

TOWN OF WILMINGTON, MASSACHUSETTS

**CONTRACT DOCUMENTS
FOR**

**MIDDLESEX AVENUE / JEFFERSON ROAD PUMP STATION,
SANITARY SEWER EXTENSION AND FORCE MAIN**

BID OPENING DATE: DECEMBER 8, 2021, 11:00 AM

Town of Wilmington, Office of the Town Manager

Wilmington Town Hall

121 Glen Road, Room 11

Wilmington, MA 01887

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SECTION 00020

INVITATION FOR BIDS

Sealed bids for furnishing the following item will be received at the Office of the Town Manager, Wilmington Town Hall, 121 Glen Road, Room 11, Wilmington, MA 01887 until the time specified below at which time the bids will be publicly opened and read.

Beginning November 10, 2021, Bidding Documents in electronic form may be obtained online at www.wilmingtonma.gov. Neither the Owner nor the Engineer will be responsible for full or partial sets of Bidding Documents, including Addenda if any, obtained from another source.

Bids will be opened in the Office of the Town Manager on Wednesday, December 8, 2021, at 11:00 a.m. Each Bid must be accompanied by a bid security consisting of a BID BOND, CASH, or CERTIFIED CHECK issued by a responsible bank or trust company in the amount of 5% of the bid price.

A performance bond in an amount equal to 100 percent of the total amount of the contract price with a surety company qualified to do business in the Commonwealth of Massachusetts will be required for the faithful performance of the contract, as well as a labor and materials bond in an amount equal to 100 percent of the total contract price.

All bids for this project are subject to applicable public bidding laws of Massachusetts, including, but not limited to G.L. c.30, §39M.

Attention is directed to the minimum wage rates to be paid as determined by the Commissioner of Labor and Workforce Development and the weekly payroll record submittal requirements under the provisions of Massachusetts General Laws, Chapter 149, Section 26 through 27D inclusive.

Selection of the contractor will be based upon bidder qualifications, including evidence of past performance in similar projects, and bid price. The contract will be awarded to the bidder deemed by the awarding authority to be the lowest responsible and eligible bidder.

The bidder agrees that its bid shall be good and may not be withdrawn for a period of 30 days, Saturdays, Sundays and legal holidays excluded, after the opening of the bids.

The Town reserves the right to waive any informalities, to accept or reject, in whole or in part any or all bids, or take whatever other action may be deemed to be in the best interest of the Town.

The Town of Wilmington

By: Jeffrey M. Hull, Town Manager

SECTION 00100

INSTRUCTIONS TO BIDDERS

1. Receipt and Opening of Bids

The Town of Wilmington, Massachusetts, herein called the Owner, acting by and through its Board of Selectmen, will receive sealed Bids for the project known as the Middlesex Avenue / Jefferson Road Pump Station, Sanitary Sewer Extension and Force Main Project.

General bids shall be addressed to the Town Manager Jeff Hull, Wilmington Town Hall, 121 Glen Road, Room 11, Wilmington, MA 01887 and endorsed "Bid for Middlesex Avenue / Jefferson Road Pump Station, Sanitary Sewer Extension and Force Main Project" will be received at the Office of the Town Manager until 11:00 a.m. prevailing time, on Wednesday, December 8, 2021 at which time and place said bids will be publicly opened and read aloud.

Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified will not be considered. The bidder agrees that its bid shall be good and may not be withdrawn for a period of 30 days, Saturdays, Sundays, and legal holidays excluded, after the opening of bids.

2. Location and Work to be Done

The Work is located along Middlesex Avenue, from Salem Street intersection to the North Wilmington train station (370 Middlesex); and along the entire length of Jefferson Road, in Wilmington, MA.

The Work consists of the following: construction of a duplex submersible sanitary pumping station, including but not limited to, precast structures (wet-well and valve vault), duplex submersible pumps, valves, control panel, associated electrical connections, and appurtenances; installation of approximately 1,380 linear feet of 8-inch gravity sanitary sewer main and approximately 3,140 linear feet of 6-inch sanitary sewer force main by open-cut excavation and/or trenchless methods, including but not limited to, piping, sewer manholes, sewer services, testing, and appurtenances; and all work incidental thereto, in accordance with the Specifications and conceptual plans attached hereto.

