33.
- C. Exterior grout: USACE CRD-C 621 non-shrink, non-metallic premixed, factory-packaged, non-corrosive non-staining, nongaseous.
- D. Provide 1 pad lock for each pedestrian gate.
- E. Signs
 - 1. Acceptable level of quality: equivalent to Duraflex .040-gauge aluminum, Model 10-03-300 by Safety Sign Co.
 - 2. Provide two, 10 inch by 14 inch signs to read as follows.

**NOTICE
NO TRESPASSING**

2.07 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONCRETE MIXING

- A. Mix materials to obtain concrete with minimum 28-day compressive strength of 3,000 psi for fence footings, 1-inch maximum size aggregate, maximum 3-inch slump, and 2-4 percent entrained air.

3.02 INSTALLATION

- A. Install in accordance with manufacturers recommended procedures and instructions. Provide secure, aligned installation with line posts spaced at maximum 10 feet on-center.
- B. For posts receiving footings, grade set posts, drill or hand excavate using post hole digger in firm undisturbed or compacted soil.
- C. For posts receiving footings, excavate hole for each post to minimum diameter recommended by fence manufacturer, but not less than diameter shown on Drawing details.
- D. For posts receiving footings, center and align posts in holes 6 inches above bottom of excavation.

- E. For posts receiving footings, place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
- F. Anchor posts with pipe sleeves, preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, non-metallic grout, mixed and placed in compliance with grout manufacturer's instructions.
- G. Run top rail continuously, bending to form radius for curved runs. Provide expansion couplings as recommended by manufacturer.
- H. Provide center rails where indicated. Install in 1-piece between posts and flush with post on fabric side, using special offset fittings where necessary.
- I. Run bottom rail continuously, bending to form radius for curved runs. Provide expansion couplings as recommended by manufacturer.
- J. Install braces so posts are plumb when diagonal rod is under proper tension.
- K. Leave approximately 2 inches of fabric between finish grade and bottom salvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so fabric remains in tension after pulling force is released.
- L. Secure stretcher bars at end, corner, pull, and gate posts by threading through or clamping to fabric at 4 inches on center, and secure to posts with metal bands spaced at 15 inches on center.
- M. Tie Wires
 - 1. Use U-shaped wire conforming to diameter of pipe, clasping pipe and fabric firmly when ends are twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
 - 2. Tie fabric to line posts with wire ties spaced 12 inches on center. Tie fabric to rails and braces with wire ties spaced 24 inches on center. Tie fabric to tension wires with hog rings spaced 24 inches on center.
- N. Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- O. Welding: performed by AWS certified welders per AWS standards.
- P. Powder coat posts, rails and castings after welding with PVC, 10 to 15 mils thick.
- Q. Install sliding gate system in compliance with ASTM F2200 and UL 325.

- R. Install pedestrian gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage, as recommended by fence manufacturer. Adjust hardware for smooth operation and lubricate where necessary.
- S. Install signs near gate, and opposing side.
- T. Hang padlocks at gate and turn over keys to Owner.

3.03 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 32 31 29

WOOD FENCES AND GATES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide wood fences and gates in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 31 00 00 – Earthwork

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. ASTM International (ASTM)
 - a. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - b. ASTM F537 Standard Specification for Design, Fabrication, and Installation of Fences Constructed of Wood and Related Materials
 - 2. Western Red Cedar Lumber Association (WRCLA)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Shop Drawings
 - 1. Shop Dimensions, fencing layout, finish, weight and size of members, methods of fastening, and installation details of fence and gates

2. Coordination drawings where inserts or sleeves are required
 3. Plan layout, spacing of components, post foundation dimensions, and materials
 4. Catalog cut sheets of fencing products
- C. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide wooden fences and gate units fabricated by a single manufacturer, including erection accessories, fittings, and fastenings as indicated on Drawings and as specified in ASTM F537.
- B. Wood Materials
1. Fence slats, boards and trim: standard grade and better per WRCLA, surfaced one side, two edges (S1S2E), sized as shown on Drawings.
 2. Horizontal supports: rough sawn, knotty grade, sized as shown on Drawings.
 3. Posts: rough sawn, No. 2 grade and better, sized as shown on Drawings.
- C. Fasteners
1. Flat head aluminum nails with ring or spiral-threaded shank and blunt point: sufficient length to penetrate support framing a minimum of 1-1/2 inch.
 2. Hot-dip galvanized bolts and washers: ASTM A153, unless otherwise noted.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONCRETE MIXING

- A. Mix materials to obtain concrete with minimum 28-day compressive strength of 3,000 psi for fence footings; 1-inch maximum size aggregate, maximum 3-inch slump, and 2-4 percent entrained air.

3.02 INSTALLATION

1. Install posts, rails and hardware in accordance with manufacturer's instructions.
2. Install with line posts spaced 10 feet on-center maximum, in accordance with manufacturer's instructions and recommended procedures.
3. Anchor securely with smooth miters and field cuts after joining. Provide adequate support for anchoring.
4. Install gates for full opening without interference. Adjust hardware for smooth operation.
5. Expansion Bolts
 - a. Install in snug fitting, smoothly drilled holes in accordance with manufacturer's written instructions.
 - b. Place bolts so load acts in shear.
6. Grade set posts receiving footings. Drill or hand excavate using post hole digger in firm undisturbed or compacted soil.
7. Excavate hole for each post receiving footings to minimum diameter recommended by fence manufacturer, but not less than diameter as shown on Drawing details.
8. Center and align posts receiving footings in holes 6 inches above bottom of excavation.
9. Place concrete around posts receiving footings and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

10. Set post plumb and to correct elevations. Post may be power driven or set by hand. If power driven, top of post must be protected by suitable driving cap. If set by hand, perform excavation, backfill and compaction in accordance with Section 31 00 00.
11. Install brace assemblies so posts are plumb when diagonal rod is under proper tension.

3.03 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 32 72 00

WETLANDS RESTORATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide wetland area landscaping and restoration in accordance with this Section and applicable reference standards listed in Article 1.03 and furnish wetland specialist to monitor construction of wetland replication area and wetland restoration area.
2. Construction Areas
 - a. Wetland restoration area of plus or minus 830 square feet consists of temporary impacts to the bordering vegetated wetlands that will be restored in place by re-grading upper 6 to 12 inches of soil as necessary to match existing wetland conditions, re-establishing a wetland plant community by spreading a native wetland seed mix and installing native wetland plantings as indicated on Drawings. Import additional topsoil to Site if necessary.
 - b. Wetland replication area of plus or minus 1,573 square feet will be created through excavation to a sub-grade 12 inches below existing adjacent wetland elevation. Import 12 inches of topsoil to match elevations with adjacent wetland. Replant area with native wetland vegetation.

B. Related Requirements

1. Section 31 00 00 Earthwork
2. Section 31 25 00 Erosion and Sedimentation Controls

1.02 PRICE AND PAYMENT PROCEDURES

- ###### A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. AOAC International (AOAC)
 - 2. Association of Official Seed Analysts (AOSA)
 - 3. Order of Conditions (OOC)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: in accordance with Division 01 General Requirements.
- B. Meet with Salem Conservation Agent to review OCC prior to beginning Work of this Section.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Provide submittals at least 30 days prior to ordering materials.
- C. Samples: as specified in Article 1.06.
- D. Source and Field Quality Control Submittals
 - 1. Suppliers' certified analysis for standard products by a recognized laboratory in accordance with methods established by AOAC for non-standard products
 - 2. Suppliers' certified analysis for soil amendments and fertilizer materials
 - 3. Seed Suppliers' certified statement for each grass seed mixture required, stating botanical and common name; percentage by weight; percentages of purity germination; and weed seed for each grass seed species
 - 4. Proposed planting schedule, indicating dates for each type of landscape Work during typical seasons as specified in Section 3.07 for such Work in area of Site correlated with specified maintenance periods to provide maintenance until Final Completion, or a minimum of 180 days, whichever is longer.
- E. Name and qualifications of wetland specialist
- F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Samples
 - 1. Topsoil material from on-Site stockpile
 - 2. Topsoil material from off-Site sources

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- A. Do not order or deliver material until submittals are approved.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Deliver grass seed in original containers identifying analysis of seed mixture, percentage of pure seed, year of production, net weight, and date and location of packaging. Do not deliver damaged packages.
 - 2. Deliver fertilizer in waterproof bags identifying weight, chemical analysis, and name of manufacturer.
 - 3. Package certified analyses with products.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 TOPSOIL

- A. Furnish new, imported topsoil, free of invasive species, consisting of mixture of organic clean leaf compost soil and clean loam mineral soil which is fertile, friable, natural loam surface soil found at a depth of not less than 4 inches from original ground surface, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, debris, and stones larger than 2 inches in any dimension.
- B. Obtain topsoil from local sources or from areas having similar soil characteristics as Site. Obtain topsoil only from naturally, well-drained Sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.
 - 1. Recommended mineral soil textures: sandy loam, fine sandy loam, silt loam or loam.

2. Have wetland specialist confirm proper ratio of mineral soil and compost mixture. Organic matter content of soil mixture: approximately 20 percent.
- C. Obtain approval of soil Supplier from wetland specialist prior to ordering soil mixture.
- D. Test soil sample to confirm it meets requirements specified. Obtain inspection and approval of soil mixture by wetland specialist before topsoil is placed in replication area and restoration area.
- E. Furnish additional topsoil to complete landscape Work if quantity of topsoil stockpiled for reuse is insufficient. as specified in Section 31 10 00, and this specification. This Section takes precedence over Section 31 00 00 for wetlands areas.

2.02 PLANTINGS

- A. Furnish native species plantings. Do not use landscape cultivars. Furnish plants of type and quantities as shown on Drawings.
- B. Contact wetland specialist prior to ordering plantings and seed mix to confirm nursery sources.

2.03 EROSION AND SEDIMENTATION CONTROL

- A. Furnish 6-inch diameter biodegradable coir fiber logs or compost filled logs for stabilization of banks between wetland replication area and banks of pond, and also between wetland restoration area and pond.
- B. Anti-erosion mulch: clean, seed-free threshed straw of wheat, rye, oats, or barley. Do not use hay.
- C. Erosion control mesh: uniform, open-weave jute matting or flexible vinyl mat. Acceptable level of quality: equivalent to Mira Mat erosion control. Acceptable level of quality for re-vegetation mat: equivalent to TenCate Mirafi.

2.04 SOIL AMENDMENTS

- A. Furnish natural limestone containing not less than 90 percent total carbonates, ground so not less than 98 percent passes a 20-mesh sieve and not less than 40 percent passes a 100-mesh sieve.

2.05 GRASS SEED

- A. Furnish fresh, clean, new crop seed, complying with tolerance for purity and germination established by AOSA. Do not use wet, moldy, or damaged seed. Seed mixtures listed below are proportions by weight.

1. Germination: minimum 80 percent.
2. Purity: minimum 85 percent.
3. Weed content: maximum 1 percent.

B. Roadside Mixture

1. 50 percent Creeping Red Fescue
2. 15 percent Kentucky Bluegrass
3. 2 percent Red Top Clover
4. 25 percent Annual Ryegrass
5. 3 percent Bird's Foot Trefoil, Variety Empire
6. 5 percent White Clover

C. Ecology Mixture

1. 50 percent Creeping Red Fescue
2. 5 percent White Clover
3. 15 percent Kentucky Bluegrass
4. 2 percent Red Top Clover
5. 25 percent Annual Ryegrass
6. 3 percent Bird's Foot Trefoil, Variety Empire

D. Lawn Repair Mixture

1. 60 percent Kentucky Bluegrass
2. 20 percent Perennial Ryegrass
3. 20 percent Chewings Fescue

- E. Wetlands Edge Mixture
 - 1. 55 percent Tall Fescue
 - 2. 10 percent Poa trivialis
 - 3. 15 percent Kentucky Bluegrass
 - 4. 5 percent Redtop
 - 5. 10 percent Perennial Ryegrass
 - 6. 5 percent Reed Canary Grass

- F. New England Conservation Seed Mixture
 - 1. Acceptable level of quality: equivalent to that manufactured by New England Wetland Plants.
 - 2. Big Bluestem (*Andropogon gerardii*)
 - 3. Switchgrass (*Panicum virgatum*)
 - 4. Little Bluestem (*Schizachyrium scoparium*)
 - 5. Canada Wild Rye (*Elymus canadensis*)
 - 6. Fox Sedge (*Carex vulpinoidea*)
 - 7. Partridge Pea (*Chamaecrista fasciculata*)
 - 8. Fringed Bromegrass (*Bromus ciliatus*)
 - 9. Pennsylvania Smartweed (*Polygonum pennsylvanicum*)
 - 10. Common Milkweed (*Asclepias syriaca*)
 - 11. Showy Tick-Trefoil (*Desmodium canadense*)
 - 12. New England Aster (*Aster novae-angliae*)
 - 13. Flat-top Aster (*Aster umbellatus*)
 - 14. Nodding Bur-Marigold (*Bidens cernua*)

2.06 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Install DEP Sign showing **DEP File # 64-596** at entrance to the Site so it can be seen from the public way prior to any Work commencing on-Site. Do not place on a living tree.
- B. Remove foreign materials, plants, roots, stones, and debris from Site. Do not bury foreign material.
- C. Do not obstruct roads, driveways, sidewalks, gutters and drainage ditches, swales and channels with excavated material.
- D. Avoid damage to utilities, buildings and private property.
- E. Avoid damage to historic brick, cobbles, and stones. APPLICABLE?
- F. Do not disturb property markers.
- G. Immediately report damage to Engineer.
- H. Complete landscape Work immediately as portions of Site become available, working within seasonal limitations for each kind of landscape Work. Notify Engineer before planting if conditions detrimental to plant growth are encountered.
- I. Plant or install materials during normal planting seasons for each type of landscape Work required.
- J. Remove contaminated subsoil.

3.02 PREPARATION

- A. Import soil to complete the wetland replication area and as needed to complete the wetland restoration area if existing impacted soils are not salvageable. Import approximately 12 inches of organic rich topsoil to the wetlands replication area. Depth of topsoil in wetland restoration area and wetland replication area may be modified as necessary by wetland specialist. Legally dispose of excess soil.
- B. Loosen subgrade of grass areas to minimum of 3 inches. Remove stones over 1-1/2 inches in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas to be planted promptly after preparation.
- C. Spread top soil to minimum depth of 4 inches after light rolling and natural settlement. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil.

- D. Preparation of soil for grass planting in areas that have not been altered or disturbed by excavating, grading, or stripping operations
 - 1. Till to a depth of not less than 6 inches.
 - 2. Apply soil amendments and initial fertilizer.
 - 3. Remove high areas and fill in depressions.
 - 4. Till soil to homogenous mixture of fine texture free of lumps, clods, stones, roots and other extraneous matter.
- E. Fine grade areas to smooth even surface with loose, uniformly fine texture. Roll, rake and remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas to be planted immediately after grading. Assure Provide positive drainage away from buildings and structures.
- F. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting grass. Do not create muddy soil conditions.
- G. Restore grassed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.03 WETLANDS SPECIALIST

- A. Furnish wetland specialist on Site to monitor construction of wetland replication area and wetland restoration area for compliance with approved Drawings and plans, the Massachusetts Wetlands Protection Act and the OOC for Project issued by the Salem Conservation Commission.
- B. Wetland specialist responsibilities
 - 1. Monitor wetland replication area and wetland restoration area in accordance with OOC and prepare monitoring reports to be submitted to Conservation Commission, and Engineer.
 - 2. Verify proper subgrades are achieved to intercept wetland hydrology in wetland replication area.
 - 3. Observe establishment of final grading of wetland replication area and wetland restoration area to verify final grades are similar to adjacent bordering vegetated wetlands.
 - 4. Confirm proposed plantings have been installed properly.
- C. Include photographic documentation, description of health of plantings, and recommendations for replacement plantings or modifications, if necessary in

monitoring reports. Address compliance with 310 CMR 10.55 (4)(b), which requires 75 percent or more coverage by native wetland indicator species within two growing seasons.

3.04 SEEDING NEW AREAS

- A. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
- B. Do not sow immediately following rain or when ground is too dry.
- C. Seed application rate
 - 1. New England Conservation Seed Mix: 1 pound per 1,750 square feet.
 - 2. All others: 1 pound per 1,000 square feet.
- D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with a fine spray.

3.05 HYDROSEEDING NEW AREAS

- A. Mix specified seed and pulverized mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
- B. Apply slurry using an approved machine. Seed and suitable corn fiber mulch may be applied in one operation. Mix materials with water in machine and agitate to keep mixture uniformly suspended. Use spraying equipment that will distribute slurry uniformly at required rates.
- C. Mulch areas with anti-erosion mulch by means of mulch blower at rate of 1,200 pounds per acre on level grades, 2,000 pounds on slopes if mulch is not part of slurry immediately following hydroseeding.
- D. Seed only areas that can be mulched on same day.

3.06 PROTECTION OF SEEDED SLOPES

- A. Protect seeded slopes against erosion with erosion netting or other acceptable methods.
- B. Spread specified mulch after completion of seeding operations to form a continuous blanket not less than 1-1/2 inches loose measurement over seeded areas.

- C. Anchor mulch by spraying with asphalt emulsion at rate of 10 to 13 gallons per 1,000 square feet. Prevent damage or staining of construction or other plantings adjacent to mulched areas.
- D. Cover seeded slopes with jute matting where grade is 3:1 or greater. Roll matting down over slopes without stretching or pulling.
- E. Lay matting smoothly on soil surface, burying top end of each section in narrow 6-inch trench. Leave 12-inch overlap from top roll over bottom roll. Leave 4-inch overlap over adjacent section.
- F. Staple outside edges and overlaps at 36-inch intervals.
- G. Lightly dress slopes with topsoil to ensure close contact between matting and soil.
- H. Unroll matting in direction of flow in ditches. Overlap ends of strips 6 inches with upstream section on top.

3.07 PLANTING OF SHRUBS AND TREES

- A. Plant areas during one of the planting seasons outlined in Section 01 15 30, weather permitting. Coordinate planting periods to provide required maintenance. Deviations from Dates listed must be approved in writing
- B. Plant Cinnamon fern (*Osmunda cinnamomea*) approximately every 24 inches on center underneath proposed boardwalk
- C. Prune injured roots or branches to make clean-cut ends prior to planting, utilizing clean, sharp tools, removing only injured or diseased branching.
- D. Remove planting containers, baskets, and non-biodegradable materials from root balls during planting. Cut natural fiber burlap from around the trunk of trees and folded down against root ball prior to backfilling.
- E. Position trees and shrubs at intended locations shown on Drawings and obtain Engineer's approval prior to excavating pits, making necessary adjustments as directed.
- F. Dig planting pits with level bottoms with width twice the diameter of root ball. Rest root ball on undisturbed grade. Backfill each plant pit in layers with thoroughly mixed, prepared soil. Prepared soil: 1 part peat moss; 1 part composted cow manure by volume; 3 parts topsoil by volume.
 - 1. Planting tablets: 21 grams, Agriform or equal.
 - a. 2 tablets per 1-gallon plant
 - b. 3 tablets per 5-gallon plant

- c. 4 tablets per 15-gallon plant
 - d. Larger plants: 2 tablets per 1/2-inch caliper of trunk
- G. Fill prepared soil around ball of plant halfway, and insert plant tablets. Complete backfill, and water thoroughly.

3.08 EROSION AND SEDIMENTATION CONTROL

- A. Furnish and install in accordance with Specification 31 25 00 and this Specification.
- B. Install coir fiber logs or compost filled logs for stabilization of banks between wetland replication area and banks of pond, and also between wetland restoration area and pond. Install logs directly on face of pond banks and anchor with earth anchors or wooden stakes.
- C. Maintain erosion and sedimentation controls during construction to protect of wetland resource areas. Do not remove erosion controls until up-gradient areas are fully stabilized with vegetation, and Salem Conservation Agent or Engineer grants approval.

3.09 REPAIR/RESTORATION

- A. Restore pavement, sidewalks and walkways, grassed areas and planted areas damaged during execution of Work as directed by Engineer.
- B. Repair grassed areas disturbed during performance of Work. Provide seed to re-establish grass where existing topsoil remains. Provide additional topsoil where necessary.
- C. Recondition existing lawn areas damaged during execution of Work and existing lawn areas where minor re-grading is required.
- D. Provide fertilizer, seed or sod, and soil amendments as specified and required for new lawns, to provide a satisfactorily reconditioned lawn. Provide new topsoil as required to fill low spots and meet new finish grades.
- E. Cultivate bare and compacted areas thoroughly to provide satisfactory planting bed.
- F. Remove diseased and unsatisfactory lawn areas. Do not bury into soil. Remove topsoil containing foreign materials resulting from execution of Work.
- G. Water newly planted areas and keep moist until new grass is established.

3.10 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

B. Site/Field Tests and Inspections

1. Provide inspection by wetlands specialist to address compliance with 310 CMR 10.55 (4)(b), which requires 75 percent or more coverage by native wetland indicator species within two growing seasons.

3.11 CLEANING

- A. Keep pavement, sidewalks, and walkways clean. Maintain protection during installation and maintenance periods.

3.12 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

3.13 MAINTENANCE

- A. Provide maintenance of grass seeded areas immediately after planting.
- B. Maintain grass by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish smooth, acceptable lawn areas free of eroded or bare areas.
- C. Maintain grassed areas to establish acceptable lawn until Final Completion, or for a minimum of 180 days after Substantial Completion, whichever is longer.
- D. If seeded in the fall season, and full 180 days of maintenance is not provided, or if not considered acceptable at that time, continue maintenance during the following spring season until acceptable lawn areas are established.
- E. Replace dead plants within 1 year of initiation of Warranty Period, or as recommended by wetland specialist and Engineer.
- F. Maintain trees and shrubs until Final Completion, or for a minimum of 180 days after Substantial Completion, whichever is longer.

END OF SECTION

SECTION 32 80 00

IRRIGATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide an automatic irrigation system in accordance with this Section and applicable reference standards listed in Article 1.03 and as shown on Drawings.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. CSA International (Canadian Standards Association) (CSA)
 - 2. National Science Foundation (NSF)
 - 3. ASTM International
 - a. D2564 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
 - b. F493 Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
 - c. D2241 Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
 - 4. Underwriters Laboratories (UL)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.
- B. Coordinate with Owner for location of controller and rain sensor.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
- C. Shop Drawings
 - 1. Location of controls and services, location and coverage or sprinkler heads, landscape features, structures, schedule of fittings, and control system wiring diagrams
- D. Certificates from each manufacturer or Supplier that product meets Specification and do not contain hazardous materials
- E. Manufacturer Instructions
- F. Source and Field Quality Control Submittals
- G. Qualification Statements including with job locations, names of owners, engineer's and/or, architects, their phone numbers, and dates on which the work on each project was started and completed
- H. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
 - 1. Record drawings identifying exact field locations of sprinkler heads, piping with pipe size, valves, sprinkler type, pop up height and nozzle for each sprinkler installed and location for quick couplers and miscellaneous equipment for the entire irrigation system and actual construction indicating horizontal and vertical locations referenced to permanent surface improvements. Reference valve box locations by distance in a triangular fashion from a minimum of two permanent locations.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements and as follows.
 - 1. Completion of at least 5 comparable projects installer has completed within the last 5 years
 - 2. Licensed in the state where Project is located

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Deliver components in manufacturer's original undamaged and unopened containers with labels intact and legible.
 - 2. Deliver piping in bundles, packaged to provide adequate protection of pipe ends, both threaded or plain.
- C. Storage and Protection
 - 1. Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.
 - 1. Draw water for the system from the water meter pit on Site at a rate of 40 GPM at 60 psi.

1.09 WARRANTY

- A. Sprinkler: 5 year, over-the-counter exchange warranty, (non-prorated).

PART 2 – PRODUCTS

2.01 SYSTEM MANUFACTURERS

- A. Hunter Industries
- B. Rainbird
- C. Toro
- D. Or equal

2.02 PIPE MATERIALS

- A. Pipe sizes 2-1/2 inches and smaller: PVC, Class 200, SDR 21, solvent-weld PVC, ASTM D2241.
- B. Pipe for sleeving: PVC, Class 160, SDR 26, gasketed joint PVC to be joined with couplers, or solvent weld, ASTM No. D2241.

2.03 PIPE FITTINGS

- A. PVC pipe fittings for sizes 2-1/2 inches and smaller: Schedule 40 solvent weld PVC fittings as manufactured by Dura, Spears, or Lasco.
- B. Acceptable level of quality for PVC pipe fittings for sizes larger than 2-1/2 inches: equivalent to ring-tite PVC fittings as manufactured by Harco.
- C. Solvent cement for use on PVC fittings: NSF approved Type I and Type II PVC pipe and Schedule 40 fittings, ASTM D2564 and ASTM F493 for potable water, pressure, gas conduit and drain pipes. Application temperature: 35 to 110 degrees F.
- D. Nipples: Schedule 80 PVC.
- E. Threaded connections: Schedule 80 toe nipples and PVC couplings. Do not use saddles and male adapters for any type of connection.

2.04 MANUAL ISOLATION VALVE

- A. Type: brass full port ball valve.
- B. Construction: cast bronze, chrome plated brass ball, blowout-proof stem with stainless steel 90 degree handle and a 600 WOG rating. Install blow-out assemblies.
- C. Acceptable level of quality: equivalent to Dura.

2.05 QUICK COUPLER VALVE

- A. Acceptable level of quality: equivalent to one-piece single lug type, Hunter Series, by Hunter Industries.
- B. Construction: brass with a wall thickness guaranteed to withstand a normal working pressure of 150 psi without leakage capable of accepting quick coupler key with a top connection of female pipe thread and male pipe thread.

2.06 SWING JOINT

- A. Swing joint assemblies for sprinklers: factory assembled 1 inch Schedule 80 PVC with four 90 degree elbows and one 12 inch long nipple with 90 degree bend on one end.
- B. PVC: Type I, Cell Classification 12454-B material listed for potable water conveyance by NSF
- C. Working pressure: 200 psi combined static and surge.

2.07 VALVE BOXES

- A. Type: adjustable telescoping type, where depth of trench dictates; otherwise use top section only. Acceptable level of quality: equivalent to Carson VB1419124.

2.08 WIRE

- A. Wire to the controller locations: sized to supply minimum 105 VAC. Size of wire: minimum 14/2 irrigation wire.
- B. Valve control wire and common wire: single, solid copper conductor, PE jacketed, direct burial irrigation wire. Common wire: different color from control wire for identification and minimum than #14.
- C. Control wire: minimum #14.
- D. Provide each controller with separate common wire.

2.09 CONTROLLER

- A. Controller: capable of manual, semi-automatic or fully automatic operation, with rapid advance through unused station and a minimum of 24 outputs for valve activation with individual station timing, and a station time multiplier for seasonal and water budgeting adjustments
- B. Acceptable level of quality: equivalent to Hunter Industries IC Controller.
- C. Furnish a lockable, wall mount, weather-resistant steel case to house irrigation controller.

2.10 ELECTRIC VALVE

- A. Type: globe pattern, normally closed and electric solenoid-actuated with reverse flow principle, equally pressurizing the top and bottom of diaphragm assembly when deactivated and with internal bleed for manual operations.
- B. Valve body and bonnet: plastic.
- C. Diaphragm: one-piece, molded, and with a burst test strength of 2,600 psi.
- D. Flow control stem: stainless steel.
- E. Acceptable level of quality: equivalent to Hunter ICV Series as manufactured by Hunter Industries.

2.11 SPRINKLER EQUIPMENT

- A. Type: large gear-driven rotary sprinklers capable of both full circle and adjustable part-circle configurations with capability to operate when installed 1/2 inch below grade.
 - 1. Adjustable part-circle unit: infinitely adjustable from 40 to 360 degrees with adjustment from the top of the sprinkler.
- B. Equip with drain check valve to prevent low head drainage and capable of checking up to 15 feet in elevation change.
- C. Pop-up stroke: minimum of 3 1/2 inches to bring rotating nozzle turret into a clean environment.
- D. Provide with co-molded rubber cover and interchangeable nozzle identifiers to indicate nozzle in use.
- E. Exposed surface diameter after installation: 2 inches
- F. Encase riser and nozzle turret assembly in stainless steel.
- G. Acceptable level of quality: equivalent to Hunter Industries.

2.12 SPRINKLER CONNECTION TO MAIN

- A. Material: PVC rated for 250 PSI
- B. MPT threads: 1 inch on riser
- C. Swing joint: square thread to prevent dirt from entering. Acceptable level of quality: equivalent to swing joint manufactured by Dura.

2.13 PVC CEMENT

- A. Cement for use on PVC fittings: NSF approved for type I and Type II PVC pipe and Schedule 40 fittings, meeting ASTM D2564 and F493 for potable water, pressure, gas conduit and drain pipes. Application temperature: 35 to 110 degrees F.

2.14 ACCESSORIES

- A. Furnish concrete for thrust blocks.
- B. Conduit: 1-1/2 inches.

- C. Wire splicing kits: DBY/DBR with wire nuts, UL listed, and CSA certified, pre-injected with water proofing compound. Acceptable level of quality: equivalent to wire nuts and connectors as manufactured by 3M Corporation, Electrical Products Division.
- D. Electrical tape: non-corrosive, water and oil resistant, 8 mil thick, suitable for use between 32 and 176 degrees Fahrenheit, and UL listed.
- E. Rain sensor: capable of shutting irrigation system off by opening the common wire to the irrigation controller and adjustable to amount of rain needed before shutdown. Acceptable level of quality: equivalent to Toro RainSensor Plus Series.
- F. Ground rods: 5/8 inch by 10 feet, UL listed, copper clad steel.
- G. Acceptable level of quality for ground rod box: equivalent to Carson VB70894 with cover.
- H. Acceptable level of quality for splice sealing: equivalent to Scotchloc Sealing Packs #3570 with wire nuts or other epoxy style connectors.

2.15 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Install irrigation system components in accordance with manufacturers' installation instruction and industry standard practices.
- B. Draining system: by purging with compressed air. Do not install drain valves.

3.02 PREPARATION

- A. Provide stakes and stake out proposed piping and wiring routes, sprinkler, valve and controller locations in accordance with Drawings. Obtain approval prior to commencement of installation.

3.03 INSTALLATION

- A. Complete excavating, vibratory plowing, and backfilling required for proper installation of the system.
- B. Install pipe in accordance with manufacturer recommendations including bedding of pipe in bottom of the trench and securely thrusting fittings to change direction of the pipe. Pour thrust blocks in a manner to not interfere with any pipe joint or connection.

- C. Minimum depth of cover over pipe and wire
 - 1. Main line piping: minimum 18 inches.
 - 2. Zone piping (downstream of automatic control valves): 12 inches for athletic fields, 12 inches for general area.
 - 3. Wire in main line pipe trench: at depth of pipe.
 - 4. Wire in separate trench from pipe (24 V wire): 18 inches.
- D. Install wire under roads and through culverts in 1-1/2-inch conduit. Extend conduit 5 feet beyond road or culvert and plug with duct tape or other approved method.
- E. Install wire in the same trench as the pipe wherever possible. Install wire with minimum 1 percent slack, 36-inch expansion loop at each 45 degree or 90 degree turn in the trench and provide 18-inch expansion loop at each automatic valve. Wire may be laid with a vibratory plow. Do not pull.
- F. Wire runs not following pipe trenches: laid in a straight line.
 - 1. Make runs at an angle between two straight runs if change of direction is required. Do not install as a sweeping curve.
 - 2. Install splice box at the angle point with sufficient wire slack to allow wires to be raised minimum 24 inches above grade.
 - 3. Splices for power cable and valve wiring: made in controller enclosures, valves boxes, or a separate splice box.
 - 4. Accurately locate on record drawings.
- G. Do not make field splices without specific approval of DBY and DBR splices. Seal splices. Accurately locate on record drawings.
- H. Backfill material: free from rock, large stones, or other unsuitable substances to prevent damage to pipe and wire during backfilling operations.
- I. Remove excess material to location on Site as directed.
- J. Complete backfilling by hand, placing it under, around and above pipe in stages and hand tamp in layers to a point 6 inches above pipe. Ensure this layer is free of stones and other deleterious matter. Backfill the remainder of the trench by hand or machine with available soil. Compact machine-placed backfill to original density by machine tamping, rolling or puddling to prevent settlement in trench.
- K. Refill trenches that have settled due to incomplete compaction or washed out by natural rainfall or run-off.

- L. Compact trenches and leave flush with final grade and hand rake clean of stone with a fine rake.
- M. Install valve boxes per manufacturer's instructions with adequate space for operation, service and removal of the equipment in the box. Place minimum of 6 inches of crushed stone under each valve box. Install boxes flush to grade, use extensions as required. Place valve boxes over main line isolation valves. Telescope boxes where required for depth of trench or use top section only.
- N. Sprinklers
 - 1. Set sprinklers to grade shown on Drawings. Sprinklers or quick coupling valves set to grade: plumb and to grade for a distance of 4 feet from sprinkler in all directions. Do not install sprinklers in low spots or on a mound.
 - 2. Connect sprinkler heads to lateral lines using swing joint for athletic fields.
 - 3. Locate rain sensor as directed.
- O. Controller
 - 1. Connect ground wire to rod with Cadwell connectors.
 - 2. Connect controller to individual grounding network. Achieve ground reading of maximum 10 ohms.
 - 3. House irrigation controller in wall mounted steel case.
 - 4. Connect to electrical power supply (120 VAC) as directed by Engineer.

3.04 PROTECTION

- A. Adequately stake and flag installed equipment with colored surveying tape to alert other trades and contractors of the locations.

3.05 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Test all main lines having continuously applied pressure at maximum system pressure for a period of 24 hours. Complete visual inspection for leaks over the full time period. Repair any leaks and re-test the lines until satisfactory. Test and provide visual inspection for any leaks for all zone lines downstream of control valves under working conditions.
- C. Adjust sprinkler heads and automatic sensors upon completion of installation to provide optimum performance.

3.06 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.07 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 32 90 00

PLANTING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide loam borrow, topsoil, seeding, and supporting materials in accordance with this Section and applicable reference standards listed in Article 1.03 including the following.
 - a. Sampling and testing of loam borrow and existing on-Site topsoil
 - b. Preparation of subgrade to receive topsoil
 - c. Modifying, screening, placing, spreading and grading of loam borrow
 - d. Modifying, screening, placing, spreading and grading of existing, on-Site topsoil
 - e. Spreading topsoil
 - f. Seeding
 - g. Hydroseeding
 - h. Maintaining seeded areas until acceptance
- B. Related Requirements
 - 1. Section 31 00 00 - Earthwork.
 - 2. Section 31 25 00 – Erosion and Sediment Control
 - 3. Section 32 72 00 – Wetlands Restoration

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. MassDOT Standard Specifications and Supplements, except for Compensation sections
 - 2. MassDOT Construction Details
 - 3. American National Standards Institute (ANSI)
 - a. ANSI Z60.1 Standard Nursery Stock
 - 4. AOAC International (AOAC)
 - 5. United States Department of Agriculture (USDA)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
- B. Samples: as specified in Article 1.06.
- C. Provide submittals at least 30 days prior to ordering materials.
 - 1. Material Product Data
 - 2. Manufacturer Instructions
 - 3. Product data of seeding and planting fertilizer and certificates showing composition and analysis
 - a. Fertilization rates for fertilizer product based upon soil testing, analysis, and recommendations
 - b. Receipt showing the total quantity purchased for Project prior to installation
- D. Source and Field Quality Control Submittals
 - 1. Suppliers' certified analysis for standard products by a recognized laboratory in accordance with methods established by AOAC for non-standard products
 - 2. Suppliers' certified analysis for soil amendments and fertilizer materials

3. Seed Supplier's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity germination, and weed seed for each grass seed species
4. Certificates of agronomic rates from Supplier for organic matter used in loam borrow manufacturing process
5. Supplier's certifications for peat moss (content), limestone, acidulant, gypsum, additives needed to amend a specific soil
6. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Survey data of on-Site topsoil stockpiles plotted on a 20-scale plan of the Site prepared by a registered surveyor or civil engineer
- C. Samples
 1. Loam Borrow: one cubic foot representative sample per each 1,000 cubic yard of proposed stockpile of loam borrow for testing. Stockpile sampling: per ASTM D 75 and appendices for securing samples from stockpiles.
 2. On-Site stockpiles of loam borrow: 25, one cubic foot representative samples selected for testing or from loam after it has been spread and amended. Take Samples from on-Site stockpiles and from spread and amended loam borrow from locations as directed by Engineer and packaged in the presence of the Engineer.
 3. Deliver samples to testing laboratories via overnight courier and have testing reports sent directly to the Engineer.
 - a. Obtain testing for gradation, organic content, soil chemistry and pH by a Certified Massachusetts Laboratory as listed with the Massachusetts Department of Environmental Protection.
 - b. Include the following tests.
 - 1) Mechanical gradation (sieve analysis): performed and compared to the USDA Soil Classification System. Sieve analysis: by combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D422 after destruction of organic matter by H₂O₂. Provide a computer generated gradation curve from

UMASS Laboratory to facilitate review and approval of sieve analysis.

- 2) Determine percent of organics by loss on ignition of oven-dried samples. Oven dry test samples minus #10 material to a constant weight at a temperature of 450 degrees Fahrenheit.
- 3) Provide chemical analysis for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, extractable Aluminum, Lead, Zinc, Cadmium, Copper, Soluble Salts, and pH and buffer pH. Use a conductivity meter to measure Soluble Salts in 1:2 soil/water (v/v). Nutrient tests: for available nutrients.
- 4) Provide recommendations for soil additives to correct soils deficiencies as necessary, and for additives necessary to accomplish planting work as specified with soil analysis tests.
 - c. Provide testing of biosolid compost to determine that compost is mature, stable and suitable for use in a growing medium by Woods End Research Laboratory, PO Box 297, Mt. Vernon, Maine, 04352 (207)-293-2457.
 - d. Provide analysis by recognized laboratory for other materials in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
4. Peat moss: one cubic foot sample.
5. Gypsum: 2 pound sample.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Do not order or deliver material until submittals are approved.
- C. Package standard products with manufacturers certified analysis.
- D. Package certified analyses with products.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 LOAM BORROW

- A. Provide in accordance with MassDOT Section 751 and MassDOT Construction Details.
- B. Type: MassDOT Section M1.05.0.
- C. Furnish sufficient loam borrow to complete loaming operations required for the Project and as directed by the Engineer. Obtain loam borrow from the following sources and meet the requirements specified after testing and addition of necessary soil additives.
 - 1. Naturally well-drained areas that have never been stripped before and have a history of satisfactory vegetative growth. Comply with City bylaws and Regulations concerning the removal of topsoil.
 - 2. Commercial processing facility specializing in the manufacturing of loam

2.02 TOPSOIL

- A. provide additional topsoil as required to complete landscape Work, if quantity of stockpiled topsoil is insufficient.
- B. Furnish new topsoil, which is fertile, friable, natural loam surface soil found at a depth of not less than 4 inches from original ground surface, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, debris, and stones larger than 2 inches in any dimension.
- C. Obtain topsoil from local sources or from areas having similar soil characteristics as Site. Obtain topsoil only from naturally, well-drained Sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

2.03 SEED AND SUPPORTING MATERIAL

- A. Provide seed, limestone, fertilizers, plant materials, water for irrigation and soil conditioners in accordance with MassDOT Section 765.40 and MassDOT Construction Details, and ANSI Z60.1.
- B. If biosolid compost (Massachusetts Department of Environmental Protection-permitted material) is used as an organic component of the proposed planting soil mixture, the amount of organic material used shall not exceed agronomic rates for nitrogen and phosphorus for trees and shrubs, turf or ornamental perennials.

2.04 PLANTING TREES, SHRUBS AND GROUNDCOVER

- A. Furnish in accordance with MassDOT Section 771s.

- B. Type: per MassDOT Section M6.06.1

2.05 GRASS SEED

- A. Furnish fresh, clean, new crop seed, complying with tolerance for purity and germination established by AOSA. Do not use wet, moldy, or damaged seed. Seed mixtures listed below are proportions by weight.

- 1. Germination: minimum 80 percent.
- 2. Purity: minimum 85 percent.
- 3. Weed content: maximum 1 percent.

- B. Roadside Mixture

- 1. 50 percent Creeping Red Fescue
- 2. 15 percent Kentucky Bluegrass
- 3. 2 percent Red Top Clover
- 4. 25 percent Annual Ryegrass
- 5. 3 percent Bird's Foot Trefoil, Variety Empire
- 6. 5 percent White Clover

- C. Ecology Mixture

- 1. 50 percent Creeping Red Fescue
- 2. 5 percent White Clover
- 3. 15 percent Kentucky Bluegrass
- 4. 2 percent Red Top Clover
- 5. 25 percent Annual Ryegrass
- 6. 3 percent Bird's Foot Trefoil, Variety Empire

- D. Wetlands Edge Mixture
 - 1. 55 percent Tall Fescue
 - 2. 10 percent Poa trivialis
 - 3. 15 percent Kentucky Bluegrass
 - 4. 5 percent Redtop
 - 5. 10 percent Perennial Ryegrass
- E. Lawn Repair Mixture
 - 1. 60 percent Kentucky Bluegrass
 - 2. 20 percent Perennial Ryegrass
 - 3. 20 percent Chewings Fescue
- F. New England Conservation Seed Mixture
 - 1. Acceptable level of quality: equivalent to that manufactured by New England Wetland Plants.
 - 2. Big Bluestem (*Andropogon gerardii*)
 - 3. Switchgrass (*Panicum virgatum*)
 - 4. Little Bluestem (*Schizachyrium scoparium*)
 - 5. Canada Wild Rye (*Elymus canadensis*)
 - 6. Fox Sedge (*Carex vulpinoidea*)
 - 7. Partridge Pea (*Chamaecrista fasciculata*)
 - 8. Fringed Bromegrass (*Bromus ciliatus*)
 - 9. Pennsylvania Smartweed (*Polygonum pennsylvanicum*)
 - 10. Common Milkweed (*Asclepias syriaca*)
 - 11. Showy Tick-Trefoil (*Desmodium canadense*)
 - 12. New England Aster (*Aster novae-angliae*)
 - 13. Flat-top Aster (*Aster umbellatus*)

14. Nodding Bur Marigold (*Bidens cernua*)

2.06 FERTILIZER

- A. Bone meal: commercial, raw or steamed, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
- C. Fertilizer: commercial grade complete fertilizer of neutral character, consisting of fast and slow release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Nitrogen, phosphorous and potassium in t amounts recommended in topsoil analysis reports from a qualified soil testing agency
 2. Minimum 1 pound per 1,000 square feet (0.45 kg/92.9 square mile) of actual nitrogen, 4 percent phosphorous and 2 percent potassium by weight

2.07 EROSION AND SEDIMENTATION CONTROL

- A. Anti-erosion mulch: clean, seed-free threshed straw of wheat, rye, oats, or barley. Do not use hay.
- B. Erosion control mesh: uniform, open-weave jute matting or flexible vinyl mat. Acceptable level of quality: equivalent to Mira Mat erosion control. Acceptable level of quality for re-vegetation mat: equivalent to TenCate Mirafi.

2.08 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

- A. Avoid damage to utilities, buildings and private property.
- B. Do not disturb property markers.
- C. Immediately report damage to Engineer.
- D. Complete landscape Work immediately as portions of Site become available, working within seasonal limitations for each kind of landscape Work. Notify Engineer before planting if conditions detrimental to plant growth are encountered.

- E. Plant or install materials during normal planting seasons for each type of landscape work required and as specified in Specification 32 72 00, section 3.07.
- F. Use topsoil stockpiled for re-use in landscape work as specified in Section 31 00 00.