Additional drawings showing details in accordance with which the Work is to be done may be furnished by addendum from time to time during the bidding period by the Owner or its Architect/Engineer, and shall then become a part of the Contract Documents.

The Contractor shall furnish all labor, services, materials, equipment, plant, machinery, apparatus, appliances, tools, supplies, and all other things necessary to do all work required for the completion of each item of the Work and as herein specified.

The Work to be done and paid for under any item shall not be limited to the exact extent mentioned or described but shall include all incidental work necessary or customarily done for the completion of that item.

3. Preparation of Bid

Each bid must be submitted on the prescribed form. All blank spaces for bid prices must filled in, in ink or typewritten, in both words and figures.

Each bid must be submitted in a sealed envelope bearing on the outside the name of the bidder, his address, and endorsed with the name of the project as specified in Receipt and Opening of Bids, above. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in Receipt and Opening of Bids, above.

4. Bid Opening Procedure

The following list of requirements shall apply to each filed bid. Bids not meeting all the requirements for timeliness and security will be rejected; bids not meeting signature and addenda requirements will be rejected prior to checking of bid amounts.

Bids shall be filed at the place and before the time specified in Receipt and Opening of Bids, above.

Properly executed bid security shall be placed in a sealed envelope and shall be attached to the outside of the envelope containing the bid.

Bid signatures will be checked.

All addenda will be sent certified mail, with return receipt requested, and/or facsimile or e-mail to all prospective bidders. All bidders shall include with their bids the written acknowledgment form provided in Section 00300, FORM OF GENERAL BID.

The total dollar amount of each bid will be read, and the three apparent lowest bids will be selected for further consideration. These three apparent low bids will be read aloud for the benefit of the other bidders and the bid opening procedure will be closed. All those present at the bid opening may examine all bids after the bid opening and after the reading of the three apparent low bids.

5. Modification

Any bidder may modify his bid by written communication at any time prior to the scheduled closing time for receipt of bids. Any telegraphic communication must be received by the Owner prior to the closing time, and, provided further, the Owner must be satisfied that a written confirmation of the telegraphic modification over the signature of the bidder was mailed prior to the closing time. If written confirmation is not received within two days from the closing time, no consideration will be given to a telegraphic communication.

The communication shall not reveal the bid price but shall provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed bid is opened.

6. Ability and Experience of Bidder

No award will be made to any bidder who cannot satisfy the Owner that he has sufficient ability and experience in this class of work and sufficient capital and plant to enable him to prosecute and complete the work successfully within the time named. The Owner's decision or judgment on these matters will be final, conclusive, and binding.

The Owner may make such investigations as it deems necessary, and the bidder shall furnish to the Owner, under oath if so required, all such information and data for this purpose as the Owner may request.

7. Conditions of Work

Each bidder must familiarize himself fully with the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of his obligation to furnish all material and labor necessary to carry out the provisions of his contract. Insofar as possible the Contractor, in carrying out his work, must employ such methods or means as will not cause any interruption of or interference with the work of any other Contractor.

8. Addenda and Interpretations

No interpretation of the meaning of the plans, specifications or other prebid documents will be made to any bidder orally. All information given to bidders other than by means of the plans, specifications, or by addenda, as described below, is given informally and shall not be used as the basis of a claim against the Owner.

Every request for such interpretation should be in writing addressed to the Town Engineer, Paul Alunni, Wilmington Town Hall, 121 Glen Road, Room 7, Wilmington, MA 01887, or via email at palunni@wilmingtonma.gov and to be given consideration must be received at least seven (7) days prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the specifications which, when issued, will be mailed by certified mail with return receipt requested to all prospective bidders (at the respective address furnished by them for such purposes), or sent via facsimile or email if time requires. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his bid as submitted. All addenda so issued shall become part of the Contract Documents.

9. Security for Faithful Performance

Simultaneously with his delivery of the executed Contract, the Contractor shall furnish a surety bond or bonds as security for faithful performance of this contract and for the

payment of all persons performing labor and materials under this contract. The surety on such bond or bonds shall be a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Owner. The bonds shall remain in force for one year after final acceptance of the work by the Owner, unless the Owner, in writing, releases the Contractor from the obligation sooner.

10. Power of Attorney

Attorneys-in-fact who sign Contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

11. Laws and Regulations

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

12. Liquidated Damages for Failure to Enter into Contract

The successful bidder, upon his failure or refusal to execute and deliver the Contract and bonds required within 10 days after presentation thereof by the Owner, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the security deposited with his/her bid, but the amount forfeited shall not exceed the difference between his/her bid price and the bid price of the next lowest responsible and eligible bidder. In case of death, disability, bona fide clerical or mechanical error of a substantial nature, or other similar unforeseen circumstances affecting the bidder, his/her bid deposit will be returned.

13. Obligation of Bidder

At the time of the opening of bids, each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Contract Documents (including all addenda). The failure or omission of any bidder to examine any form, instrument, or document shall in no way relieve any bidder from any obligation in respect of his bid.

14. Information Not Guaranteed

All information given in the Contract Documents relating to subsurface and other conditions, natural phenomena, existing pipes, and other structures is from the best sources at present available to the Owner. All such information is furnished only for the information and convenience of bidders and is not guaranteed.

It is agreed and understood that the Owner does not warrant or guarantee that the subsurface or other conditions, natural phenomena, existing pipes, or other structures encountered during construction will be the same as those indicated in the Contract Documents. It is further agreed and understood that no bidder or Contractor shall use or be entitled to use any of the information made available to him or obtained in any

examination made by him in any manner as a basis of or ground for any claim or demand against the Owner or the Architect/Engineer, arising from or by reason of any variance which may exist between the information made available and the actual subsurface or other structures actually encountered during the construction work, except as may otherwise be expressly provided for in the Contract Documents.

15. Bid Security

Each bid and sub-bid must be accompanied by bid security in the form of a certified check, a bid bond, cash, or a treasurer's or cashier's check, payable to the Owner, in the amount of five (5) percent of the value of the bid. Such security of general bidders will be returned to all except the three lowest responsible and eligible bidders within five days, Saturdays, Sundays, and legal holidays excluded, after the opening of bids, and the remaining securities will be returned promptly after the Owner and the accepted bidder have executed the Contract, or if no notice of intent to award has been presented to the selected contractor within 30 days, Saturdays, Sundays and holidays excluded, after the date of the opening of bids, upon demand of the bidder at any time thereafter.

16. Right to Reject Bid

The Owner reserves the right to waive any informalities in bids and to reject any and all bids, should the Owner deem it to be in the public interest to do so.

The Owner may also reject bids which in its sole judgment are either incomplete, conditional, obscure or not responsive or which contain additions not called for, erasures not properly initialed, alterations, or similar irregularities.

17. Time for Completion

The successful general bidder must agree to commence work within ten (10) days of the date of the Notice to Proceed and to fully complete the project within the time limit stated in Section 00300, FORM OF GENERAL BID.

18. Comparison of Bids

Bids will be compared on the basis of prices set forth in the bid forms. In the event that there is a discrepancy between the lump sum or unit prices written in words and figures, the prices written in words will govern.

19. Award of Contract

The Contract will be awarded to "the lowest responsible and eligible bidder" pursuant to General Laws Chapter 30, Section 39M, as amended. Such a bidder shall possess the skill, ability and integrity necessary for the faithful performance of the work, shall be able to furnish labor that can work in harmony with all other elements of labor employed, or to be employed, in the work, and shall otherwise comply with all applicable provisions of law. Contract award shall be subject to availability of an appropriation for funding.

20. Statutes Regulating Competitive Bidding

Any bid which does not comply with the provisions of Massachusetts General Laws Chapter 30, Section 39M, as amended, need not be accepted and the Owner may reject every such bid.