3.02 LOAM BORROW

- A. Place loam borrow at designated locations where plant material (grasses, bushes, and trees) are to be installed or re-installed in accordance with MassDOT Section 751 and MassDOT Construction Details and the Drawings or as directed by the Engineer.
- B. Protect loam borrow delivered to the Site from erosion and spread immediately. Cover material that sit on Site for more than 24 hours with tarpaulin or other soil erosion system acceptable to the Engineer and surround with silt fence as shown on the Drawings.
- C. Do not handle, plant or see loam borrow if it wet or frozen. Use moist loam borrow.

3.03 PLANTING TREES, SHRUBS AND GROUNDCOVER

- A. Provide in accordance with MassDOT Section 771 and MassDOT Construction Details.
- B. Type: per MassDOT Section M6.06.1
- C. Prune injured roots or branches to make clean-cut ends prior to planting, utilizing clean, sharp tools, removing only injured or diseased branching.
- D. Remove planting containers, baskets, and non-biodegradable materials from root balls during planting. Cut natural fiber burlap from around the trunk of trees and folded down against the root ball prior to backfilling.
- E. Position trees and shrubs at intended locations shown on the Drawings and obtain Engineer's approval prior to excavating pits, making necessary adjustments as directed.
- F. Dig planting pits with level bottoms with width twice the diameter of root ball. Rest root ball on undisturbed grade. Backfill each plant pit in layers with thoroughly mixed, prepared soil. Prepared soil: 1 part peat moss; 1 part composted cow manure by volume; 3 parts topsoil by volume.
 - 1. Planting tablets: 21 grams, Agriform or equal.
 - a. 2 tablets per 1-gallon plant

- b. 3 tablets per 5-gallon plant
 - c. 4 tablets per 15-gallon plant
 - d. Larger plants: 2 tablets per 1/2-inch caliper of trunk
- G. Fill prepared soil around ball of plant halfway, and insert plant tablets. Complete backfill, and water thoroughly.

3.04 FINE GRADING

- A. Clean subgrade of stones greater than 2 inches all debris or rubbish immediately prior to dumping and spreading loam borrow and remove debris and rubbish from Site. Do not rake to edges and bury. Obtain Engineer's approval of subgrade conditions prior to spreading loam borrow.
- B. Spread and thoroughly incorporate soil additives into the layer of loam borrow by harrowing or other approved methods. Incorporate the following soil additives.
1. Ground limestone or acidulant: as required by soil analysis to achieve the required pH as specified. Spread limestone at the rate required by soil analysis up to maximum limit of 200 pounds per 1,000 square feet. Make a surface application of limestone not in excess of 50 pounds per 1,000 square feet to the established planting area during the season after Final Acceptance if recommendations of soil analysis require rates of application greater than 200 pounds per 1,000 square feet.
 2. Fertilize at the rate and of analysis recommended by soil analysis.
 3. Use biosolid compost, peat moss, sand or other soil amendments as required by soil analysis.
- C. Prepare loam borrow by scarifying, harrowing, or tilling the loam to integrate soil additives into the top 6 inches of the loam after loam borrow and required additives have been spread. Remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove all stones over 1 inch in diameter from the top 6 inches of the loam bed from unscreened soils. Remove smaller stones in excessive quantities as directed.
- D. Set sufficient grade stakes for checking the finished grades. Set stakes in bottom of swales and at the top of slopes. Do not deviate more than one-tenth of foot from indicated elevations. Connect contours and spot elevations with an even slope. Finish grades: smooth and continuous with no abrupt changes at the top or bottom of slopes.
- E. Fill depressions caused by settlement or rolling during the compaction process with additional loam borrow and regrade surface and roll until finish is smooth and even corresponding to the required grades.

- F. Install loam borrow in successive horizontal lifts no thicker than 6 inches in turf areas and 12 inches in plant bed areas to the desired compaction as described herein. Install soil at a higher level to anticipate any reduction of loam borrow volume due to compaction, settling, erosion, and decomposition during Warranty Period. Obtain full depths of loam borrow for plant beds by digging holes in the loam borrow at the same frequency as for compaction testing.
1. Compact loam to the specified density.
 2. Maximum dry density for topsoils and loam: determined in accordance with ASTM D698. Achieve the following percentages of minimum to maximum dry densities for fill materials or prepared subgrades.
 - a. Fills within plant beds, tree pits and treeways: minimum 80 percent; maximum 85 percent for areas in top 18 inches of finished grade.
 3. Scarify surface area of each lift be by raking prior to placing next lift.
- G. Compact each lift sufficiently to reduce settling but not enough to prevent movement of water and feeder roots through the soil in addition to the range cited above. Loam borrow in each lift: firm underfoot and make only slight heel prints. Loam borrow at completion of installation: firm, even resistance when a soil sampling tube is inserted from lift to lift. Perform percolation tests after placement of each lift to determine if soil has been over compacted using the following percolation test procedure.
1. Dig a hole in the installed soil minimum of 4 inches in diameter. Holes in 6-inch lift in turf areas: 4 inches deep. Holes in 12-inch lifts in plant beds: 8 inches deep. Do not penetrate through the lift being tested.
 2. Fill hole with water and let it drain completely. Immediately refill hole with water and measure rate of fall in water level.
 3. Till the soil to a depth required to break the over compaction if water drains at a rate less than one inch per hour.
 4. Perform a minimum of one soil percolation test per 10,000 square feet area of turf area and 2,500 square feet of tree and shrub planting area as directed.
- K. Select equipment and phase installation of the loam borrow so wheeled equipment does not travel over subsoil, placed fills or ordinary borrow, or already installed soil. Movement of tracked equipment over said soils will be reviewed and considered by the Engineer for approval. If it is Engineer determines that wheeled equipment must travel over already installed soil, provide a written description of sequencing of Work that ensures compacted soil is loosened and uncompacted as

the Work progresses or place one-inch thick steel plate ballast (or approved equivalent ballast) over the length and width of any travelway to cover loam borrow to protect it from compaction.

- H. Grade disturbed areas outside the limit of Work smooth and spread with minimum 6 inches of loam borrow to the finished grade.
- I. Maintain stockpiles of existing on-Site topsoil until final placement of existing on-Site topsoil and loam borrow is approved. Provide survey data plotted on a 20-scale plan of the Site prepared by a registered surveyor or civil engineer showing volume of stockpiles of existing on-Site topsoil. Remove excess, unused existing on-Site topsoil from the Site and legally dispose of it upon approval.

3.01 SEED AND SUPPORTING MATERIAL

- A. Install and apply seed and supporting materials at the rates of application and in accordance with MassDOT Section 765.40 and MassDOT Construction Details and the Drawings.

3.02 HYDROSEEDING NEW AREAS

- A. Mix specified seed and pulverized mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
- B. Apply slurry using an approved machine. Seed and suitable corn fiber mulch may be applied in one operation. Mix materials with water in machine and agitate to keep mixture uniformly suspended. Use spraying equipment that will distribute slurry uniformly at required rates.
- C. Mulch areas with anti-erosion mulch by means of mulch blower at rate of 1,200 pounds per acre on level grades, 2,000 pounds on slopes if mulch is not part of slurry immediately following hydroseeding.
- D. Seed only areas that can be mulched on same day.

3.03 SEEDING NEW AREAS

- A. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
- B. Do not sow immediately following rain or when ground is too dry.
- C. Seed application rate
 - 1. New England Conservation Seed Mix: 1 pound per 1,750 square feet.

- 2. All others: 1 pound per 1,000 square feet.
- D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with a fine spray.

3.01 PROTECTION OF SEEDED SLOPES

- A. Protect seeded slopes against erosion with erosion netting or other acceptable methods.
- B. Spread specified mulch after completion of seeding operations to form a continuous blanket not less than 1-1/2 inches loose measurement over seeded areas.
- C. Anchor mulch by spraying with asphalt emulsion at rate of 10 to 13 gallons per 1,000 square feet. Prevent damage or staining of construction or other plantings adjacent to mulched areas.
- D. Cover seeded slopes with jute matting where grade is 3:1 or greater. Roll matting down over slopes without stretching or pulling.
- E. Lay matting smoothly on soil surface, burying top end of each section in narrow 6-inch trench. Leave 12-inch overlap from top roll over bottom roll. Leave 4-inch overlap over adjacent section.
- F. Staple outside edges and overlaps at 36-inch intervals.
- G. Lightly dress slopes with topsoil to ensure close contact between matting and soil.
- H. Unroll matting in direction of flow in ditches. Overlap ends of strips 6 inches with upstream section on top.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Replace rejected Work, and continue specified maintenance until re-inspected by Engineer and accepted. Remove rejected plants and materials promptly from Site.

3.01 CLEANING

- A. Keep pavement, sidewalks, and walkways clean. Maintain protection during installation and maintenance periods.

3.02 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

3.03 MAINTENANCE

- A. Provide maintenance of grass seeded areas immediately after planting.
- B. Maintain grass by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish smooth, acceptable lawn areas free of eroded or bare areas.
- C. Maintain grassed areas to establish acceptable lawn until Final Completion or for a minimum of 180 days whichever is longer by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.
- D. Maintain trees and shrubs until Final Completion, or for a minimum of 180 days, whichever is longer

END OF SECTION

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 – GENERAL

1.01 SUMMARY

- A. Provide buried water utility distribution piping system in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 33 12 19 – Water Utility Distribution Fire Hydrants
 - 2. Section 33 22 16 – Water Utility Distribution Valves and Fittings

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.
- B. Trench Payment Limit: For all exterior piping, fittings, valves and appurtenances, the payment limits for excavation and backfill shall be a maximum width as noted in the drawing details.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings
- B. American Public Works Association (APWA)
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 2. ASTM A197 – Standard Specification for Cupola Malleable Iron
 - 3. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs 60,000 PSI Tensile Strength
 - 4. ASTM A506 – Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
 - 5. ASTM A575 – Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

6. ASTM B68 – Standard Specification for Seamless Copper Tube, Bright Annealed
 7. ASTM B75 – Standard Specification for Seamless Copper Tube
 8. ASTM B88 – Standard Specification for Seamless Copper Water Tube
 9. ASTM C177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
 10. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 11. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
 12. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 13. ASTM F402 – Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- D. American Water Works Association (AWWA)
1. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 2. AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 3. AWWA C150/A21.50 – American National Standard for Thickness Design of Ductile-Iron Pipe
 4. AWWA C151/A21.51 – American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
 5. AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances
 6. AWWA C601 – Standard for Disinfecting Water Mains
 7. AWWA C651 – Disinfecting Water Mains
 8. AWWA C653 – Disinfection of Water Treatment Plants
 9. AWWA C800 – Underground Service Lines Valves and Fittings
 10. AWWA M41 – Ductile Iron Pipe and Fittings

- E. Ductile Iron Pipe Research Association (DIPRA)
- F. NSF International (NSF)
 - 1. NSF/ANSI 14 – Plastics Piping System Components and Related Materials
 - 2. NSF/ANSI 61 – Drinking Water System Components – Health Effects
- G. City of Salem Public Works Requirements
- H. State and local plumbing codes

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 - 1. Manufacturers' descriptive data, technical literature, catalog cuts, including dimensional data for each type of pipe, gaskets, hardware, and appurtenances
 - 2. Material safety data sheets accompanying each chemical product delivered for use in pipe installations, including solvents, solvent cements, glues and other materials that may contain hazardous compounds
 - 3. Type, thickness, application procedure, and test for coatings, and non-metallic and metallic linings
- C. Shop Drawings
 - 1. Layout and dimensions of equipment, major components, key alignment locations, and locations of bolt holes and access points for maintenance and operations
 - 2. Critical field dimensions and actual pipe lengths, diameters, fittings, and appurtenances
 - 3. Joint couplings and fittings showing style, layouts and dimensions of piping and supports
- D. Certificates

1. Certified affidavit of compliance from pipe manufacturer certifying pipe, fittings, gaskets, linings and exterior coatings for Project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein
- E. Design Data
1. Pipe manufacturer's anti-floatation calculations for each pipe material and details, signed and stamped by a licensed professional engineer in the state where Project is located. Criteria for calculations:
 - a. Groundwater elevation: set at grade above pipe.
 - b. Factor of safety: 0.1; downward forces from weight of pipe. Soils over pipe: 1.1 times buoyant uplift forces.
 - c. Consider pipe empty. Do not consider weight of internal water in calculation.
- F. Manufacturer Instructions
1. Installation instructions
- G. Field Quality Control Submittals
1. Names of personnel or firm performing disinfection Work
 2. Test results
 3. Logs of inspection and testing
- H. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
1. Record depth and take a minimum of three tape ties to structures identified on the drawings as redlines on record drawings.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Certifications
1. Welders and operators: certified in accordance AWS and ANSI codes for shop and project site welding of piping work. Welders must provide written proof of certification.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Unload and string pipe in accordance with manufacturer's recommendations to prevent damage to pipe. Do not roll or drop pipe off truck. Use padding on hooks, slings, and pipe tongs to prevent damage. Do not skid piping against stationary piping during unloading or stacking.
 - 2. Handle chemicals for piping installation per ASTM F402.
- C. Acceptance at Site
 - 1. Provide manufacturers' certificate of compliance with each shipment of pipe, pipe fittings and appurtenances.
 - 2. Inspect pipe immediately upon delivery and reject any that does not conform to specified requirements or has been damaged beyond repair.
- D. Storage and Protection
 - 1. Stack pipe no more than three layers high with proper blocking between layers. Elevate and support bottom row from ground surface with timbers, rails, or concrete, as recommended by piping manufacturer.
 - 2. Keep interior of piping and fittings free from dirt and foreign material using suitable caps or wrapping. Exercise extra care when handling cement lined pipe. Do not use piping with damage to interior lining.
 - 3. Store pipe and tube inside to protect from weather. If storing outside is necessary, elevate above grade and enclose in durable, waterproof wrapping. Protect flanges and fittings from moisture and dirt by inside storage and enclosure or by packaging with durable, waterproof wrapping.
- E. Waste Management and Disposal
 - 1. Rejected pipe: immediately removed from Site and legally disposed of.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide fittings of same type and class of materials as pipe with single piece gasket and commercially manufactured wyes or tees for service connections.
- B. Products in contact with raw or drinking water: certified to meet requirements of NSF/ANSI 61 for water service, including protective materials (coatings, linings, liners), joining and sealing materials (solvent cements, welding materials, gaskets), and mechanical devices used in transmission/distribution systems, (valves, gates).

2.02 BURIED DUCTILE IRON PIPE, DI or DIP, AND FITTINGS

- A. Acceptable Manufacturers
 - 1. U.S. Pipe
 - 2. American Cast Iron Pipe Company
 - 3. Clow Water System Company
 - 4. Or equal
- B. Type: Class 52 DI pipe in accordance with AWWA C150/A21.50 and C151/A21.51 with factory applied bituminous coatings in accordance with AWWA/ANSI C151, double cement lined in accordance with AWWA/ANSI C104/A21.4, push-on joint or mechanical joint type, unless otherwise specified on Drawings.
 - 1. Supply pipe in 18 to 20-foot lengths and permanently mark with manufacturer, date of manufacture, size, type, class/wall thickness, and standard produced to.
- C. Mechanical joint: AWWA/ANSI C111/A21.
- D. Restrained joints: AWWA M41.
- E. Design accessories for complete piping system: AWWA/ANSI C111/A21.11.
- F. Restrained gland gaskets: per manufacturers' recommendations for maximum pressures in pipe.
- G. As Specified in Section 33 22 16 – Water Utility Distribution Valves and Fittings

2.03 SERVICE TUBING/PIPING

- A. Type K copper tubing: AWWA C800, ASTM B68, B75, and B88 as applicable to Type K copper tubing, and NSF/ANSI 14 certified for potable water use.
 - 1. Nominal size: 1 inch minimum or replace in-kind if larger.
 - 2. Pressure rating: 200 psi.

2.04 ACCESSORIES

- A. Furnish anchorages for tees, plugs, caps, and bends.
- B. Clamps, straps and washers: steel, ASTM A506.
- C. Rods: steel, ASTM A575.
- D. Rod couplings: malleable iron, ASTM A197.
- E. Bolts: steel, ASTM A307.
- F. Cast iron washers: ASTM A126, Class A.
- G. Thrust blocks: minimum 3,000 psi concrete, sized per thrust block schedule shown on Drawings.
- H. Pipe lubricant: suitable for use in potable water supply.

2.05 TRACE WIRE

- A. Provide 12-gauge solid copper trace wire for non-metallic service piping

2.06 UNDERGROUND MARKING TAPE

- A. Furnish detectable marking tape with aluminum core, minimum 6 inches wide and minimum 5 mils thick with APWA uniform color-coding for identification and location. Text or lettering: “CAUTION BURIED POTABLE WATER LINE BELOW” repeated continuously along length of tape at maximum intervals of minimum 3 feet.

2.07 INSULATION

- A. Extruded polystyrene foam: 2 inches thick; ASTM C578 Type VII.
- B. Rated: minimum R-10, ASTM C518 and C177.
- C. Compressive strength: 60 psi, ASTM D1621.

2.08 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Coordinate water line Work with Owner.
- B. Remove and legally dispose of existing pipe, hydrants and fittings and associated materials proposed for replacement as indicated on Drawings. Existing water pipe may be abandoned in place, in locations where the proposed water pipe can be installed adjacent to existing pipe to avoid water bypassing.

3.02 GENERAL

- A. Provide that vertical separation of water lines from sanitary sewer is maintained at an elevation where top of sewer is minimum 18 inches below bottom of water line.
- B. Provide following protection when elevation of sewer cannot be buried as specified.
 - 1. Adequate structural support for sewers to prevent excessive deflection of joints and settling on and breaking water lines
 - 2. One full length of water pipe centered at point of crossing so that joints are equal distance and as far as possible from sewer
- C. Separate water lines from cable TV lines, telephone lines, and electrical cables.
 - 1. Parallel installation: minimum of 10 feet of separation of water line from any cable.
 - 2. Water line crossings of cables: 45 degree minimum angle. House cable in iron or steel conduit where possible, minimum 6 feet on either side of water line. Separate cable carrying conduit minimum 18 inches from water line.
- D. Do not allow valves to bear stress from loads of adjacent DI pressure pipe.

3.03 BURIED DI PIPE INSTALLATION

- A. Install DI pipe per trench detail as shown on Drawings.
 - 1. If trenching operation exceeds typical section, use higher strength class pipe instead of designated class if directed.
- B. Bedding: as shown on Drawings. Do not cover or backfill trench until approved.

- C. Install DI pipe and fittings true to alignment in accordance with AWWA C600, unless otherwise specified or indicated on Drawings. Adjust line and grade to meet field conditions.
1. Install each run of piping with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes where indicated on Drawings by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerances.
 2. Locate piping runs, except as otherwise indicated, vertically and horizontally, pitched to drain, and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of buildings.
 3. Install pipe beginning at stub end, unless otherwise approved. Thoroughly clean pipe prior to laying and keep clean during Work, conforming to lines and grades indicated. Close open ends of piping with watertight plugs or other approved means when laying is not in progress. Swab and wipe interior of each length of pipe clean before laying next length.
 4. Construct firm, even bearing by digging bell holes at each joint and tamping screened gravel at sides of pipe up to mid-diameter. Provide minimum 1 foot of fill over top of pipe per details shown on Drawings. Remove and replace defective pipe.
 5. Provide fittings for crossing utilities encountered upon opening trench. Use solid sleeve couplings where indicated on Drawings or, if approved, in writing.
 6. Install pipe with minimum 5 feet of cover, measured from pipe crown to finished grade, unless otherwise shown on Drawings or approved in writing.
 - a. Where new pipe is to connect to existing pipe and less than 5 feet of cover exists, use off-sets or joint deflection to transition from existing pipe elevation to new pipe elevation in accordance with specified allowances.
 - b. When necessary to deflect pipe from a straight line in either horizontal or vertical plane, do not exceed maximum joint deflection specified in AWWA C600 or maximum allowable deflection permitted by manufacturer.
 - c. Insulate pipe installed within 3 feet of culvert or with minimum 5 feet of cover, where approved. Extend insulation width of trench,

minimum of 4 feet above pipe envelope and on vertical sides of trench bottom from bottom to above pipe envelope.

D. Joints and Connections

1. Make exterior pipe jointing in dry trench per manufacturer's recommendations and best practices for pipe class laid. Wipe pipe ends clean before making joints.
2. Clean excess tar and other obstructions from bell of pipe and wipe out before cleaned and prepared spigot of next pipe is inserted.
3. Lubricate gasket, bell, and spigot with gasket lubricating compound compatible with potable water. Push new pipe firmly into place until properly seated and held securely until joint is completed. Push pipes home using method that protects driving end. Drive minimum of 2 copper or bronze wedges between each cast iron and ductile joint.
4. Assemble mechanical joints in accordance with Appendix A of AWWA C111/A21.11 and pipe manufacturer's instructions. Thoroughly clean and lubricate joint surfaces and rubber gaskets with soapy water before assembly. Tighten bolts to specified torques. Do not use extension wrenches or pipe-over handle of ordinary ratchet wrenches to secure greater leverage. Tighten bolts in mechanical or restrained joints evenly and alternately. Torque mechanical joint bolts with torque wrench to range specified in AWWA C600 and re-torque to range specified in AWWA C600 after waiting 2 hours. Disassemble and thoroughly clean joint and reassemble if effective sealing of joint is not attained at maximum torque specified. Do not overstress bolts to tighten leaking joints. Assembling Mechanical Joints: Surfaces against which gasket will come in contact shall be thoroughly brushed with a wire brush prior to assembly of joint. Clean gasket. Gasket, bell, and spigot: lubricated by using gasket lubricating compound compatible with potable water. Insert spigot into bell until it is correctly seated, then seat gasket evenly in bell at all points, centering spigot, and press gland firmly against gasket. After bolts have been inserted and nuts have been made up finger-tight, diametrically opposite nuts shall be progressively and uniformly tightened all around joint to proper tension by means of torque wrench. Assemble mechanical joints with mechanical joint retainer glands where appropriate.
5. Install restrained joints for water mains, fittings, and valves using restraint devices. Install restrained gland gaskets a minimum of 30 feet beyond each fitting.