21. Wage Rates

Prevailing Wage Rates as determined by the Commissioner of Department of Labor and Workforce Development under the provision of the Massachusetts General Laws, Chapter 149, Section 26 to 27G, as amended, apply to this project. It is the responsibility of the bidder, before bid opening, to request any additional information on Prevailing Wage Rates for those tradespeople who may be employed for the proposed work under this contract.

22. Contractor Records

The Contractor shall comply with the provisions of Massachusetts General Laws, Chapter 30, Section 39R concerning Contractor records.

23. INSURANCE

The Contractor shall carry and continuously maintain until completion of the Contract, insurance as specified in Agreement and in such form as shall protect him performing work covered by this Contract, and the Town of Wilmington and its employees, agents and officials, from all claims and liability for damages for bodily injury, including accidental death, and for property damage, which may arise from operations under this Contract. The Town shall be named as an additional insured. The Contractor covenants and agrees to hold the Town and its employees, agents and officials harmless from loss or damage due to claims for bodily injury or death and/or property damage arising from, or in connection with, operations under this Contract.

25. PROJECT MANAGER

The Owner may utilize the services of a project manager, whose duties shall be as set forth in an Agreement for Project Manager Services.

SECTION 00300

FORM OF GENERAL BID

Bid of _____ (hereinafter called "Bidder")*

() a corporation, organized and existing under the laws of the state of _____

() a partnership

() a joint venture

() an individual
doing business as _____

To the Town of Wilmington, Massachusetts (hereinafter called "Owner").

Gentlemen:

A) The undersigned Bidder, in compliance with your invitation for bids for the project known as "Middlesex Avenue / Jefferson Road Pump Station, Sanitary Sewer Extension and Force Main Project", having examined the plans and specifications and related documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all labor, materials, and supplies, and to construct the project in accordance with the contract documents and the plans and specifications within the time set forth below, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the contract documents, of which this bid is a part.

The Bidder hereby agrees to commence work on or before the date to be specified in written "Notice to Proceed" of the Owner, and to fully complete the project within 240 consecutive calendar days thereafter. The Bidder further agrees to pay as liquidated damages the sum of (\$1,000) Dollars for each consecutive calendar day thereafter that the work is not complete as provided in the contract.

*Specify corporation, partnership or individual as applicable.

B) Bidder acknowledges receipt of and this bid includes the following addenda:

No. _____ Dated: _____

No. _____ Dated: _____

No. _____ Dated: _____

No. _____ Dated: _____

C) The Bidder agrees to perform the bid work described in the specifications and shown on the plans for the following contract price: \$ _____ .

Phase 1: MassWorks Public Infrastructure Improvements
Sanitary Sewer Extension Plan Middlesex Avenue Wilmington, MA

Item No.	Brief Description and Unit or Lump Sum Price Bid in Words	Estimated Quantity	Unit	Unit Price Bid in Numbers	Total Item Bid Price
1. Sanitary Sewer Pump Station and Appurtenances					
1	Sanitary Sewer Pump Station and Appurtenances Dollars	-	LS	\$	\$
2. Sanitary Sewer Force Main and Fittings					
2a	6 - Inch SDR21 PVC Force Main Dollars	1,670	LF	\$	\$
2b	6 - Inch SDR21 PVC Force Main (Same Trench as Gravity Sewer) Dollars	-	LF	\$	\$
2c	6 - Inch DI Force Main w/ Mechanical Joints (Same Trench as Gravity Sewer) Dollars	-	LF	\$	\$
2d	Force Main Cleanout Manhole (Under 9 FT Depth) Dollars	1	EA	\$	\$
2e	Force Main Cleanout Manhole (14 FT - 18 FT Depth) Dollars	-	EA	\$	\$
2f	Force Main Air Release Valve Manhole (Under 9 FT Depth) Dollars	1	EA	\$	\$
3. Sanitary Gravity Sewer Main and Appurtances					
3a	8 - Inch SDR35 PVC Pipe (Under 12 FT) Dollars	-	LF	\$	\$
3b	8 - Inch SDR35 PVC Pipe (Over 12 FT) Dollars	-	LF	\$	\$
3c	6 - Inch SDR35 PVC Pipe Service Connections & Appurtances (25 Services) Dollars	-	LF	\$	\$
3d	Sewer Manhole (Under 9 FT in Depth) Dollars	-	EA	\$	\$
3e	Sewer Manhole (9 FT - 14 FT in Depth) Dollars	-	EA	\$	\$
3f	Sewer Manhole (14 FT -18FT in Depth) Dollars	-	EA	\$	\$
3g	Sewer Manhole (Over 18FT in Depth) Dollars	-	EA	\$	\$
4. Environmental Protection					
4	Erosion and Sedimentation Controls Dollars	1	LS	\$	\$