- E. Pipe Cutting
 - 1. Cut sections of pipe to provide shorter sections of pipe where necessary and approved in accordance with pipe manufacturer's recommendations.
 - 2. Cut pipe material using a saw or milling process approved by pipe manufacturer. Do not break pipe, cut end square to axis of pipe and grind rough edges smooth.
 - 3. Use machine to cut pipe, leaving a smooth cut at right angles with axis of pipe. Join cut ends of pipe with a bell and bevel to conform to manufactured spigot end. Do not damage cement lining. Seal field cut ends with approved epoxy per pipe manufacturer's instructions. Obtain acceptance of cutting of restrained joint pipe from Engineer and only cut at approved locations. Provide restrainer glands or field adaptable restrained joints.
- F. Provide thrust restraint for water mains where bends, tees, plugs, wyes, or valves are installed. Use concrete thrust blocks as shown on Drawings or with restrained joints.

3.04 WATER SERVICE PIPING

- A. Extend water service piping of size and in location indicated on Drawings or as directed. Replace water services 1 inch or less in diameter with 1-inch Type K copper tubing and water services 1-1/4 inches to 2 inches with 2-inch Type K copper tubing. Replace water services to property line or as directed, unless otherwise shown on Drawings or otherwise approved. Do not crimp service tubing along water service.
- B. Do not use sweat fittings between street main and meter regardless of meter location. Owner to approve size of service pipe where service length is 100 feet or greater.
- C. Do not crimp service tubing along water service.

3.05 REPAIR CLAMPS

- A. Do not use repair clamps for permanent repairs. Cut out defective pipe and install new section of pipe using solid cast couplings.

3.06 ACCESSORIES

- A. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of rods and clamps after installation.

3.07 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.08 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

1. Disinfection

- a. Flush and disinfect piping in accordance with AWWA C651 and C653. Prevent contaminated or highly chlorinated water from entering new or previously disinfected mains.
- b. Flush using water from existing main. Drain at hydrant first and then building.
- c. Minimum flow

4-inch diameter	100 GPM
6-inch diameter	220 GPM
8-inch diameter	390 GPM
12-inch diameter	880 GPM

- d. Use slug method using sodium hypochlorite.
- e. Provide sampling taps in accordance with latest revision of AWWA C651. Take 1 sample at each location as described in Section 5 of AWWA C651. Do not use hose of fire hydrant in collection of samples.
- f. Provide water pumps with adequate metering devices. Provide chlorine injection pumps or chlorinators which allow accurate measurement of chlorine being introduced to water service.
- g. Neutralize chlorine residual of disposed water. Recommended method: neutralization chemical tablets of dosages listed in Appendix C of AWWA C651.
- h. Remove sample taps to corporation stop once piping is accepted and put in service.

2. Testing of Water Service Piping

- a. Perform hydrostatic testing of completed lines. Apply 1.5 times working pressure for 20 minutes; 2 psi gage drop or less is acceptable.
- b. Perform operational testing of valves by opening and closing under water pressure to ensure proper operation.

3. Testing of DI Piping

- a. Perform pressure and leakage tests in accordance with AWWA C600 and the following under observation by Engineer.
- b. Perform hydrostatic testing. Apply 1.5 times working pressure at lowest point for 2 hours, 150 psi minimum.
- c. Formula for allowable leakage of DI pipe; where L is allowable leakage in gallons per hour, S is length of pipe in feet, D is nominal diameter in inches, and P is average test pressure in psi.

$$L = \frac{SD P^{1/2}}{133,200}$$

- d. Reference table from DIPRA

Recommended Allowable Leakage for DI Water Main Installations
 (For mechanical or push-on joint pipe with 18-foot nominal lengths)

Average Test Pressure (psi)	Nominal Pipe Diameter					
	4 inches	6 inches	8 inches	10 inches	12 inches	16 inches
	gallons per hour per 1,000 feet of pipeline					
450	0.64	0.95	1.27	1.59	1.91	2.55
400	0.60	0.90	1.20	1.50	1.80	2.40
350	0.56	0.84	1.12	1.40	1.69	2.25
300	0.52	0.78	1.04	1.30	1.56	2.08
275	0.50	0.75	1.00	1.24	1.49	1.99
250	0.47	0.71	0.95	1.19	1.42	1.90
225	0.45	0.68	0.90	1.13	1.35	1.80
200	0.43	0.64	0.85	1.06	1.28	1.70
175	0.40	0.59	0.80	0.99	1.19	1.59
150	0.37	0.55	0.74	0.92	1.10	1.47
125	0.34	0.50	0.67	0.84	1.01	1.34
100	0.30	0.45	0.60	0.75	0.90	1.20

To obtain recommended allowable leakage for pipe with 20-foot nominal lengths, multiply leakage calculated in above table by 0.9.

If pipeline under test contains sections of various diameters, allowable leakage will be sum of the computed leakage for each size.

3.09 UTILITIES TO BE ABANDONED

- A. Close open ends of abandoned underground utilities which are not indicated to be removed. Provide sufficiently strong closures acceptable to Engineer to withstand hydrostatic or earth pressure which may result after ends of abandoned utilities have been closed.

3.10 CLEANING

- A. Clean and flush piping after Work is completed and before final acceptance.

3.11 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES AND FITTINGS

PART 1 – GENERAL

1.01 SUMMARY

- A. Provide water utility distribution valves and fittings, including gate valves, valve boxes, water services, ductile iron fittings, restraints, couplings, foundations, anchors, and related appurtenances as shown on Drawings, in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 09 90 00 – Painting and Coating
 - 2. Section 33 11 00 – Water Utility Distribution Piping

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI)
 - 1. ASME/ANSI B1.1 - Unified Inch Screw Threads, (UN and UNR Thread Form)
 - 2. ASME/ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
 - 3. ASME/ANSI B18.2 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
- B. American Society of Safety Engineers (ASSE)
 - 1. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel
 - 2. ASTM A197 - Standard Specification for Cupola Malleable Iron

3. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes
4. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
5. ASTM A506 - Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
6. ASTM A536 - Standard Specification for Ductile Iron Castings
7. ASTM A575 - Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
8. ASTM B138 - Standard Specification for Manganese Bronze Rod, Bar, and Shapes
9. ASTM B505 - Standard Specification for Copper Alloy Continuous Castings
10. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications
11. ASTM D429 - Standard Test Methods for Rubber Property—Adhesion to Rigid Substrates
12. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications
13. ASTM E8 - Standard Test Methods for Tension Testing of Metallic Materials
14. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
15. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

- D. American Water Works Association (AWWA)
1. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pressure Pipe and Fittings
 2. AWWA C105 – Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
 3. AWWA C110 – Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in for Water and Other Liquids
 4. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 5. AWWA C115 – Standard for Flanged Ductile-Iron Pipe with Threaded Flanges
 6. AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast in Metal Molds olds or Sand-Lined Molds for Water or Other Liquids
 7. AWWA C153 – Ductile-Iron Compact Fittings, 3-in Through 64-in for Water and Other Liquids
 8. AWWA C201 - Standard for Fabricated Electrically Welded Steel Water Pipe
 9. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
 10. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe
 11. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service
 12. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service
 13. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
 14. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
 15. AWWA C600 – Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
 16. AWWA C601 Section 4 - Preventive Measures During Construction
 17. AWWA C651 – Disinfection Water Mains
 18. AWWA C800 - Underground Service Line Valves and Fittings

- 19. Manual of Cross Connection (Manual M-14)
- E. Ductile Iron Pipe Research Association (DIPRA)
- F. Manufacturers Standardization Society (MSS)
 - 1. MSS SP-60 - Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
- G. Ductile Iron Society
- H. Factory Mutual Research Corporation (FM)
- I. National Sanitation Foundation (NSF)
 - 1. NSF/ANSI 61 – Drinking Water System Components – Health Effects
- J. Underwriters Laboratories (UL)
- K. University of Southern California
 - 1. Foundation of Cross Connection Control and Hydraulic Research
- L. City of Salem Public Works Requirements

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 - 1. Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions including dimensional data for each type of pipe, fitting, gaskets, hardware, and appurtenances
 - 2. Material safety data sheets in conformance with 29 CFR 1910 Section 1200(g) accompanying each chemical product delivered for use in pipe installations, including all solvents, solvent cements, glues and other materials that may contain hazardous compounds
 - 3. Type, thickness, application procedure, and test for coatings, and non-metallic and metallic linings

- C. Shop Drawings
 - 1. Layout and dimensions of equipment, major components, key alignment locations, and locations of bolt holes. Indicate where access points for maintenance and operations are located on equipment. Show critical field dimensions and actual pipe lengths, diameters, fittings, and appurtenances.
 - 2. Show joint couplings and fittings and specifically identify styles. Show layouts and dimensions of piping and pipe supports for pipe systems.
- D. Certificates
 - 1. Certified affidavit of compliance from pipe manufacturer stating that pipe, fittings, gaskets, linings and exterior coatings for Project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified.
 - 2. Welders certifications
- E. Manufacturer Instructions
 - 1. Manufacturer's recommended shipping, unloading, storage, installation, testing, operation and maintenance procedures including a list of special tools and equipment required to maintain the units.
- F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Certifications
 - 1. Welders and operators: certified in accordance with AWS and ANSI codes for shop and Site welding of piping work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Valves and fittings: lifted off truck and placed on ground in accordance with manufacturer's recommendations to prevent damage to pipe. Utilize padding on hooks and slings used for unloading to prevent damage to piping.

- C. Acceptance at Site
 - 1. Inspect valves and fittings after delivery. Pipe rejected after delivery: be specifically marked for non-use and removed from Site.
- D. Storage and Protection
 - 1. Keep interior of valves and fittings clean and free from dirt or other foreign material at all times. Utilize suitable caps or wrapping to prevent entry of dirt or foreign material into piping. Exercise extra care when handling cement lined pipe. Do not use piping with damaged interior lining.
 - 2. Store valves and fittings inside and protected from weather. Elevate above grade and enclose with durable, waterproof wrapping if stored outside. Protect flanges and fittings from moisture and dirt by inside storage and enclosure or packaging with durable, waterproof wrapping.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Furnish fittings and appurtenances of same type and grade of materials as connecting pipe conforming to AWWA and ANSI standards as appropriate to type of pipe specified.
- B. Furnish valves and strainers suitable for services specified and intended with pressure ratings and materials specified. Pressure rating for valves and strainers: no less than that required for system in which they are installed.
- C. Products in contact with drinking water: per NSF Standard 61 including protective materials, joining and sealing materials, and mechanical devices used in transmission/distribution systems.

2.02 VALVES - GENERAL

- A. Valve sizes: equal to line sizes as shown on Drawings, unless otherwise indicated. Provide reducers and expansion fittings for connection of valves to pipelines that are not of equal size.
- B. Flanged valves: ANSI B16.1 unless otherwise noted.
- A. Provide cast markings on valves and strainers to include size, working pressure, cast arrow to indicate direction of flow, name of manufacturer, and year of

manufacture. Locate marking on an appropriate part of valve in a clearly visible location.

- B. Do not furnish renewable parts of lower quality than those specified and furnished with original valves and strainers.
- C. Provide that valves open by turning/rotating valve clockwise (OPEN RIGHT) unless otherwise specified or shown on Drawings. Provide special adaptors needed to ensure compatibility between valves, appurtenances, and adjacent piping.

2.03 FITTINGS

- A. Acceptable Manufacturers
 - 1. U.S. Pipe & Foundry Company
 - 2. American Cast Iron Pipe Company
 - 3. Clow Water System Company
 - 4. Or equal
- B. Type: ductile iron, cement lined fittings with mechanical joints. Design fittings per AWWA/ANSI C153/A21.53 or AWWA/ANSI C110/A21.10.
- C. Minimum thickness: Class 52 per ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51.
- D. Working pressures: rated 350 psi for 3-inch through 24-inch diameter and rated 250 psi for 30-inch through 48-inch.
- E. Double cement lining: per ANSI/AWWA C104/A21.4.
- F. Fitting joints: mechanical joint per ANSI/AWWA C111/A21.11.
- G. Accessories such as gaskets, glands, bolts, nuts: designed per AWWA/ANSI C-111/A21.11. Furnish as required for complete piping systems.
- H. Coat exterior of pipe and fittings with an asphaltic, shop applied primer coating meeting AWWA C151, C115, C110, and C153 standards.
- I. Pipe and fittings: permanently marked with manufacturer, date of manufacture, size, type, class/wall thickness, and applicable standards.

2.04 CORPORATION STOPS

- A. Acceptable Manufacturers

1. A.Y. McDonald
 2. Ford
 3. Mueller
 4. Or equal
- B. Furnish corporation stops conforming to AWWA Standard C800 and individually inspected and tested for leaks by air pressure under water, capable of being installed using a standard tapping machine.
1. Design: ball type, straight-through/full port with AWWA Standard CC inlet threads and compression outlet to prevent blow-out and bubble-tight at 300 psig working pressure.
 2. Stop: no-lead brass, UNS Copper Alloy No. C89520 or C89833 in accordance with chemical and mechanical requirements of ASTM B584 and AWWA C800 with double O-ring type Buna-N seals.
 3. Ball: coated with nontoxic, non-water soluble, self-lubricating film. Acceptable level of quality: equivalent to Teflon.

2.05 CURB STOPS

- A. Acceptable Manufacturers
1. A.Y. McDonald
 2. Ford
 3. Mueller
 4. Or equal
- B. Furnish curb stops conforming to latest revision of AWWA C800 and individually inspected and tested for leaks by air pressure under water.
1. Curb stops: ball type, straight-through/full port design, rated for 150 psig working pressure, with compression joints on both ends, a drain and be open right.
 2. Stop: no-lead brass, UNS Copper Alloy No. C89520 or C89833 in accordance with chemical and mechanical requirements of ASTM B584 and AWWA C800 with double O-ring type Buna-N seals and positive shut-off in either direction.

3. Ball: coated with nontoxic, non-water soluble, self-lubricating film. Acceptable level of quality: equivalent to Teflon.

2.06 SOLID SLEEVE TYPE COUPLINGS

A. Acceptable Manufacturers

1. Acceptable level of quality: equivalent to couplings manufactured by Dresser Piping Specialties or Smith-Blair Inc.
2. Or approved equal

B. Provide solid sleeve type couplings to join plain end pipes and/or exterior below grade transitions in piping materials as shown on Drawings, as specified and in accordance with AWWA C201. In cases where outside diameters of piping segments to be connected differ, provide reduction/expansion sleeve type couplings.

1. Provide sleeve type couplings for exterior below grade piping runs prior to entering and exiting buildings or structures.
2. Sleeve type couplings: AWWA C219 rated for use with same operational pressure as connecting pipes.
3. Sleeve type couplings for low pressure air service: 304L stainless steel with 316L stainless steel followers.
4. Provide 316 stainless steel hardware.
5. Coupling lugs: in accordance with ASTM A36; washers in accordance with ASTM F3125. Fit couplings with plastic plugs to protect bolt holes.
6. Bolts: ASTM A307 and ANSI B1.1, coarse thread fit type, square or hexagonal head type; threaded over full length. Bolt ends: rounded or chamfered. Install bolts so minimum of 1/4-inch of bolt projects beyond surface of nut.
7. Hexagonal nuts: in accordance with ANSI B18.2 with ANSI B1.1 threads.
8. Provide gaskets to match particular service application. Gaskets for low pressure air service: EPDM and gaskets for wastewater service nitrile, Buna-N/NBR unless otherwise specified or recommended by coupling manufacturer. Match coupling gasket to gasket material used for piping system.
9. Omit pipe stop within inner surface of middle ring of couplings as required to permit removal of valves, flow meters, equipment, and appurtenances.

10. Thickness of middle ring of sleeve type coupling: at least equal to connecting piping thickness where coupling is to be used.
 - a. For pipe 30 inches diameter and larger: minimum of 10 inches long.
 - b. For pipe under 30 inches in diameter: minimum 7 inches long.
11. Self-restrained couplings not required to meet minimum middle ring length requirements specified.
12. Provide other couplings with pipe stops.

2.07 RESTRAINT DEVICES FOR DUCTILE IRON PIPE AND FITTINGS

- A. Restraint devices for mechanical joint pipe and fittings: ANSI/AWWA C111/A21.11 or C153/A21.53, multiple gripping wedges incorporated into a follower gland meeting ANSI/AWWA C110/A21.10
- B. Working pressure rating: 350 psi for 3-16 inches and 250 psi for 18-48 inches for water pressure. Safety factor: 2 to 1 in all sizes.
- C. Gland body, wedges and wedge actuating components: cast from grade 65-45-12 ductile iron material per ASTM A536. Heat treat ductile iron gripping wedges within a range of 370 to 470 BHN.
- D. Identification number: cast into each gland body with year, day, plant and shift (YYDDD) (plant designation) (Shift number).
- E. Flange class and bolt hole layout: matched to connecting mechanical joint flange.
- F. Finishes
 1. Phosphate wash, rinse and dry process wedge assemblies and related parts: prior to coating application. Coating: minimum 2 coats of liquid thermoset epoxy coating with heat cure to follow each coat.
 2. Surface pretreat casting bodies with a phosphate wash, rinse and sealer before drying. Coating: polyester based powder to provide corrosion, impact and UV resistance, electrostatically applied and heat cured. Acceptable level of quality for coating system: equivalent to MEGA-BOND by EBAA Iron, Inc.

2.08 RESTRAINED MECHANICAL JOINT COUPLINGS

- A. Restrained mechanical joint couplings: UL listed, UL 6M46 and FM approved.
- B. Restrained mechanical joint couplings: ANSI A21.10, AWWA C111/A21.11, and AWWA C153/A21.53. Coating: two-part epoxy coating on ferrous metallic surfaces.

- C. Working pressure: minimum 350 psi
- D. Minimum safety factor: 2:1.

2.09 RETAINER AND FOLLOWER GLANDS

- A. Mechanical joint retainer glands: incorporated in design of follower gland and include a restraining ring that imparts a restraining force against pipe that increases as pressure increases when actuated by wedging action of gland. Provide restraining ring to grip full pipe circumference.
- B. Do not use coupling devices that restrain by method of Point-Loading on pipe.
- C. Glands and restraining rings: ductile iron meeting ASTM A536, Grade 65-45-12. Restraint ring: actuated solely by tee-head bolts.
- D. Restraining rings: heat treated to minimum hardness of Rockwell 40.

2.10 REDUCED PRESSURE ZONE (RPZ) BACKFLOW PREVENTOR

- A. Acceptable level of quality for assembly: equivalent to Watts Series LF909.
- B. Furnish pressure differential relief valve located in zone between two positive seating check valves and captured springs. Back siphonage protection: provision via separate channel from water discharge channel to admit air directly into reduced pressure zone. Provide with 2 tightly closing shutoff valves before and after valve and test cocks.
- C. RPZ assembly: ASSE 1013; AWWA C511-92; CSA B64.5; and UL Classified File No. EX3185 and per state codes and standards where applicable with reduced lead content.

2.11 INSERTION VALVES

- A. Acceptable Manufacturers
 - 1. ROMAC
 - 2. Advance Valve Technologies
 - 3. Hydra-Stop
 - 4. Or equal
- B. Provide with tapping sleeve and valve assembly capable of providing an effective shut-down of water service on existing water main.
- C. Tapping Sleeve

1. Fabricate sleeve to provide 360-degree seal around pipe under working pressures up to 150 psi and test pressures up to 225 psi.
2. Design sleeve to accommodate equipment and fixtures necessary to drill and ream pipe and install insertion valve without any interruption in water service.
3. Sleeve: ASTM A36 steel, coated with fusion-bonded epoxy to 10-12 mils. Epoxy: AWWA C213.
4. Provide special flange and neck to mate with valve installation equipment and insertion valve for proper alignment, support, and sealing.
5. Configure lugs on sleeve for alignment of sleeve halves during installation and provide a bolting surface to provide a 360-degree seal.
6. Bolts and nuts: AWWA C111 high strength low alloy.
7. Gaskets: Styrene Butadiene Rubber (SBR) compounded for potable water service per ASTM D2000 3 BA715, to provide a positive 360-degree tight, durable and resilient seal on pipe at pipe sleeve-valve insert junction.
8. Sleeves: ductile iron construction per ASTM A536 Grade 65-45-12, rated for 250 psig maximum working pressure, unless otherwise specified.
9. Coat sleeve with asphaltic varnish and certify to requirements of ANSI/NSF-61.
10. Slide flange seals: O-ring type, either round, oval or rectangular in cross-sectional shape.
11. Provide tapping sleeves with end joint accessories and split glands to assemble sleeve to pipe.
12. Tapping sleeves 12-inches and smaller: capable of working on Class ABCD pipe diameters without changing either half of sleeve.
13. Tapping sleeves for pipe sizes greater than 12-inches: field measured to determine class required.
14. Outlet flanges dimensions and drilling: ANSI B16.1, class 125 and with MSS SP-60.
15. Furnish valves to OPEN RIGHT (clockwise).
16. Verify pipe material and diameter in location sleeve will be installed.

D. Valve Assembly

1. Provide valve assembly to perform as water control device with effective shutoff of flow of water when installed in sleeve.
2. Insert: ductile iron casting coated with SBR rubber compounded for water service with durometer of 55 Shore A.
3. Stem and nut assembly: AWWA C500-80, Section 3.12.
4. Flange: ASTM A36 steel to hold valve assembly together and act to seal against valve sleeve flange.
5. Valve flange gasket: SBR rubber, compounded for water service per ASTM D2000 3 BA715, with a durometer of 70 Shore A. Gasket: sealing interface between valve flange and sleeve flange.
6. Bolts and nuts: grade 3 alloy steel, zinc plated for corrosion protection.

2.12 BURIED GATE VALVE (METAL SEATED DOUBLE DISC)

A. Acceptable Manufacturers

1. Clow Valve Company
2. Mueller Company
3. Kennedy Valve Company
4. M&H Valve Company
5. Or equal

A. Furnish buried gate valves of same type, style, and duty supplied by a single manufacturer.

B. Type: AWWA C500 double disc, designed for buried service, non-rising stem design with sealing by double O-rings, with parallel seats and internal four-point wedging; equipped with positive operating internal device TO press disc seats firmly against body seats when valve is closed; and release load before disc starts to move when valve is being opened and with valve boxes.

1. Furnish valves to OPEN RIGHT (clockwise).
2. Size: 2-inch through 48-inch matched to piping size shown on Drawings.
3. End connection: mechanical joint with AWWA C151 Bituminous Coating System
4. End connection valves 2-inches and smaller: threaded NPT.

5. Operating nut: 2-inch nut securely fastened to shaft.
- C. Provide sufficient length T-Handle valve extension stem wrench for operating valves of various depths.
 - D. Valve boxes: cast iron, tar coated, sliding type, adjustable up to 6-inches with cast iron cover. Bell end of valve box: sufficiently large to fit over stuffing box of gate valve.

2.13 METALLIC Y-TYPE STRAINERS

- A. Acceptable Manufacturers
 1. Apollo by Conbraco Industries Inc.
 2. Watts Regulator Company
 3. Hammond Valve Company
 4. Or equal
- B. Furnish metallic Y strainers of same type, style, and duty supplied by single manufacturer.
- C. Provide with machined seat that allows screen to be self-aligning to provide perfect fit, and with bolted screen retainer cover and non- asbestos gasket. Screen retainer cover: NPT tapped for blow-off plug. Design strainers for installation in both horizontal and vertical.
 1. Ratings: 150 psi at 400 degrees F and 225 psi at 150 degrees F.
 2. Size: 1/4-inch to 8-inches matched to piping size as shown on Drawings.
 3. End connections: less than 3-inches.
 4. End connections 3-inches and larger: flanged, ANSI 150.
 5. Body and plug: bronze, ASTM B62, ASTM B584.
 6. Screen cover: bronze, ASTM B62, ASTM B584.
 7. O-Rings/gaskets: Teflon or PTFE.
 8. Screen: 304 stainless steel.
 9. Mesh code: 20.

- D. Provide 2 additional spare strainer screens for each Y strainer. Provide 1 spare 40 mesh 1/64-inch opening screen and 1/60 mesh, 0.009-inch opening screen for each strainer.

2.14 UNDERGROUND OPERATORS

- A. Furnish buried operators on valves larger than 2.5 inches with a 2 inch operating nut. Furnish buried operators on valves 2 inches and smaller with a cross handle for operation by a forked key.
- B. Design buried service operators for quarter-turn valves to withstand an input torque of 450 foot-pounds at fully open or fully closed positions; and grease pack and gasket to withstand a submersion in water to 10.2 psig.
- C. Enclose moving parts of valves and operators in housing to prevent contact with soil.
- D. Provide with extension stems, bonnets, and valve boxes.

2.15 EXTENSION STEMS & STEM GUIDES

- A. Acceptable Manufacturers
 - 1. Clow Valve Company
 - 2. Troy Valve Company
 - 3. M&H Valve Company
 - 4. Kennedy Valve Company
 - 5. Or equal
- B. Furnish stem guides and extension stems of same type, style, and duty supplied by a single manufacturer. Furnish stem guides and extension stems from manufacturer of the valve being served.
- C. Furnish operator extension stem with 2 inch operating nut for valves with centerline of depth of more than 6 inches below grade or operator level, to bring operating nut to a point 6 inches below surface of ground or box cover. Rating: minimum 5 times maximum operating torque.
- D. Extension stems: 2 inch, 304L stainless steel with support brackets for spans greater than 5 feet and universal joints and pin couplings when longer than 10 feet.
- E. Furnish with stem adaptors as required.

- F. Stem guides: high strength stainless steel, adjustable wall bracket type with bronze bushings where extension stem passes through.
 - 1. Bracket: 304L stainless steel.
 - 2. Guide: 304L stainless steel.
 - 3. Bushing: brass CDA 360.
 - 4. Bolts and nuts: 316 stainless steel ASTM A276.
 - 5. Operator: 2-inch square nut or handwheel as shown on Drawings

2.16 VALVE BOXES (OUTDOOR SUBGRADE VALVES)

- A. Acceptable Manufacturers
 - 1. Acceptable level of quality: equivalent to valves boxes manufactured by Crescent Foundry Company or EJ USA, Inc.
 - 2. Or equal
- B. Furnish valve boxes of same type, style, and duty: supplied by single manufacturer.
- C. Furnish each exterior valve with a valve box.
- D. Type: cast iron, adjustable, telescoping, extension type with slide-type adjustment and flared base, heavy-pattern type, designed and constructed to prevent direct transmission of traffic loads to pipe or valve.
 - 1. Minimum metal thickness: 3/16-inch. Bell end of valve box: sufficiently large enough to fit over stuffing box of respective valve.
- E. Adjustability: through at least 6 inches vertically without reduction of lap between sections to less than 4 inches.
- F. Length: as necessary to suit finish grade elevation.
- G. Inside diameter of box: minimum 5 1/4 inches. Covers: close fitting and dirt-tight with top of cover flush with top of box rim. Housing: sufficient size to completely cover valve or service stop.
- H. Furnish minimum of 2 T-handles for 2 inch square operating nuts. Size T-handle wrenches for box length.
- I. Concrete boxes: standard product of manufacturer of precast concrete structures.

2.17 SERVICE BOXES

- A. Furnish service curb boxes manufactured in United States, Buffalo style, slide type, with top, cover and base constructed of heavy cast iron.
- B. Provide with cover fitting flush with top of box, locking type with brass pentagonal nut and word WATER cast in cover.

2.18 FINISHINGS & COATINGS

- A. Certify coatings and lubricants in contact with potable water as acceptable for use with potable water. Provide that valve manufacturer submits statement in writing if manufacturer does not require finished coating on any interior surfaces.
- B. Iron body valves: exterior primed with shop coat of approved rust-inhibitive primer applied per instructions of paint manufacturer and compatible with finish coat provided. Match finish coat to connecting pipe in type and color. Do not coat stainless steel, brass, bronze, and plastic body valves. Field painting: accordance with Section 09 90 00.
- C. Interior ferrous surfaces: shop finished with asphalt varnish or epoxy coating per AWWA C550 and AWWA C509.
- D. Epoxy paint: either 2-part liquid material or heat-activated fusion material. Use heat-activated material if valve coating is specified as fusion or fusion bonded epoxy. Dry film thickness of epoxy lining and coating: minimum 4.0 mils dry film thickness except where limited by valve operating tolerances.
- E. Ferrous surfaces not intended to be painted: shop coated with grease or other acceptable rust-inhibitive coating.
- F. Paint safety isolation valves and lockout valves with handles, handwheels, or chain wheels Safety Yellow color.

2.19 ACCESSORIES

- A. Furnish anchorages for tees, plugs, caps, and bends.
- B. Steel clamps, straps and washers: ANSI/ASTM A506.
- C. Steel rods: ANSI/ASTM A575.
- D. Rod couplings: malleable iron, ANSI/ASTM A197.
- E. Steel bolts: ANSI/ASTM A307.
- F. Cast iron washers: ANSI/ASTM A126, Class A.

- G. Thrust blocks: 3 000 psi concrete minimum.
- H. Pipe lubricant: suitable for use in potable water supply.

2.20 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements and as follows.
 - 1. Three test bars: incrementally poured per production shift per UL and ASTM A536.
 - 2. Testing for tensile, yield and elongation: ASTM E8.
 - 3. Perform chemical and nodularity tests as recommended by Ductile Iron Society, on a per ladle basis.
 - 4. Record physical and chemical test results so they can be accessed via identification number on casting, referred to as Material Traceability Records (MTR). Make MTR's available in hard copy if requested and when gland body identification number is provided.
 - 5. Control production pieces that are too small to accommodate individual numbering, such as fasteners and wedges, in segregated inventory until quality control tests are passed.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Comply with AWWA C651, including Section 4.3, Preventive and Corrective Measures During Construction, for cleanliness.
- B. Existing pipe and fittings and associated materials: removed and disposed of as indicated on Drawings.
- C. Inspect valves before installation; clean and lubricate well before installing in line.
- D. Thoroughly clean items, including valves and valve interiors prior to installation, testing, and final acceptance. Remove dirt, debris, and other foreign materials.

3.02 GENERAL

- A. Restrain mechanical joints with restraint devices. Use restrained mechanical joint couplings where indicated on Drawings or as specified and only if approved when not specified or indicated on Drawings. Do not use restrained mechanical joint couplings in place of concrete thrust blocks.
- B. Install couplings prior to building or structure wall penetration to allow for differential settlement of piping and structure. Provide sleeve couplings on piping buried directly under a structure at structure's expansion joints. Provide minimum of 3-inch-thick Styrofoam placed perpendicular to horizontal centerline of coupling in applications where piping is encased in concrete.
- C. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces after installation of rods and clamps.
- D. Locate extension stem operating nut in a valve box. Stem guide spacing: maximum 10 feet.
- E. Adapt valve box length to length required for depth of line and to depth of cover required over pipe at valve location without full extension. Install concrete boxes only in locations not subjected to vehicular traffic.

3.03 BURIED VALVE INSTALLATION

- A. Install valves in accordance AWWA C600, AWWA C515 and manufacturer's recommendations.
- B. Independently support valves. Do not allow connecting piping to support valves. Do not allow valves to bear stress due to loads from adjacent pipe. Secure to distribution main by means of rods or retainer glands.

- C. Install valves as shown on Drawings in strict accordance with manufacturer's recommendations with stems pointed up, in vertical position where possible, but in no case, with stems pointed downward of horizontal plane. Allow sufficient room for maintenance, removal and proper operation. Locate and orient valves to permit easy access to valve operator, and to avoid interferences.
- D. Tapping Sleeves, Valves and Insertion Valves
 - 1. Adequately support pipe so that machinery used to tap main does not put undue stress on pipe.
 - 2. Install insertion valve in open position, under water pressure without any interruption of water service to provide an unobstructed full flow waterway after installation and provides seal on inside diameter of sleeve neck and lower half of water main.
- E. Install flanged valve bolt holes to straddle vertical centerline of pipe. Clean flanged faces prior to inserting gasket and bolts. Tighten nuts progressively and uniformly. Clean threaded ends by wire brushing or swabbing threads prior to installation.
- F. Install valve connections and joints in accordance with specified and applicable standards unless otherwise specified or shown on Drawings. Verify manufacturer's torque requirements.

3.04 REDUCED PRESSURE ZONE (RPZ) BACKFLOW PREVENTER INSTALLATION

- A. Provide installation and maintenance of backflow assemblies by qualified, licensed technician.

3.05 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements and related Specification Sections.
- B. Site/Field Tests and Inspections
 - 1. Test valves visually for leaks and proper operation under pressure and to ensure proper valve function and actuation. Test valves as part of respective piping system or segment in accordance with Section 33 11 00.
 - 2. Valves may either be tested while testing pipelines, or as separate test. Demonstrate that valves open and close smoothly with operating pressure on one side and atmospheric pressure on other, and in both directions for 2-way valve applications. Count and record number of turns required to open and close each valve, and account for any discrepancies with manufacturer's data.
 - 3. Examine air and vacuum relief valves as associated pipe is being filled to verify venting and seating is fully functional. Set, verify, and record set pressures for

relief and regulating valves. Test self-contained automatic valves at both maximum and minimum operating ranges, and reset upon completion of test to design value.

4. Take care not to overpressure any valve and appurtenances during testing.
5. If equipment does not successfully pass tests listed above, the manufacturer/Contractor shall repair equipment and perform the tests again until passing tests successfully. If any deficiencies are revealed during any test, such deficiencies shall be corrected and tests re-conducted.

3.01 TESTING OF BACKFLOW PREVENTERS

- A. Provide certified testing of each backflow prevention assembly by an independent backflow prevention assembly testing agency. Test each assembly using gauges and equipment specifically designed for testing of backflow prevention assemblies.
- B. Test each backflow prevention assembly for accuracy and proper functionality in accordance with requirements of state or local regulatory agencies including testing each assembly for accuracy and proper functionality in accordance with requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or AWWA Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assemblies. Provide test report and form for each assembly including the following minimum information.
 1. Data on device
 2. Type of assembly
 3. Manufacturer
 4. Model number
 5. Serial number
 6. Size
 7. Location
 8. Test pressure readings
 9. Testing firm information
 - a. Name
 - b. Address
 - c. Certified tester

- d. Certified tester number
 - e. Date of test
 - f. Serial number and test data
- C. Repair and retest each unit if units fail to meet test standard requirements. Provide retesting of each unit following repairs.

3.02 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements and as follows and as specified in Section 33 11 00 – Water Utility Distribution Piping.

3.03 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 33 12 19

WATER UTILITY DISTRIBUTION FIRE HYDRANTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide American-Darling B-62-B-5, manufactured by American Flow Control hydrants and ductile iron pipe and off sets as shown on Drawings, in accordance with this Section and applicable reference standards listed in Article 1.03.
 - a. The Owner has determined that specifying this proprietary equipment for the Project is in the public's best interest as the Owner maintains a standardized replacement parts inventory for equipment manufactured by the same manufacturer, to ensure compatibility and interchangeability of parts and to simplify and reduce the cost of maintenance and repairs.

B. Related Requirements

1. Section 33 11 00 – Water Utility Distribution Piping
2. Section 33 12 16 – Water Utility Distribution Valves and Fittings

1.02 PRICE AND PAYMENT PROCEDURES

- ###### A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- ###### A. Requirements of the local water district
- ###### B. State Plumbing Code and local plumbing codes where more stringent.
- ###### C. Reference Standards
1. American National Standards Institute (ANSI)
 - a. ANSI B16.1: Cast Iron Pipe Flanges and Flanged Fittings
 2. American Water Works Association
 - a. AWWA C502: Dry-Barrel Fire Hydrants

- b. AWWA C600: Standard for Installation of Ductile Iron Water Mains and their Appurtenances
- 3. National Sanitation Foundation (NSF)
 - a. NSF/ANSI 61 – Drinking Water System Components – Health Effects
- 4. National Fire Protection Association (NFPA)
 - a. NFPA 25: Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Manufacturer's product data and installation instructions for each product specified
- A. Manufacturer's recommendations for the storage, protection, handling, and installation of piping, valves, and appurtenances.
- C. Manufacturer's notarized certificate certifying compliance with Specification.
- D. Qualifications Statement: names and qualifications of personnel or firm to perform performing disinfection Work.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Products in contact with drinking water: per NSF Standard 61 including protective materials, joining and sealing materials, and mechanical devices used in transmission/distribution systems.

- B. Provide that replacement parts are fully interchangeable.
- C. Concrete for thrust blocks: minimum 3,000 psi.
- D. Crushed stone for bollards: ¾” Crushed Stone

2.02 FIRE HYDRANTS

- A. Furnish American-Darling B-62-B-5, manufactured by American Flow Control, no substitution allowed.
- B. Hydrant marking: per AWWA 502.
- C. Provide cast markings on valves to include size, working pressure, cast arrow to indicate direction of flow, name of manufacturer, and year of manufacture. Locate marking on an appropriate part of valve in a clearly visible location.
- D. Factory apply 2 coats of epoxy paint conforming to the color code currently in use by the City. Consult the Water Department Superintendent regarding color code.

2.03 PIPE BOLLARDS

- A. Furnish concrete filled, 4-inch diameter ductile iron pipe. Concrete: minimum 3,000 psi and rounded at the top of the bollard.

2.04 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Coordinate all waterline work with the local Water Department.

3.02 INSTALLATION

- A. Install hydrants in accordance with AWWA C502 and AWWA C600, the manufacturer’s recommendations and as shown on the Drawings.
- B. Thoroughly clean interior of hydrants and valves before being lowered into the trench and keep clean during laying operations.
- C. Construct hydrants and valves in dry trenches. Do not install when conditions of the trench or weather are unsuitable.
- D. Secure hydrants to lateral valve or distribution main by means of rods or retainer glands.

- E. Open ends of hydrants and securely close valves to prevent trench water, earth, or other substance from entering when Work is not in progress.
- F. Install hydrants so that existing grade is flush with bury line. Install offsets or extensions as needed so that bury line meets existing grade. Do not mound soil to make existing grade flush with bury line.
- G. Install anchor tees at each hydrant locations. Hydrant valves: 6-inch in accordance with Section 33 12 16 except provide OPEN LEFT. Bolt valve directly to anchor tees and in true vertical alignment. Center valve boxes over operating nut and carefully backfill so valve box remains centered over operating nut.
- H. Do not make service connection between distribution main and hydrant along the hydrant lateral.
- I. Hydrant lateral: 6-inch cement lined ductile iron pipe. Avoid making joints in hydrant laterals. Install joints with retain gaskets if joints are required and retaining glands are used. Secure hydrant to valve by means of rods or retaining glands.
- J. Install hydrant in true vertical alignment and check with a level in both the vertical and horizontal directions in the presence of Engineer.
- K. Construct a crushed stone sump to one side of the hydrant and to the dimensions indicated on the Drawings with each hydrant. Cover drain holes with crushed stone. Install geotextile filter fabric over crushed stone sump to prevent siltation of the sump.
- L. Install thrust blocks to dimensions shown on the Drawings behind the anchor tee and against the undisturbed trench wall. Install concrete so that tee bolts can be removed. Do not backfill thrust blocks until thrust blocks have cured and are approved.
- M. Install pipe bollards below the frost line or a minimum of 4 feet 6 inches below grade and extend 2 feet 6 inches above grade. Set bollards on 6 inches of 3/4 inch crushed stone and in a 3,000 psi concrete base, a minimum twice the diameter of the pipe bollard.
- N. Field apply 2 coats of safety yellow epoxy paint.

3.03 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Complete disinfection, testing and pressure testing in accordance with Section 33 11 00.
- C. Test hydrants in accordance with NFPA 25

3.04 STARTUP & COMMISSIONING

- A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 33 31 00

SANITARY UTILITY SEWERAGE PIPING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide polyvinyl chloride (PVC) sanitary utility sewerage system in accordance with this Section and applicable reference standards listed in Article 1.03, and the Drawings.
- B. Related Requirements
 - 1. Section 01 51 40 – Temporary Sewage Bypass
 - 2. Section 01 57 05 – Temporary Dewatering
 - 3. Section 31 00 00 - Earthwork
 - 4. Section 31 05 19.13 – Geotextiles for Earthwork
 - 5. Section 33 39 13 – Sanitary Utility Sewerage Manholes, Frames and Covers

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Public Works Association (APWA)
 - 2. ASTM International (ASTM)
 - a. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - b. ASTM C443 - Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - c. ASTM C1173 – Standard Specification for Flexible Transition Couplings for Underground Piping Systems

- d. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 - e. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - f. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
3. American Water Works Association (AWWA)
- a. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
4. Uni-Bell PVC Pipe Association
- a. UNI-B-06 – Recommended Low-Pressure Air Testing of Installed Sewer Pipe
 - b. UNI-TR-1 - Deflection: The Pipe/Soil Mechanism

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 - 1. Manufacturer's data for pipe, fittings, and appurtenances
- C. Certificates
 - 1. Manufacturer's notarized certificate certifying compliance with Specifications
- D. Manufacturer Instructions
 - 1. Manufacturer's recommendations for storage, protection, handling, and installation of pipe, fittings, and appurtenances
- E. Source and Field Quality Control Submittals
 - 1. Test results, inspection video on DVD, and logs from inspection and testing

- F. Description of proposed bypass system and emergency response plan in accordance with Section 01 51 40
- G. Closeout and Maintenance Material Submittals per Division 01 General Requirements and as follows.
 - 1. Video recordings of post-construction inspections, showing watertight connection between existing sewer and new PVC sewer, provided on portable USB hard drive

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Accompany each shipment of pipe, pipe fittings and appurtenances with manufacturers' certificates of compliance.
- C. Store materials and equipment in accordance with manufacturer's instructions.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.
- B. Notify Owner immediately if Site conditions prevent access to manholes or pipes identified as part of Work.
- C. Existing pipe material shown on Drawings is not guaranteed. Verify pipe material prior to conducting Work.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. Type: ASTM D3034.
 - 1. PVC pipe with less than 4 feet of cover: SDR 26 grade.
 - 2. PVC pipe between 4 feet and 16 feet deep: SDR 35 grade.
 - 3. PVC pipe over 16 feet deep: SDR 26 grade.
- B. Furnish Neoprene sleeve with stainless steel bands for connecting new PVC pipe to existing sewer. Acceptable level of quality equivalent to: Fernco Strong Back RC flexible couplings.

- C. Provide fittings of same type and class of materials as pipe, unless otherwise specified.
- D. Furnish commercially manufactured wyes or tee/yses for service connections and manhole outside drop connections. Provide fittings with single piece gasket. Use nitrile gaskets in contaminated soils areas.

2.02 INSULATION

- A. Extruded closed-cell rigid formed polystyrene: 2 inches thick by 4 feet wide. Acceptable level of quality: “Styrofoam HI-60 inch” by Dow Chemical.

2.03 FILTER FABRIC

- A. Furnish non-woven filter fabric for working mat in accordance with Specification 31 05 19.13.

2.04 ELECTROMETRIC MANHOLE PIPE CONNECTIONS

- A. Furnish for use between new pipe and existing manholes Acceptable level of quality: equivalent to Kor-n-Seal.

2.05 SEWER CHIMNEYS

- A. Sewer chimneys: PVC with factory-made ductile iron tees at main.