Phase 1: MassWorks Public Infrastructure Improvements
Sanitary Sewer Extension Plan Middlesex Avenue Wilmington, MA

Item No.	Brief Description and Unit or Lump Sum Price Bid in Words	Esitimated Quantity	Unit	Unit Price Bid in Numbers	Total Item Bid Price
5. Pavement Replacement					
5a	Temporary Pavement Dollars	6,680	SF	\$	\$
5b	Permanent Pavement Dollars	6,680	SF	\$	\$
	SUBTOTAL ITEMS 1 THROUGH 5, INCLUSIVE				\$
6. Mobilization and Demobilization					
6a	Mobilization and Demobilization (max. 5% of subtotal for all previous items) Dollars	1	LS	\$	\$
6b	Implementation of Traffic Management Plan Dollars	1	LS	\$	\$
7. Uniformed Police Officers					
7a	Uniformed Police Officers-Standard Rate Dollars	480	HR	\$	\$
7b	Uniformed Police Officers-Overtime Rate Dollars	48	HR	\$	\$
					Total Bid Price (Numbers)
	TOTAL BASE BID PRICE IN WORDS Dollars				\$
Additive Alternate Bid Item, Pavement Replacement					
5c	Permanent Pavement, Full Width Dollars	42,750	SF	\$	\$
					Total Bid Price (Numbers)
	TOTAL BASE BID PLUS ADDITIVE ALTERNATE PRICE IN WORDS Dollars				\$

Phase 2: MassWorks Public Infrastructure Improvements
Sanitary Sewer Extension Plan Middlesex Avenue Wilmington, MA

Item No.	Brief Description and Unit or Lump Sum Price Bid in Words	Estimated Quantity	Unit	Unit Price Bid in Numbers	Total Item Bid Price
1. Sanitary Sewer Pump Station and Appurtenances					
1	Sanitary Sewer Pump Station and Appurtenances Dollars	1	LS	\$	\$
2. Sanitary Sewer Force Main and Fittings					
2a	6 - Inch SDR21 PVC Force Main Dollars	1,370	LF	\$	\$
2b	6 - Inch SDR21 PVC Force Main (Same Trench as Gravity Sewer) Dollars	100	LF	\$	\$
2c	6 - Inch DI Force Main w/ Mechanical Joints (Same Trench as Gravity Sewer) Dollars	-	LF	\$	\$
2d	Force Main Cleanout Manhole (Under 9 FT Depth) Dollars	-	EA	\$	\$
2e	Force Main Cleanout Manhole (14 FT - 18 FT Depth) Dollars	-	EA	\$	\$
2f	Force Main Air Release Valve Manhole (Under 9 FT Depth) Dollars	-	EA	\$	\$
3. Sanitary Gravity Sewer Main and Appurtances					
3a	8 - Inch SDR35 PVC Pipe (Under 12 FT) Dollars	540	LF	\$	\$
3b	8 - Inch SDR35 PVC Pipe (Over 12 FT) Dollars	860	LF	\$	\$
3c	6 - Inch SDR35 PVC Pipe Service Connections & Appurtenances (5 Services) Dollars	190	LF	\$	\$
3d	Sewer Manhole (Under 9 FT in Depth) Dollars	2	EA	\$	\$
3e	Sewer Manhole (9 FT - 14 FT in Depth) Dollars	1	EA	\$	\$
3f	Sewer Manhole (14 FT -18FT in Depth) Dollars	4	EA	\$	\$
3g	Sewer Manhole (Over 18FT in Depth) Dollars	2	EA	\$	\$
4. Environmental Protection					
4	Erosion and Sedimentation Controls Dollars	1	LS	\$	\$