2.06 FLEXIBLE COUPLINGS

- A. Furnish ASTM 1173 flexible couplings for approved use and locations.
 - 1. Type A: pressure application cast coupling with followers and middle ring-coated with fusion bonded epoxy to prevent corrosion. Alloy bolts and nuts: corrosion resistant. Gasket material: suitable for application including operating temperature, maximum pressure, and material going through pipe and to provide a positive seal against both infiltration and exfiltration.
 - 2. Type B: non-pressure application, elastomeric sleeve or rubber sleeve incorporating stainless steel tension bands and tightening mechanism to provide a positive seal against both infiltration and exfiltration, resilient and unaffected by soil conditions, resistant to chemicals, ultraviolet rays, fungus growth, and normal sewer gases. Stainless steel bands: 300 Series.

2.07 SEWER MAIN CONNECTIONS TO LATERALS

- A. Furnish 3-piece service connection consisting of PVC hub, rubber sleeve, and stainless steel band with compression fit into cored wall of mainline sewer pipe. Provide that connection accepts ASTM D3034 PVC pipe, SDR 35 grade.

2.08 UNDERGROUND MARKING TAPE

- A. Furnish detectable marking tape with aluminum core, minimum 6 inches wide and minimum 5 mils thick with APWA uniform color-coding for quick and easy identification and location. Text or lettering: “CAUTION BURIED SANITARY SEWER LINE BELOW” repeated continuously along length of tape at maximum intervals of 3 feet.

2.09 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Confirm locations of branch service connections prior to installation of new PVC sewer pipe. Reinstate service connections deemed “active”. Owner will decide if service connection is “active” or “abandoned”.
- B. Provide bypass pumping in accordance with Section 01 51 40.

3.02 INSTALLATION OF GRAVITY PIPE AND FITTINGS

- A. Install pipe in accordance with manufacturer's recommendations. Secure each length of pipe with bedding before placing next length. Plug open ends whenever Work is suspended. Bed pipe as shown on Drawings. Provide minimum 30 inches of cover over top of PVC pipe before trench is wheel-loaded.
- B. Lay pipe to line and grade shown on Drawings. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to a uniform grade between these points. Line and grade may be adjusted by Engineer as required by field conditions.
- C. Lay pipe in the dry trench. Dewater trench pursuant to Section 01 57 05. Do not use installed pipe to remove water from Work area.
- D. Flush pipe and remove debris using approved flushing method. Do not use gravity flushing.

- E. Connections to Manholes
 1. Provide short length of pipe so joints are located within 3 feet of inside surface of manholes.
 2. Provide new flexible pipe-to-manhole connector, manhole boot, as specified. Repair manhole penetration as necessary to install flexible connector.
- F. Repair manhole brick invert and bench as necessary to provide a smooth transition from manhole to pipe as Specified in Section 33 39 15
- G. Lay pipe at elevation so top of sewer is minimum 18 inches below bottom of water or drain line whenever sewers must cross water or storm drain lines. Center one full length of water pipe at point of crossing so that joints are equal distance and as far as possible from sewer.
- H. Service Laterals and Manhole Drop Connections
 1. Verify location and size of service laterals as indicated on Drawings.
 2. Provide tee/wye or fittings on main line pipe and connect existing services/drop connections to main line. Maximum length of new PVC service pipe: from main sewer to building property line.
 3. Enclose upright portion of sewer chimney with sonotube filled with 3/4-inch crushed stone. Cut sonotube to 1 foot below elevation of tee connecting chimney to service connection pipe.
 4. Assist Engineer in measurement of pipe installed and swing ties to pipe connection with existing pipe.

3.03 OPEN CUT SPOT REPAIR OF EXISTING GRAVITY PIPE

- A. Repair damaged sewer pipe as indicated on Drawings. Locate existing utilities using test pits, Dig Safe, and other subsurface investigation methods.
- B. Location and length of open cut point repair are approximate. Remove damaged pipe to a point where clean pipe capable of making a waterproof connection is available. Report pipe lengths removed to Engineer prior to backfilling.
- C. Replace defective sewer with SDR 35 or SDR 26 PVC, as specified in Part 2, regardless of original pipe material. Pipe fittings: appropriate for pipe size and materials to be joined and form a watertight connection.
- D. Maintain flows at all times during manhole, sewer, and open cut point repairs in accordance with Section 01 51 40.

- E. Provide installation of new watertight manhole boots and watertight cement sealing of pipe penetration at open cut locations where pipe replacement is required at manhole interface.
- F. Use trench shoring and necessary protection at open cut locations where sewer pipe is within 5 feet of water or sewer force main or other utilities.
- G. Clean saw cut existing pavement at open cut locations and provide smooth transition to existing, undamaged pavement.
- H. Excavation under utilities: backfilled with controlled density fill as specified in Section 31 00 00.

3.04 INSULATION

- A. Install insulation when gravity sewer pipe depth is less than 4 feet, or as directed.
- B. Provide minimum 4 inches of sand layers directly above and below insulation.

3.05 DIGITAL VIDEO INSPECTION

- A. Perform CCTV inspection of new sewer installation or open cut repair upon completion in presence of Engineer.
- B. Complete inspection of interior of pipe and service lateral connections installed prior to final paving of Project by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television. Submit DVD and suitable log for review prior to final paving.

3.06 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Test sanitary sewer pipes after backfilling. Install service leads on main line before testing. Perform tests in presence of Engineer. Install a maximum of 1,000 linear feet of pipe without testing.
- C. Perform low pressure air testing of gravity sewer piping systems.
 - 1. Leakage test for PVC pipe: low-pressure air test per UNI-B-06. Minimum times for test: more stringent requirement of following table or Table 1 of UNI-B-06.
 - a. Plug ends of sections to be tested.
 - b. Supply air slowly to pipe to be tested until the air pressure inside pipe is 4.0 psi greater than average back pressure of any groundwater submerging pipe.

- c. Disconnect air supply and allow minimum of 2 minutes for stabilization of pressure.
- d. Measure drop in pressure over test period based on piping size following stabilization period.
- e. Acceptable pressure drop: maximum 1.0 psi.

**Minimum Specified Time Required for a 1.0 psig Pressure Drop
for Size and Length of Pipe Indicated for Q=0.0015**

Pipe Diameter (inches)	Minimum Time (min:sec)	Length for Minimum Time (feet)	Time For Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)						
				100 feet	150 feet	200 feet	300 feet	350 feet	400 feet	450 feet
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:24	14:15	17:05	19:56	22:47	25:38

2. Deflection test for PVC gravity sewer pipe

- a. Test pipe with "GO/NO-GO" gauge allowing a 5 percent maximum deflection. Mandrel dimensions: based on base pipe ID from ASTM 3034 DR35/SDR21 or AWWA C900 DR18, as appropriate, and calculation provided in UNI-TR-1.

$$\text{Mandrel O.D.} = ((100-7.5) / 100) \times \text{base pipe ID}$$

- D. Repair and retest piping systems that do not pass tests using approved materials and methods.

3.07 CLEANING

- A. Do not discharge, bypass, or flooding of sewage, cleaning water, or debris to public or private property, including ground, surrounding residences, and downstream sewer lines. Immediately and completely clean and repair any damage resulting from new pipe installation activities to satisfaction of Owner and Engineer.

3.08 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 33 39 13

SANITARY UTILITY SEWERAGE MANHOLES, FRAMES, AND COVERS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Design and provide precast concrete manholes and precast concrete structures complete with steps, inverts, risers, frames, covers, hatches and anti-flotation slabs in accordance with this Section, the Drawings, and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. 01 51 42 Temporary Stormwater Drainage Bypass
 - 2. 33 31 00 Sanitary Utility Sewerage Piping
 - 3. 33 39 15 Sanitary Utility Sewerage Manhole Inverts

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Association of State and Highway Transportation Officials (AASHTO)
 - a. AASHTO HB-17 Standard Specification for Highway Bridges
 - b. AASHTO T111 Standard Method of Test for Mineral Matter or Ash in Asphalt Materials
 - 2. ASTM International (ASTM)
 - a. ASTM A36/A36M Standard Specification for Carbon Structural Steel
 - b. ASTM A48/A48M Standard Specification for Gray Iron Castings
 - c. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

- d. ASTM B26/B26M Standard Specification for Aluminum-Alloy Sand Castings
- e. ASTM C32 Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)
- f. ASTM C33/C33M Standard Specification for Concrete Aggregates
- g. ASTM C139 Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
- h. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
- i. ASTM C150/C150M Standard Specification for Portland Cement
- j. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes
- k. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete
- l. ASTM C270 Standard Specification for Mortar for Unit Masonry
- m. ASTM C478 Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
- n. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete
- o. ASTM C857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- p. ASTM C877 Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
- q. ASTM C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
- r. ASTM C913 Standard Specification for Precast Concrete Water and Wastewater Structures
- s. ASTM C923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- t. ASTM C990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- u. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

- v. ASTM C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
- w. ASTM D4 Standard Test Method for Bitumen Content
- x. ASTM D6 Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds
- y. ASTM D71 Standard Test Method for Relative Density of Solid Pitch and Asphalt (Displacement Method)
- z. ASTM D113 Standard Test Method for Ductility of Bituminous Materials
- aa. ASTM D217 Standard Test Methods for Cone Penetration of Lubricating Grease
- bb. ASTM D1187/D1187M Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 - 1. Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions
 - 2. Dimensional data for each structure
 - 3. Product data for manholes, joint sealants, catch basins, inverts, risers, frames, covers, grates and frost barriers
- C. Shop Drawings
 - 1. Precast manholes and precast concrete items showing components to be used, elevations of top of precast sections, base and pipe inverts, rim elevation, location of pipe penetrations, and steps for each manhole, and finish grade elevation at each proposed manhole location
- D. Design Data for precast structures including anti-flotation slabs

- E. Certificate of design signed by a professional engineer certifying precast structures including the anti-flotation slabs, whether provided separately or as a monolithic unit, have been designed to withstand all forces including soil, traffic and hydrostatic loads in accordance with applicable Laws, Regulations, rules and codes.
- F. Source and Field Quality Control Submittals
 - 1. Leakage test reports for each structure
 - 2. Record as-built structure information neatly in a permanently bound notebook. Provide access to records for the Engineer at all times. Submit copies to the Engineer on a weekly basis.
- G. Qualification Statements
- H. Closeout and Maintenance Material Submittals per Division 01 General Requirements and include the following in record documents.
 - 1. Location and rim elevations of all precast concrete structures
 - 2. Locations and invert elevations of all pipe penetrations

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements and as follows for structure design.
 - 1. Professional engineer, registered in the state in which the Project is located, with 5 years' minimum experience in the design of similar structures

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Handle and place concrete units in accordance with manufacturer's written rigging instructions.
 - 2. Provide slings, straps, and other devices for handling and support of catch basin sections during lifting, installing, and final positioning using lifting holes.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 DESIGN CRITERIA

- A. Design structures to resist soil loads, surcharges, and buoyant forces.
- B. Design complete manhole and precast concrete structures to meet AASHTO HB-17, including a HS-20 vehicle load unless otherwise specified or indicated on the Drawings. Apply a lateral vehicle surcharge load of 125 psf.
- C. Design Loads
 - 1. ASTM C890, unless otherwise specified or indicated on the Drawings.
 - 2. ASTM C857 unless otherwise specified or indicated on the Drawings.
- D. Equivalent lateral fluid pressure: 100 psf per linear foot below flood or design groundwater elevation and 60 psf per linear foot above such elevation. Add the specified lateral vehicle surcharge load to this load.
- E. Anti-Flotation Design
 - 1. Design precast structures with anti-flotation slabs and provide the precast structures requiring anti-flotation slabs as one complete unit.
 - 2. Criteria for each structure
 - a. Factor of safety: minimum 1.15 against buoyancy with an assumed flood elevation at the top of the structure. Do not include frictional resistance in this calculation.
 - b. Weight of segments: same factor of safety for buoyancy or include stainless steel mechanical connections to connect the segments together, where the structure is composed of successive vertical segments.
 - c. Include positive anchorage to a reinforced concrete anti-buoyancy slab of the required size.

2.02 MANHOLES AND STRUCTURES – GENERAL

- A. Base sections: precast monolithic construction with steps.
- B. Barrel sections: precast with steps.

- C. Top sections: precast eccentric cone top as shown on the Drawings.
- D. Flat top structures: as shown on the Drawings.
- E. Precast manhole components: ASTM C478.

2.03 PRECAST CONCRETE

- A. Comply with ASTM C913.
- B. Concrete compressive strength: minimum 5,000 psi after 28 days.
- C. Concrete structure thickness: minimum 5 inches unless otherwise specified or indicated on the Drawings. Provide increased thicknesses to accommodate loadings from vehicles or mechanical equipment. Provide increased thicknesses to accommodate H-20 load ratings.
- D. Portland cement: ASTM C150/C150M Type II.
- E. Fine aggregate: ASTM C33/C33M natural sand.
- F. Coarse aggregate: ASTM C33/C33M well graded crushed stone.
- G. Air entrainment admixture: ASTM C260. Air-entrained content: minimum 4 percent, maximum 7 percent.
- H. Super plasticizer: ASTM C494/C494M type F or G.
- I. Cement content: minimum 564 pounds per cubic yard.
- J. Concrete fillet: minimum 3,000 psi concrete.

2.04 REINFORCEMENT

- A. Concrete reinforcement: in accordance with design criteria and conditions specified.
- B. Reinforcing steel yield stress: minimum 40,000 psi.
- C. Concrete cover over reinforcing bars: minimum 1-1/2 inches.
- D. Wire fabric: ASTM1064/A1064M.
- E. Reinforcing bars: billet steel, deformed, ASTM A615/A615M, Grade 60.

2.05 BRICK AND MORTAR

- A. Sewer Brick: ASTM C32, Grade SS, hard brick.

- B. Concrete Masonry Units: ASTM C139.
 - 1. Portland cement: ASTM C150/C150M, Type II.
 - 2. Sand: ASTM C144.
 - 3. Hydrated lime: ASTM C207, Type S.
 - 4. Use Type II Portland cement, Type S Lime.
 - 5. Proportions for mortar: 1 part Portland cement, 1/4 part hydrated lime, 3 to 3-3/4 parts sand.

2.06 STEPS

- A. Material: plastic, aluminum or steel reinforced copolymer polypropylene conforming to ASTM C478.
- B. Furnish cast-in-place or installed utilizing approved inserts.
- C. Size: 12 inches on center with abrasive step surface and safety edge, drop front design, 1-inch diameter and 16 inches wide.
- D. Coat metal items embedded in concrete with a bituminous coating.

2.07 JOINTS

- A. Furnish bell and spigot or tongue-in-groove ends with precast concrete sections to ensure proper connection of the joints. Provide flat joints only where specified or indicated on the Drawings.
- B. Factory seal joints with minimum 2 rows of butyl rubber sealant. Apply compatible primer and apply seals in accordance with the manufacturer's recommendations. Hydrostatic performance requirements for joint seals: ASTM C990, Section 10.1.
 - 1. Acceptable Manufacturers for Sealant
 - a. Concrete Sealants, Inc. - Conseal CS-102 or CS-202 (Per Temperature)
 - b. Hamilton Kent – Kent Seal No. 2
 - c. Press-Seal Gasket Corporation – Pro-Stik
 - d. Or equal
 - 2. Sealant Properties

- a. Hydrocarbon blend content: minimum 50 percent per ASTM D4.
- b. Inert mineral filler: minimum 30 percent by weight per AASHTO T111.
- c. Volatile Matter: maximum 2 percent by weight per ASTM D6.
- d. Specific gravity: 1.15-1.50 per ASTM D71.
- e. Ductility: minimum 5.0 per ASTM D113.
- f. Penetration Cone: 50-100 mm per ASTM D217 at 77 degrees F, 150 gm. 5 seconds
- g. No deterioration, cracking or swelling after 30 days immersion in 5 percent solutions of HCl, H₂SO₄, NaOH, KOH, and H₂S.

2.08 PIPE CONNECTIONS

- A. Provide seals for piping penetrations in precast structures as indicated on the Drawings. Provide pre-molded elastomeric (boot type) sealed joints between the pipe and precast sections where the pipe sealing system has not been specifically indicated. Provide mechanical link type seals for piping penetrations where specified or indicated on the Drawing.
- B. Acceptable Manufacturers
 1. Trelleborg Pipe Seals, Inc. – Kor-N-Seal
 2. A-Lok Products, Inc.
 3. Press-Seal Gasket Corporation
 4. Or equal
- C. Pre-molded elastomeric seals: EPDM with 300 series stainless steel pipe clamps, bands and wedges, designed in accordance with the following.
 1. Head Pressure: 13 psi for 10 minutes at 00, per ASTM C923.
 2. Head Pressure: 10 psi for 10 minutes at 00, per ASTM C923.
 3. Deflection: 70, in any direction, per ASTM C923..
 4. Load Test: 150 pounds per inch pipe diameter, per ASTM C923

2.09 STAINLESS STEEL CONNECTOR

- A. Provide 304 stainless steel plate connectors between manhole sections to prevent frost separation. Provide stainless steel connectors for valve manholes.

2.10 DAMP-PROOFING AND WATER SEALANTS

- A. Provide a 2-coat bituminous damp-proofing (water sealing) system for precast structures, ASTM D1227 and ASTM D1187/D1187M, designed for use both above and below grade.
- B. Acceptable Manufacturers
 - 1. Acceptable level of quality: equivalent to BASF Construction Chemicals, Inc. Hydrocide 600, 700 or 700B and Karnak Corporation – 100AF.
 - 2. Or equal.

2.11 JOINT WRAP

- A. Provide ASTM C877 (Type III) self-shrinking EPDM rubber joint wrap for precast structure joints.
- B. Acceptable level of quality: equivalent to Press-Seal Gasket Corporation – EZ-Wrap or Sealing Systems, Inc. – Infi-Shield Gator Wrap.
- C. Thickness: minimum 30 mils with back side coated with a cross-linked reinforced non-hardening butyl adhesive. Sealant: minimum of 30 mils thick.
- D. Design sealing system to stretch entirely around each structure along the joint and then be overlapped to create a fused bond. Width of the joint wrap: minimum 6 inches and overlap each wrap by at least 2 times the width of the wrap.
- E. Butyl component of tape: minimum 50 percent (minimum) butyl rubber and contain 2 percent or less volatile matter.

2.12 RISERS (GRADE RINGS)

- A. Furnish precast concrete grade rings to raise rim elevations of the frame and covers if required.

2.13 FRAMES, GRATES AND COVERS

- A. Cast iron: ASTM A48/A48M Class 30.
- B. Aluminum: ASTM B26/B26M alloy number 713.0.
- C. Carbon steel: ASTM A36/A36M.
- D. Acceptable level of quality: equivalent to EJ Iron Inc. or Neenah Foundry products meeting specified performance requirements and sizing shown on Drawings. labeled "SEWER" in 3-inch high raised letters on cover.

2.14 MISCELLANEOUS

- A. Butyl rubber caulking: ASTM C990, Type B.

2.15 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION OF MANHOLES

- A. Place precast bases on compacted bedding material so bottom of structure is plumb, and pipe inverts are at proper elevations. Place barrel and top sections in appropriate height combinations. Plug lifting holes inside and out with non-shrink grout. Fill below structure with 3,000 psi concrete, if required. Place concrete at a slump of between 5 and 8 inches Provide a trowel finish on concrete pours.
- B. Lay pipe to alignment and grade shown on the Drawings. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to a uniform grade between these points. Line and grade may be adjusted by the Engineer as required by field conditions. Install a mechanical water stop for every 10 vertical feet of sewer main elevation change.
- C. Install sealing joints between precast sections per manufacturer's instructions and provide two rings of 1-inch diameter butyl rubber sealant and joint wrap.
- D. Frames and Covers
 - 1. Set to final grade as shown on the Drawings. Set frames and covers 1/2-inch below pavement grade in paved areas, 1/2-inch below finish grade in unpaved gravel roads, or 24 inches above grade in cross-country areas unless otherwise specified or indicated on the Drawings. Provide adequate temporary covers to prevent accidental entry until final placement of frame and cover is made.
 - 2. Provide two rings of 1-inch diameter butyl rubber sealant between frame and chimney joints. Provide downward force to frame to compress the joint, provide a watertight seal, and prevent future settlement. Point compressed joint with butyl rubber caulk sealant.
 - 3. Set manhole frames and covers to final grade only after pavement base course has been applied, or after final grading of gravel roads.
- E. Inverts: per detail on Drawings and in accordance with Specification 33 39 15
- F. Replace any steps that are out of plumb and without proper horizontal placement.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Preparation
 - 1. Provide structures are complete except for shelf and invert brickwork.
 - 2. Make pipe connections prior to testing. Plug pipes and other openings in the structure walls prior to test.
- C. Test precast concrete manholes immediately after installation and prior to backfilling. Provide for Engineer to observe tests.
- D. Vacuum Tests for Manholes
 - 1. Conduct Manhole Acceptance Test using the vacuum test procedure in ASTM C1244, except as modified herein.
 - 2. Passing determined by time for vacuum to drop from 10 inches of mercury to 9 inches of mercury regardless of diameter:

Greater than	Manhole depth
2.0 minutes	0 feet – 10 feet
2.5 minutes	10 feet to 15 feet
3.0 minutes	15 feet and over

- 3. Locate leak, make repairs, and retest structure if the vacuum drops in excess of the prescribed rate.
- 4. Conduct water exfiltration test if unit fails repeat of vacuum test after repair as directed.
 - a. Plug pipes into and out of structure and secure plugs.
 - b. Lower groundwater table (GWT) to below structure. Maintain GWT at this level throughout test. Provide means of determining GWT level at any time throughout test.
 - c. Fill structure with water to top of structure.
 - d. Allow a period of time for absorption as determined by Engineer.
 - e. Refill to top of cone.
 - f. Determine volume of leakage in an 8-hour minimum test period and calculate rate.

- g. Acceptable leakage rate for manholes and wet wells: maximum 1 gallon per vertical foot per 24 hours.

3.03 REPAIRS

- A. Repair leaks after determining cause. Perform earthwork required for repairs if manhole has already been backfilled.
- B. Perform repairs using materials approved by Engineer.
- C. Remove and replace or reconstruct the manhole if necessary.
- D. Remove and replace defective sections if required by Engineer.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 33 39 15

SANITARY UTILITY SEWERAGE MANHOLE INVERTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide sanitary utility sewerage manhole brick and mortar invert in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. ASTM International (ASTM)
 - a. ASTM C32 Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)
 - b. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
 - c. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product data
- C. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Furnish sound, hard, and uniformly burned brick, regular and uniform in shape and size, of compact texture, and satisfactory to Engineer. Bricks: ASTM C32, Grade SS, hard brick. Mean of 5 tests for absorption: maximum 8 percent by weight.
- B. Mortar: Portland cement, hydrated lime, and sand.
- C. Cement: Type II Portland cement as specified for concrete masonry.
- D. Hydrated lime: Type S conforming to ASTM C207.
- E. Sand: ASTM C144 specifications for Fine Aggregate, with exception that sand passes a No. 8 sieve.

2.02 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Immediately remove rejected brick from Work and replace with brick approved by Engineer.
- A. Form invert of brick and mortar upon the manhole base. Do not use poured concrete inverts.
- B. Remove debris from bottom of manhole before invert is constructed.
- C. Sufficiently moisten bricks so not dry enough to absorb water from mortar but not so wet as to be slippery when laid.

- D. Mortar
 - 1. Volume of sand: maximum 3 times sum of volumes of cement and lime. Proportions of cement and lime: as directed and may vary from 1:1/4 for dense hard burned brick to 1:3/4 for softer brick.
 - 2. Mix mortar for Grade SS brick in volume proportions of 1:1/2:4 1/2; portland cement to hydrated lime to sand.
- E. Lay each brick as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling. Thoroughly bond as directed.
- F. Conform brick inverts accurately to size of adjoining pipes. Curve side inverts. Lay out main inverts, where direction changes, in smooth curves of longest possible radius tangent to centerlines of adjoining pipe.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

3.03 CLEANING

- A. Thoroughly clean manholes of silt, debris and foreign matter prior to final inspection.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide storm drain systems including drainage ductile iron force main in accordance with this Section, Drawings, and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 01 51 42 - Temporary Stormwater Drainage Bypass
 - 2. Section 01 57 05 – Temporary Dewatering
 - 3. Section 31 00 00 – Earthwork
 - 4. Section 31 05 19.13 - Geotextile Fabrics for Earthwork
 - 5. Section 33 11 00 – Water Utility Distribution Piping
 - 6. Section 33 12 16 - Water Utility Distribution Valves and Fittings

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. AASHTO M170 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - b. AASHTO M198 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
 - 2. American National Standards Institute (ANSI)
 - 3. American Water Works Association (AWWA)

- a. ANSI/AWWA C104/A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - b. ANSI/AWWA C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast
 4. American Public Works Association (APWA)
 5. ASTM International (ASTM)
 - a. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - b. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - c. ASTM C1173 – Standard Specification for Flexible Transition Couplings for Underground Piping Systems
 - d. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - e. ASTM D2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
 - f. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - g. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 - h. ASTM D4101 – Standard Specification for Polypropylene Injection and Extrusion Materials
 - i. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 - j. ASTM F679 – Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- B. Definitions
1. PVC: polyvinyl chloride
 2. PP: polypropylene
 3. RCP: reinforced concrete pipe
 4. DI OR DIP: ductile iron pipe

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
- B. Product Data
 - 1. Manufacturer's data
- C. Certificates
 - 1. Manufacturer's notarized certificate certifying compliance with Specifications
- D. Design Data
 - 1. Manufacturer's anti-floatation calculations for each pipe material and details, signed and stamped by a licensed professional engineer in state where Project is located, based on following criteria.
 - a. Set groundwater elevation at grade above pipe.
 - b. Factor of safety: 1.1. Downward forces from weight of pipe and soils over pipe: 1.1 times buoyant uplift forces.
 - c. Consider pipe is empty. Do not consider weight of internal water in calculations.
- E. Manufacturer Instructions
 - 1. Manufacturer's recommendations for storage, protection, handling, and installation of the pipe, fittings, and appurtenances
- F. Source and Field Quality Control Submittals
 - 1. Force Main pressure testing procedures
 - 2. Test results, inspection video on DVD, and logs from inspection and testing
- G. Closeout and Maintenance Material Submittals per Division 01 General Requirements and as follows:
 - 1. Video recordings of post-construction inspections
 - 2. Record depths and take ties to locations for Conformed to Construction Record Drawings.

- a. Pipe stub capped ends
- b. Locations of plugged pipes
- c. Manholes and catch basins

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Accompany each shipment of pipe, pipe fittings and appurtenances with manufacturers' certificates of compliance.
- C. Store materials and equipment in accordance with manufacturer's instructions.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.
- B. Notify Owner immediately if Site conditions prevent access to manholes or pipes identified as part of Work.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide fittings of same type and class of materials as pipe with single piece gasket
- B. Minimum pipe stiffness at 5 percent deflection: 46 psi for all sizes when tested in accordance with ASTM D2412.
- C. Joint deflection: accommodate an offset along pipe axis of minimum of 7 inches over 20 horizontal feet.
- D. Provide anti-floatation system for each pipe material where required designed by pipe manufacturer.
- E. Gasket lubricant: solution of vegetable soap or other solution supplied by pipe manufacturer.

2.02 DRAIN PIPE LESS THAN 24 INCHES

- A. PVC pipe, joints and fittings
 - 1. 15-inch diameter and smaller: ASTM D3034.

2. 18-inch diameter and larger: ASTM F679.
3. Joints: rubber gasketed bell and spigot type in accordance with ASTM D3212.
4. Gaskets: in accordance with ASTM F477.

2.03 DRAIN PIPE 24 INCHES TO 48 INCHES

- A. PVC or PP pipe for areas shown on Drawings: ASTM F679.
1. Joints: ASTM 3212, rubber gasketed bell and spigot type.
 2. Gaskets: ASTM F477.
- B. PP Pipe
1. Acceptable level of quality: equivalent to ADS N-12 HP Sanitary Pipe with water tight joint.
 2. Furnish thermoplastic pipe and joint fittings with smooth interior and exterior surface with annular inner corrugations.
 - a. Pipe stiffness: minimum 46 psi when tested in accordance with ASTM D2412.
 - b. Material: virgin per ASTM D4101.
 - c. Pipe joining: gasketed integral bell and spigot with watertight joint.
 - 1) Watertight joint: ASTM D3212.
 - 2) Spigots: ASTM F477 with 2 gaskets.
 - a) Gaskets: installed by pipe manufacturer and covered with a removable, protective wrap to keep free from debris.
 - b) Provide with manufacturer's joint lubricant for use on gasket and bell during assembly.
 - 3) Furnish reinforced bell with polymer composite band.

2.04 RCP

- A. Furnish ASTM C76/AASHTO M170 Class V pipe.

- B. Concrete joint with confined O-ring gasket: ASTM C443/AASHTO M198, sealed on inside with cement mortar or with gunite by grout-weld method using pneumatic machine.

2.05 DI OR DIP

- A. Pipes, valves and fittings: per Section 33 11 00 and Section 33 12 16.
 - 1. Ratings for pressures: minimum of 150 psi, and manufactured per AWWA/ANSI C151/A21.51.
 - 2. Type: double cement lined per AWWA/ANSI C104/A21.4, push-on joint.
 - 3. Coatings: factory applied bituminous coatings per AWWA C151.

2.06 FLEXIBLE COUPLINGS

- A. Furnish ASTM 1173 flexible couplings for pipe to pipe connections.
 - 1. Type A: non-pressure application, elastomeric sleeve or rubber sleeve incorporating stainless steel tension bands and tightening mechanism to provide positive seal against both infiltration and exfiltration. Stainless steel bands: 300 Series. Coupling: resilient and unaffected by soil conditions, resistant to chemicals, ultraviolet rays, and fungus growth.
 - 2. Type C: PVC repair coupling of same type and class of materials as pipe. Fitting: provided with single piece gasket.

2.07 UNDERGROUND MARKING TAPE

- A. Furnish detectable marking tape with aluminum core, minimum 6 inches wide and minimum 5 mils thick with APWA uniform color-coding for quick and easy identification and location. Text or lettering: CAUTION BURIED DRAIN LINE BELOW repeated continuously along length of tape at maximum intervals of 3 feet.

2.08 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's recommendations. Secure each length of pipe with bedding before placing next length. Plug open ends whenever Work is suspended. Bed pipe as shown on Drawings. Place and compact enough backfill material between pipe and sides of trench to hold pipe in correct alignment when each pipe has been properly bedded.

- B. Excavate bell and coupling holes or provide in base material to receive bell or coupling so only barrel of pipe receives bearing pressure from supporting material. Do not permanently support pipe or fittings on blocks, wedges, boards or stones.
- C. Prevent floatation of pipe from water in trenches.
- D. Maintain flows during Work per Section 01 51 42.
- E. Assist Engineer as needed to run level checks on pipe slopes, and take ties.
- F. Lay pipe to line and grade shown on Drawings. Field verify elevations and slope and make adjustments as necessary. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to uniform grade between manholes. Line and grade may be adjusted by Engineer as required by field conditions. Lay each pipe to form a close joint with next adjoining pipe and bring inverts continuously to required line and grade.
- G. Immediately lay pipe as soon as excavation is completed and bedding material is at proper grade.
 - 1. Insert circular rubber gasket in gasket seat provided and apply a thin film of gasket lubricant to inside surface of gasket.
 - 2. Clean spigot end of pipe and enter into rubber gasket in bell. Keep joint from contacting ground.
 - 3. Complete joint by forcing plain end to seat of bell. Mark pipes without depth mark before assembly to ensure spigot end is inserted to full depth of joint.
- H. Do not lay next length of pipe until previous length has had sufficient material tamped around it to secure it firmly in place and prevent movement or disturbance.
- I. Lay pipe in the dry trench. Dewater trench pursuant to Section 01 57 05. Do not use installed pipe to remove water from Work area.
- J. Lay pipe with bell ends facing direction of laying unless otherwise permitted by Engineer. Make joints according to pipe manufacturer recommendations.
- K. Flush pipes and remove debris by method approved by Engineer. Do not perform gravity flushing.
- L. Connections to manholes and catch basins: short length of pipe so joints are located within 3 feet of inside surface of manholes and catch basins.
- M. Use manufacturer recommended anti-floatation system for each pipe material.

N. Flexible couplings

1. Use compression type flexible connector cast into manhole wall or flexible boot connection for pipe connections to new manholes, according to pipe manufacturer recommendations. Do not field core new manholes.
2. Core existing manhole and install boot type flexible connector for pipe connections to existing manholes.

O. PVC Pipe Installation

1. Store pipe bundles on flat surface to support barrels evenly to prevent warping. Do not use warped sections.
2. Keep pipe stacked in original shipping bundles and remove only quantity of pipe needed for 1 day of laying, and distribute along trench.

P. PP Pipe Installation

1. Bedding and burial of pipe and fittings: per ASTM D2321 and manufacturer's recommended installation guidelines.
2. Minimum cover in traffic areas: 2 feet.

Q. RCP Installation

1. Apply cement mortar by trowel. Thoroughly fill joint and finish smooth with inside surface of pipe.
2. Provide application of grout-weld seal by experienced and skilled workmen in accordance with pneumatic machine manufacturer's instructions.
3. Inspect interior of each pipe while being joined to confirm alignment is preserved.

R. DI Pipe Installation

1. Inspect interior of each pipe while being joined to confirm alignment is preserved and ensure no dirt or debris has entered pipe after laying and partial backfilling.
2. Lower pipe fittings and accessories into trench piece by piece, by means of derrick, crane, slings and other suitable tools and equipment. Prevent damage to pipe and protective coating and linings. Do not pass chains or slings through inside bore of pipes, valves, or fittings.
3. Cut ductile iron pipe square and even without ragged and rough ends using abrasive wheel cutter, rotary wheel hand cutter with carbide cutter, or

guillotine pipe saw. Bevel and file field cut pipe lengths to avoid damage to gaskets and facilitate making joints. Taper outside of cut end with a coarse file or portable grinder, back approximately 1/8-inch at angle of approximately 30 degrees with center line of pipe when cut end of pipe is used as a joint.

4. Install DI pipe, valves and fittings in accordance with Section 33 11 00 and Section 33 12 16, excluding disinfection requirements.

3.02 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Subject pipe to thorough inspection and tests per applicable ASTM standards
 1. Test DI pipe in accordance with leakage and pressure testing requirements in Section 33 11 00.
- C. Remove and replace damaged pipe, or encase in Class A concrete collar or envelope as directed.
- D. Perform digital video inspection of interior of pipe and catch basin lateral connections prior to final paving with experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television. Submit a DVD and suitable log to Engineer for review prior to final paving.
- E. Perform deflection test for flexible pipe within 30 days of completion of PVC and PP pipe installation. Test 100 percent of pipe with a Go/No-Go mandrel. Size outside dimension of mandrel to permit maximum 7.5 percent deflection. Base mandrel dimensions on base pipe ID.

$$\text{Mandrel O.D.} = ((100-7.5)/100) \times \text{base pipe ID}$$

3.01 CLEANING

- A. Clean and flush piping after Work is complete and before final acceptance.

3.03 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 33 42 16.13

PRECAST CONCRETE CULVERTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide culverts, outlet controls, frames, grates, opening protection and headwalls in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 03 30 00 – Cast-In-Place Concrete
 - 2. Section 33 49 00 – Storm Drainage Structures

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. MassDOT Standard Specifications, Supplements, and Construction Details
 - a. Section 901 – Cement Concrete Masonry
 - b. Section M9 – Miscellaneous Materials
- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO HS 20-44 – Standard Specifications for Highway Bridges
 - 2. AASHTO M198 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
 - 3. AASHTO M220 – Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

- C. American Concrete Institute (ACI)
 - 1. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures
- D. ASTM International (ASTM)
 - 1. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 2. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 3. ASTM A775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars
 - 4. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete
 - 5. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
 - 6. ASTM C1582 – Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete
 - 7. ASTM D1066 – Standard Practice for Sampling Steam
- E. Massachusetts Highway Design (MHD) Bridge Manual, most recent update <http://www.massdot.state.ma.us/highway/doingbusinesswithus/manualspublicationsforms.aspx>
- F. Federal Specification MMM-A-1617B for Adhesive, Rubber Base, General Purpose (MIL A 5092B)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
- B. Product Data
- C. Shop Drawings
 - 1. Plan layout of structures indicating piece mark of each box culvert unit

2. Fabricating plant production schedule
 3. Description of fabricating plant, including any backup concrete mixing facilities, original design mix and proposed method of placement
 4. Modification or deviations from original design mix after original approval
 5. Proposed admixtures to concrete mix including brand and dosage rates
 6. Outline of proposed concrete curing procedures for both box culverts and test cylinders
 7. Reinforcing steel manufacturer name
 8. Complete details of precast units, including dimensions and tolerances, locations and types of reinforcement, finish treatments and concrete strengths at lifting and at 28-days
 9. Joint dimensions and details including type and brand of joint sealing materials
 10. Locations and methods of forming lifting holes, type and location of lifting devices and the method of handling and transporting all precast units to the job site
 11. Provisions for repair of minor non-structural defects
 12. Attachment type, size, and location of reinforcing steel; connection and anchoring methods; details for joints between precast concrete units and sections for watertight structure
- D. Certificates
1. Manufacturer's notarized certificate of conformance with Specifications to accompany shipments.
- E. Design Data/Submittals
1. Manufacturer computations for precast units in accordance with MassDOT Standards using English units and H2O live loading and considering all loadings appropriate for each stage of fabrication, shipment, construction
- F. Field Quality Control Submittals
1. Test results
 2. Manufacturer concrete compression test results for 28-day strength

- G. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Provide manufacturers' certificate of conformance with each shipment of precast concrete headwalls and culverts.
 - 2. Inspect upon delivery and reject structures immediately that do not conform to specified requirements or have been damaged beyond repair and immediately remove from Site.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide in accordance with MassDOT Section 230 and MassDOT Construction Details and as specified below.
- B. Culvert design: AASHTO Specifications for Highway Bridges with interims and MHD Bridge Manual Part I and II. Design sections to accommodate AASHTO HS 20-44 loading in addition to utility loads and soil loading at Site location.
- C. Design and fabricate units to safely withstand handling stresses without damage and to adequately and safely support loads imposed by Work of other trades which might affect construction.

2.02 MATERIALS

- A. Cement: Per Section 03 30 00.
- B. Aggregate: Per Section 03 30 00.
- C. Use water clean and free of injurious and deleterious substances.

- D. Concrete minimum strength: 5,000 psi at 28 days and 3,000 psi at time of form release. The minimum compressive strength shall be 1,500 psi before precast section is removed from the forms. Use corrosion inhibiting admixtures conforming to ASTM C1582 and air entraining admixtures conforming to ASTM C260 to achieve air content between 4.5 to 7.5 percent.
- E. Reinforcement bars: ASTM A615, Grade 60 and epoxy coated per ASTM A775.
- F. Welded wire fabric: ASTM A1064.
- G. Butyl rubber joint sealant: ASTM C990 and ASSHTO M198.
- H. Joint fillers: pre-formed non-expansive, non-extruding type and appropriate for intended use.
- I. Non corrosive grout: Five Star Grout, by Five Star Products, Inc.; MasterFlow 713 grout by Master Builders; F 100 Grout by Sauereisen; Upcon by Upco Div/Emhart Corp; or equal.
- J. Anchors and lifting hooks engineered in concrete: stainless steel.

2.03 FABRICATION

- A. Placement of reinforcement: 2-inch minimum clear cover of concrete over reinforcement. Assemble reinforcement using any combination of single or multiple layers of welded-wire fabric or deformed billet steel bars. Use non-coated reinforcement tie wires.
- B. Monolithically cast each culvert section as four sided box section with open ends, with metal or metal faced forms. Inside surfaces of culvert: smooth with 45 degree chamfered fillets monolithically cast in four inside corners.
- C. Recess hardware into wall on inside surface of culvert and grout over after assembly to maintain a smooth, unbroken inside wall surface.
- D. Provide a suitable number of reinforced lifting fixtures designed by manufacturer for 100 percent impact loading and sufficiently ductile to ensure obvious deformation before failure, to ensure safe and level handling, and to prevent damage.
- E. Glue preformed joint filler to concrete surface with adhesive in accordance manufacturer's recommendations and AASHTO M220 where required.
- F. Factory cure units by suitable heating moisture or steam curing until required strength for release or handling is obtained. Do not expose surfaces to direct sunlight or direct wind during curing.

- G. Grout areas shown on Drawings with non-shrinking, nonmetallic grout. Clean and roughen concrete surface and keep continuously moist for 24-hours immediately prior to application of grout to prevent flash setting. Keep grout moist for 7 days.
1. Mix and place grout in accordance with manufacturer's instructions and conform to ACI minimum and maximum temperature requirements while placing grout. Remove excessive grout around hole after placement to provide smooth surface.
 2. Fill voids between opening in precast box culvert section and fastening systems for curtain walls and copings.
- H. Bituminous damp-proofing:
1. Two coats of factory applied, UV resistant, black bituminous damp-proofing using cutback asphalt (AASHTO M81 or M82) or asphalt emulsion (AASHTO M140) at 5 gallons per 100 square feet minimum per coat.
 2. Provide a 2-coat bituminous damp-proofing (water sealing) system for precast structures, ASTM D1227 and ASTM D1187/D1187M, designed for use both above and below grade
- I. Acceptable Manufacturers
1. Acceptable level of quality: equivalent to BASF Construction Chemicals, Inc. Hydrocide 600, 700 or 700B or Karnak Corporation – 100AF.
 2. Or equal
- J. Coat concrete with approved waterproofing.
- K. Provide male and female shiplap joints with minimum 4-inch concrete overlaps and factory installed neoprene gasket fastened to shiplap joint surface on each culvert section.
1. Neoprene cord: ASTM D1066.
 2. Affix neoprene gaskets for joints between precast units using MIL A 5092B, Type 2 contact cement.
 3. Provide joints with polyolefin backed exterior joint.
 4. Provide holes or inserts for lifting hardware and recessed inserts for attachments of assembly pulling irons.

- L. Concrete masonry for precast box culvert: in accordance with MassDOT Section 901.
 - 1. Minimum 28-day compressive strength: 5,000 psi.
 - 2. Maximum nominal aggregate size: 3/4-inch.
 - 3. Use corrosion inhibiting admixtures conforming to ASTM C1582 and air entraining admixtures conforming to ASTM C260 to achieve air content between 4.5 to 7.5 percent.
 - 4. Furnish and install dowel coupler bar splicers, inserts, lifting hardware, and other items incidental to furnishing and placing of concrete.
- M. Patch imperfections at plant only with Owner and Engineer approval and before shipping unit.
 - 1. Patches: same material used in unit being patched and 2-part epoxy compound to produce proper bonding of patch to unit.
- N. Factory mark each precast concrete unit per marking and identifying procedure designated on approved Shop Drawings and setting plans.

2.04 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Manufacturer Field Services
 - 1. Furnish manufacturer's service representatives for necessary lengths of time to instruct Contractor's personnel in proper handling, installation, and jointing of precast concrete units in accordance with manufacturer's recommendations and instructions.
 - 2. Manufacturer's service representatives to witness complete installation of box culverts, headwalls and certify installation is complete in accordance with manufacturer's recommendations and instructions.

PART 3 – EXECUTION

3.01 GENERAL

- A. Perform Work in accordance with manufacturer's instructions and recommendations.
- B. Coordinate with manufacturer's field representatives. Obtain written affidavit from manufacturer that installation means and methods were according to manufacturer's instructions, witnessed and approved.

- C. Do not use cracked, warped, or broken units, or units which show defects that might adversely affect serviceability of units. Remove and replace defective units.

3.02 INSTALLATION

- A. Use lifting devices designed by manufacturer for 100 percent impact loading and sufficiently ductile to ensure obvious deformation before failure.
- B. Services of Manufacturer's Field Service Representative
 - 1. Supply anchoring and fastening devices.
 - 2. Supply specific lifting devices for each unit on a temporary basis if required. Contractor to return lifting devices upon completion.
 - 3. Oversee installation, verify supplied units are installed in accordance with manufacturer's instructions in a manner to prevent overstressing, marring or damaging of units.
 - 4. Perform patching required due to damage during delivery if approved by Owner.
- C. Make joints between precast sections and units using method to guarantee a leak-proof, watertight joint. Do not use joint designs incorporating O-rings and cement grout.
 - 1. Provide joint filler as required and install joint sealant on interior and exterior sides of joints. Cover joints between all units with preformed sheet membrane in accordance with MassDOT M9.08.0.
- D. Protect precast culverts against flotation or uplift during construction.

3.03 PATCHING

- A. Use patches of same material used in unit being patched and a 2-part epoxy compound to produce proper bonding of patch to unit where patching is permitted.

3.04 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Provide manufacturer's field services to perform installation assistance specified above.
- C. Subject structures to thorough inspection and tests in accordance with methods prescribed by and acceptance or rejections based on applicable ASTM standards.

3.05 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 33 46 16

SUBDRAINAGE PIPING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Provide subdrainage systems associated with natural grass baseball field for composite flat drains below athletic field areas, and HDPE collector drain system in accordance with this Section and applicable reference standards listed in Article 1.03.
- B. Related Requirements
 - 1. Section 31 00 00 – Earthwork
 - 2. Section 31 05 19.13 – Geotextiles for Earthwork
 - 3. Section 33 41 00 – Storm Utility Drainage Piping

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. AASHTO M252 Standard Specifications for Corrugated Polyethylene Drainage Pipe 4”- 10” Diameter
 - b. AASHTO M294 Standard Specifications for Corrugated Polyethylene Drainage Pipe 12”- 48” Diameter
 - 2. ASTM International (ASTM)
 - a. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - b. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

3. Corrugated Polyethylene Pipe Association (CPPA)
 - a. Recommended Installation Practices for Corrugated Pipe Polyethylene Pipe and Fittings
- B. Definitions
 1. HDPE - High-density polyethylene
 2. PE - Polyethylene
 3. PP - Polypropylene
 4. PS - Polystyrene
 5. PVC - Polyvinyl chloride

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01 General Requirements.
- B. Product Data
 1. Flat drain drainage composite and filter fabric, composite fittings, and perforated drainage pipe and fittings
- C. Shop Drawings
 1. Field verified subdrainage layout plan showing pipe types, locations, lengths, sizes, slopes, invert elevations, connection to proposed structures, and new and existing pipe invert elevations at proposed structures
- D. Certificates
 1. Manufacturer's certification that products are manufactured, tested, and supplied in accordance with Specification
- E. Manufacturer Instructions
- F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Handle materials according to manufacturer's written rigging instructions.
- C. Storage and Protection
 - 1. Do not store plastic pipe or fittings in direct sunlight.
 - 2. Protect pipe, pipe fittings, and seals from dirt and damage.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 FLAT DRAIN DRAINAGE COMPOSITE BELOW ATHLETIC FIELD AREA

- A. Provide flat drain composite turf drainage system consisting of three-dimensional, high flow drainage core and non-woven, needle punched filter fabric.
 - 1. Acceptable level of quality: equivalent to 12-inch AdvanEDGE pipe, product number 0491 with 4-ounce. needle punched fabric, as manufactured by Advanced Drainage Systems.
- B. Provide splice, end cap and end out fittings for drainage composite as manufactured by drainage composite manufacturer.

2.02 COLLECTOR DRAINAGE PIPES AND FITTINGS

- A. Acceptable Manufacturers
 - 1. Advanced Drainage Systems
 - 2. Hancor, Inc.
 - 3. Prinsco, Inc.
 - 4. Or equal
- B. Pipe and fittings: perforated and non-perforated, rigid, corrugated smooth inner wall HDPE pipe.

1. HDPE Type N-12 full circular cross-section pipe with outer corrugated wall and smooth inner wall: AASHTO Type S. Corrugations: annular or spiral. Provide perforated collector pipes.
2. Comply with requirements for test methods, dimensions, and markings in AASHTO M252 and M294.
3. Pipe and fittings: virgin HDPE compounds conforming to cell class 324420C for 4-inch through 10-inch diameter, or 335420C for 12-inch through 30-inch diameter in ASTM D3350; free of foreign inclusions and visible defects. Do not allow holes in corrugation crests or sidewalls. Ends of pipe cut squarely and cleanly.
4. Nominal size for pipe and fittings: based on nominal inside diameter of pipe. Corrugated fittings: molded or fabricated by manufacturer. Provide fittings supplied by pipe Supplier only, unless otherwise approved
5. Furnish corrugated split couplings for joints.

2.03 COLLECTOR DRAIN CLEANOUT

- A. Materials as shown on the Drawings.
- B. Cast-in-place concrete as specified per Section 03 30 00.

2.04 SPECIAL COUPLINGS

- A. Furnish special couplings for joining piping made of different materials and dimensions compatible with and able to fit both pipe materials and dimensions.

2.05 COLLECTOR DRAINAGE BACKFILL AND BEDDING MATERIAL

- A. Stone material: as specified in Section 31 00 00.
- B. Gravel borrow: as specified in Section 31 00 00.

2.06 GEOTEXTILE FILTER FABRIC

- A. Non-woven type: as specified in Section 31 05 19.13.

2.07 WARNING TAPE

- A. Provide green warning tape in accordance with Section 31 00 00.

2.08 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions
 - 1. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
 - 2. Locate and mark existing utilities, underground structures, and above-ground obstructions before beginning installation to avoid disruption and damage of services.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 WORK SEQUENCE

- A. Install perimeter perforated collector pipe drainage system prior to flat drain composite drainage below athletic field areas. Ensure flat drains will outlet into 3/4-inch stone backfill prior to backfilling with crushed stone and gravel borrow.
- B. Do not install composite drainage and sand cover until subgrade approved.
- C. Do not backfill sub drainage system until testing and system approved.

3.03 EARTHWORK

- A. Excavating, trenching, and backfilling: in accordance with Section 31 00 00.

3.04 IDENTIFICATION

- A. Install green warning tape over nonferrous piping and over edges of underground structures in accordance with Section 31 00 00.

3.05 COLLECTOR PIPE DRAINAGE INSTALLATION

- A. Install subdrainage collector pipe with a horizontal distance between pipe and trench sidewalls as shown on Drawings. Grade bottom of trench excavation to required slope and compact to firm, solid bed for drainage system. Make joints with split couplings engaging a minimum of 4 corrugations, 2 on each side of pipe joint.
- B. Before installing drainage fill, lay geotextile filter fabric in trench and overlap trench sides and subgrades as indicated. After installing drainage fill, do not wrap top of gravel borrow with geotextile filter fabric. Place geotextile fabric only on bottom and sidewalls of collector pipe trenches. Backfill top of trench with gravel borrow as a filter between Athletic Field Root Zone Mix and 3/4-inch crushed stone. Do not backfill sand blanket over 3/4-inch crushed stone.

- C. Drainage backfill: supporting layer of 3/4-inch stone over trench bottom to compacted depth of not less than 3 inches. Add 3/4-inch stone to top of pipe and perform tests after installing drainage piping. Cover piping with crushed stone and gravel borrow as indicated on Drawings to achieve proper subgrade elevations prior to placement of Athletic Field Root Zone Mix after satisfactory testing. Place gravel borrow in layers not exceeding 9 inches in loose depth. Compact each layer placed by watering or hand-tamping.
- D. Grade fill material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer and fill to grades indicated on Drawings.

3.06 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and as specified.
 - 1. Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 12 inches, unless otherwise indicated.
 - 2. Lay perforated pipe with perforations down.
 - 3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Do not reduce pipe size in direction of flow.
- C. Install HDPE piping in accordance with ASTM D2321.

3.07 PIPE JOINT CONSTRUCTION

- A. Join both solid and perforated HDPE pipe and fittings with couplings for soil tight joints in accordance with ASTM D 2321.
- B. Join piping made of different materials and dimensions with special couplings. Use couplings compatible with and that fit both pipe materials and dimensions. Utilize neoprene gaskets with coupling to provide a soil tight joint.

3.08 COLLECTOR DRAIN CLEANOUT INSTALLATION

- A. Install cleanouts from subdrainage piping to grade.
- B. Set cleanout frames and covers in a cast-in-place concrete anchor, 6-inches thick, as indicated on Drawings.

3.09 COLLECTOR PIPE CONNECTIONS

- A. Install piping as specified in Section 33 41 00 and in accordance with Drawings that indicate general arrangement of piping, fittings, and specialties.

3.10 FLAT DRAIN DRAINAGE COMPOSITE BELOW ATHLETIC FIELDS

- A. Install flat drain drainage composite in accordance with manufacturer's written instructions.
- B. Lay drainage composite directly over subgrade. Slope drainage composite positively, at minimum 0.5 percent towards drainage collector pipe. Install end caps on upgradient end of flat drains Prior to backfill. Cover drainage composite completely with sand over extent of drainage composite as indicated on Drawings.
- C. Wrap and bond filter fabric to drainage core to prevent intrusion of filter fabric into flow channels and furring during backfilling process.

3.11 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Site/Field Tests and Inspections
 - 1. Test drain piping with water to ensure free flow before backfilling after installing drainage fill to top of pipe. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.12 CLEANING

- A. Clear interior of installed piping and structures of dirt and other material as Work progresses. Maintain swab or drag in piping and pull past each joint as completed. Place plugs in ends of uncompleted pipe at end of each day or when Work stops.

3.13 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 33 49 00

STORM DRAINAGE STRUCTURES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Remove existing and Provide new storm drainage catch basins, manholes, inverts and castings in accordance with this Section and applicable reference standards listed in Article 1.03.
 - 2. Related Requirements
 - a. 31 00 00 Earthwork
 - b. 33 41 00 Storm Utility Drainage Piping
 - c. 33 39 15 Sanitary Utility Sewerage Inverts

1.02 PRICE AND PAYMENT PROCEDURES

- A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

- A. Reference Standards
 - 1. American Association of State Highway Transportation Officials (AASHTO)
 - a. AASHTO M81 – Standard Specification for Cutback Asphalt (Rapid-Curing Type)
 - b. AASHTO M82 – Specification for Cutback Asphalt (Medium-Curing Type)
 - c. AASHTO M140 – Standard Specification for Emulsified Asphalt
 - d. AASHTO M198 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
 - 2. ASTM International (ASTM)
 - a. ASTM A48/A48M – Standard Specification for Gray Iron Castings
 - b. ASTM A615/A615M – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

- c. ASTM C139 – Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
 - d. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
 - e. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
 - f. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
 - g. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
 - h. ASTM D4101 – Standard Specification for Polypropylene Injection and Extrusion Materials
3. MassDOT Standard Specifications
- a. M4.02.15 – Cement Mortar

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

- A. Submit in accordance with the Division 01 General Requirements.
- B. Product Data
 - 1. Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions
 - 2. Dimensional data for each structure
 - 3. Product data for manholes, joint sealants, catch basins, inverts, risers, frames, covers, grates and frost barriers
- C. Shop Drawings
 - 1. Precast manholes, catch basins and precast concrete items showing components to be used, elevations of top of precast sections, base and intermediate levels and pipe inverts, rim elevation, location of pipe penetrations, cutouts, and steps for each manhole, and finish grade elevation at each proposed manhole location

- D. Design Data for precast structures including anti-flotation slabs
- E. Certificate of design signed by a professional engineer certifying precast structures including the anti-flotation slabs, whether provided separately or as a monolithic unit, have been designed to withstand all forces including soil, traffic and hydrostatic loads in accordance with applicable Laws, Regulations, rules and codes.
- F. Qualification Statements
- G. Source and Field Quality Control Submittals
 - 1. Leakage test reports for each structure
 - 2. Record as-built structure information neatly in a permanently bound notebook. Provide access to records for the Engineer at all times. Submit copies to the Engineer on a weekly basis.
- H. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.
 - 1. Location and rim elevations of all precast concrete structures
 - 2. Locations and invert elevations of all pipe penetrations

1.06 QUALITY ASSURANCE

- A. Provide in accordance with Division 01 General Requirements.
- B. Qualifications: per Division 01 General Requirements and as follows for structure design.
 - 1. Professional engineer, registered in the state in which the Project is located, with 5 years' minimum experience in the design of similar structures

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Division 01 General Requirements.
- B. Packing, Shipping, Handling, and Unloading
 - 1. Handle and place concrete units in accordance with manufacturer's written rigging instructions.
 - 2. Provide slings, straps, and other devices for handling and support of catch basin sections during lifting, installing, and final positioning using lifting holes.

1.08 SITE CONDITIONS

- A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 ANTI-FLOTATION DESIGN

- A. Design precast structures with anti-flotation slabs and provide the precast structures requiring anti-flotation slabs as one complete unit.
- B. Criteria for each structure
 1. Factor of safety: minimum 1.1 against buoyancy with an assumed flood elevation at the top of the structure. Do not include frictional resistance in this calculation.
 2. Weight of segments: same factor of safety for buoyancy or include stainless steel mechanical connections to connect the segments together, where the structure is composed of successive vertical segments.
 3. Include positive anchorage to a reinforced concrete anti-buoyancy slab of the required size.

2.02 CASTINGS

- A. Cast iron: in accordance with ASTM A48/A48M Class 30.
- B. Storm drain manhole frames and covers
 1. Acceptable level of quality: equivalent to EJ Iron, Inc. Model 00200627 cover and Model 00200811 frame
 2. Manhole cover: 30 inches in diameter labeled DRAIN in 3-inch high raised letters.
- C. Catch basin frames and grates: heavy duty, bicycle safe, cascading type frame and grate. Acceptable level of quality: equivalent to Neenah Foundry products meeting specified performance requirements and sizing shown on Drawings.
- D. Catch basin hood / oil and grease trap: R-3704 with vent holes, cast iron, and mounted in accordance with manufacturer specifications. Acceptable level of quality: equivalent to Neenah Foundry products.

2.03 CATCH BASINS AND DRAIN MANHOLES

- A. Precast structures: ASTM C478 and as shown on Drawings, capable of supporting H-20 and HL-93 loading.

- B. Precast concrete base and first riser: monolithic.
 - 1. Include crystalline waterproofing additive in concrete prior to casting of riser section.
- C. Precast bases and top slabs: same construction as precast riser sections of dimensions shown on Drawings.
- D. Anti-floatation slab: ASTM C139 precast monolithic base unit or cast in place, based on manufacturer's recommendation and as approved.
- E. Wall thickness
 - 1. 4-foot diameter manholes: minimum 5-inch thick wall sections
 - 2. 5-foot and larger diameter manholes: minimum 6-inch thick wall sections.
- F. Embed cast openings for pipe and materials in structure wall during manufacture.
- G. Cone sections: precast sections of similar manufacture, with varying heights, to meet construction requirements.
- H. Lift holes: maximum 2, cast or drilled in any section, with suitable rubber or concrete stopper or other approved device for plugging holes.
- I. Clearly mark date of manufacture and name or trademark of manufacturer on inside of riser structure.
- J. Factory applied coating: UV resistant, black bituminous damp proofing, AASHTO M81 or M82 cutback asphalt, or AASHTO M140 asphalt emulsion. Coat exterior surface of precast manhole and catch basin bases and walls at 5 gallons per 100 square feet minimum per coat.
- K. All-weather joint sealant: butyl rubber material in flexible rope form, AASHTO M198 and ASTM C990 Section 6.2.1. Factory seal joints between precast sections with watertight, shiplap-type seal.
- L. Steps: accurately positioned and embedded in concrete. Manufacture from deformed 1/2-inch steel reinforcement rod per ASTM A615 and encased in polypropylene per ASTM D4101 with pattern design to prevent lateral slippage off step. Size: 12 inches on center with minimum width of 16 inches and 7 inches from wall for full height of manhole.

2.04 PIPE CONNECTIONS (MANHOLES AND CATCH BASINS)

- A. Compression type connector: ASTM C923 single rubber gasket; constructed solely of synthetic or natural rubber.

- B. Boot type connector: ASTM C923 rubber gasket or boot with metal expansion ring and double metal take-up clamps.

2.05 MASONRY MATERIALS

- A. Furnish in accordance with Section 33 39 15.

2.06 AREA DRAINS

- A. Type: PVC, 24-inch diameter with integrated square ductile iron frame and grate to match area drain outer diameter.
- B. Acceptable level of quality: equivalent to Nyloplast Drain Basin.

2.07 SOURCE QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Remove existing structures.
- B. Set catch basin and manhole frames to finished lines and grades as specified
- C. Set castings in bituminous concrete collars and underlay with cement concrete. Collars: minimum 9 inches deep and extend to radius of 1-foot beyond circumference of frame, as shown on Drawings.
 1. Place so bottom of structure is plumb and pipe inverts are at proper elevations. Position tops of structures flush with finished grade.
 2. Locate each structure and set accurate templates to required line and grade as shown on Drawings. Remove and rebuild structures incorrectly and improperly located, oriented or aligned.
 3. Establish sufficient length of proposed curb or edge of pavement adjacent to structure prior to construction of drain inlet and/or catch basin to ensure that structure is correctly located and oriented.
 4. Place foundation course on firm soil of uniform bearing. Remove and replace with crushed stone per Section 31 00 00 If soil below foundation course is classified as Unsuitable.
 5. Seal joints between precast sections with an all-weather joint sealant as specified prior to backfill or completion of manhole, if above grade.

- D. Touch up dampproofing in field prior to backfilling.
- E. Adjust existing drainage structures as specified in Drawings or as directed. Refill excavated area with gravel and set casting into concrete collar. Engineer will determine new elevation of structure.
- F. Remodeling: as specified in Drawings or as directed.
 - 1. Provide remodeling of cone of structure where line or grade requires a change greater than 6 inches at existing drainage structures or where noted on Drawings.
 - 2. Refill excavated area with gravel and set casting into a concrete collar and overlay with 3-inch thick bituminous concrete top course when structures are in roadway. Engineer will determine new elevation of structure.
- G. Transport and stack existing frames and grates belonging to City and not needed for Work at City DPW yard or otherwise dispose of as directed.
- H. Frames and Covers
 - 1. Set to final grade of 1/2-inch below pavement grade, as shown on Drawings. Provide adequate temporary covers to prevent accidental entry until final placement of frame and cover is made.
 - 2. Use 2 rings of 1-inch diameter butyl rubber sealant between frame and chimney joints. Provide downward force to frame to compress joint, provide a watertight seal, and prevent future settlement. Point compressed joint with butyl rubber caulk sealant.
 - 3. Set manhole frames and covers to final grade only after pavement base course has been applied.
- I. Seal drain pipe connections to catch basin/manhole structures with mortar in accordance with MassDOT M4.02.15.
- J. Inverts: as indicated on Drawings.
- K. Replace steps that are out of plumb and not to proper horizontal placement.
- L. Use material removed from excavation for manholes that remains after backfilling finished structure wherever possible within location. Remove and legally dispose of material if not needed or unsuitable.
- M. Backfill structures with Controlled Density Fill, as specified in Section 31 00 00, when installed with less than 18 inches of horizontal clearance from adjacent structures and/or pipe as directed by Owner or Engineer.

- N. Do not pave over any utility appurtenances or structures unless specifically directed otherwise.
- O. Remove and replace defective castings with new castings as directed. Repair or replace damaged castings.

3.02 REPAIRS

- A. Repair leaks after determining cause. Perform earthwork required for repairs if manhole has already been backfilled.
 - 1. Make repairs by approved methods to bring leakage within allowable rate if less than 3 gallons per vertical foot per 24 hours but more than 1 gallon per vertical foot per 24 hours.
- B. Perform repairs using approved methods and materials. Remove and replace or reconstruct if necessary. Remove and replace defective sections if required.

3.03 FIELD QUALITY CONTROL

- A. Provide in accordance with Division 01 General Requirements.
- B. Preparation
 - 1. Provide structures are complete except for shelf and invert brickwork.
 - 2. Make pipe connections prior to testing. Plug pipes and other openings in the structure walls prior to test.
- C. Test precast concrete manholes immediately after installation and prior to backfilling. Provide for Engineer to observe tests.
- D. Vacuum Tests for Manholes
 - 1. Conduct Manhole Acceptance Test using the vacuum test procedure in ASTM C1244, except as modified herein.
 - a. Plug lift holes with an approved non shrink grout.
 - b. Plug pipes entering manhole, securely bracing plug from being drawn into manhole.
 - c. Place test head at inside of top section and inflate seal in accordance with manufacturer's recommendations.
 - 2. Passing determined by time for vacuum to drop from 10 inches of mercury to 9 inches of mercury regardless of diameter:

Greater than	Manhole depth
2.0 minutes	0 feet – 10 feet
2.5 minutes	10 feet to 15 feet
3.0 minutes	15 feet and over

3. Locate leak, make repairs, and retest structure if the vacuum drops in excess of the prescribed rate.
4. Conduct water exfiltration test if unit fails repeat of vacuum test after repair as directed.
 - a. Plug pipes into and out of manhole and secure plugs.
 - b. Lower groundwater table (GWT) to below manhole. Maintain GWT at this level throughout test. Provide means of determining GWT level at any time throughout test.
 - c. Fill manhole with water to bottom of flat slab.
 - d. Allow period of time for absorption.
 - e. Refill to bottom of flat slab.
 - f. Determine volume of leakage in minimum 8-hour test period and calculate rate.
 - g. Grounds for rejection: any manhole with exfiltration rate exceeding 3 gallons per vertical foot per 24 hours.
 - h. Infiltration test may be required if results of exfiltration test are not satisfactory.
5. Inspections
 - a. Make manhole accessible for inspection by Engineer prior to backfilling.

3.04 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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