Phase 2: MassWorks Public Infrastructure Improvements
Sanitary Sewer Extension Plan Middlesex Avenue Wilmington, MA

Item No.	Brief Description and Unit or Lump Sum Price Bid in Words	Esitmated Quantity	Unit	Unit Price Bid in Numbers	Total Item Bid Price
5. Pavement Replacement					
5a	Temporary Pavement Dollars	8,500	SF	\$	\$
5b	Permanent Pavement Dollars	8,500	SF	\$	\$
	SUBTOTAL ITEMS 1 THROUGH 5, INCLUSIVE				\$
6. Mobilization and Demobilization					
6a	Mobilization and Demobilization (max. 5% of subtotal for all previous items) Dollars	1	LS	\$	\$
6b	Implementation of Traffic Management Plan Dollars	1	LS	\$	\$
7. Uniformed Police Officers					
7a	Uniformed Police Officers-Standard Rate Dollars	480	HR	\$	\$
7b	Uniformed Police Officers-Overtime Rate Dollars	48	HR	\$	\$
					Total Bid Price (Numbers)
	TOTAL BASE BID PRICE IN WORDS Dollars				\$
Additive Alternate Bid Item, Pavement Replacement					
5c	Permanent Pavement, Full Width Dollars	43,700	SF	\$	\$
					Total Bid Price (Numbers)
	TOTAL BASE BID PLUS ADDITIVE ALTERNATE PRICE IN WORDS Dollars				\$

The above unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, etc., to cover the finished work of the several kinds called for.

The Bidder understands that all bids for this project are subject to the applicable bidding laws of the Commonwealth of Massachusetts, including General Laws Chapter 149 and Chapter 30, Section 39M, as amended.

The Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding.

The Bidder agrees that this bid shall be good and may not be withdrawn for a period of 30 days, Saturdays, Sundays and legal holidays excluded, after the opening of bids.

Within 10 days of receipt of the written notice of acceptance of this bid, the Bidder will execute the formal Agreement set forth in Section 00500 CONTRACT.

Bid security is attached in the sum of five percent (5%) of the total bid in accordance with the conditions of Section 00100 INSTRUCTIONS TO BIDDERS. The bid security may become the property of the Owner in the event the contract and bond are not executed within the time set forth above.

The selected Contractor shall furnish a performance bond and a payment bond in an amount at least equal to one hundred percent (100%) of the contract price in accordance with Section 00610 PERFORMANCE BOND, Section 00620 PAYMENT BOND, and as stipulated in the contract.

The undersigned offers the following information as evidence of his qualifications to perform the work as bid upon according to all the requirements of the plans and specifications.

1. Have been in business under present name for ____ years.
2. The names and addresses of all persons interested in the bid (if made by a partnership or corporation) as principals, are as follows:

(attach supplementary list if necessary)

3. The bidder is requested to state below what work of a similar character to that included in the proposed contract he has done, and give references that will enable the Owner to judge his experience, skill and business standing (add supplementary page if necessary).

<u>Completion Date</u>	<u>Project Name</u>	<u>Contract Amount</u>	<u>Design Engineer</u>	<u>Reference Name</u>	<u>Telephone No.</u>
a.					
b.					
c.					
d.					
e.					
f.					

Bank reference _____
(Name)

(Bank)

(Address)

(Telephone No.)

Pursuant to G.L. c.62C, §49A, I certify hereby in writing, under penalties of perjury, that the within named Bidder/Contractor has complied with all laws of the commonwealth relating to taxes, reporting of employees and contractors, and withholding and remitting of child support.

The undersigned Bidder hereby certifies under penalties of perjury, as follows: (1) that he/she is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (2) that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and (3) that all employees to be employed in the work subject to this bid have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration.

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

The undersigned bidder hereby certifies, under pains and penalties of perjury, that the foregoing bid is based upon the payment to laborers to be employed on the project of wages in an amount no less than the applicable prevailing wage rates established for the project by the Massachusetts Department of Labor and Workforce Development. The undersigned bidder agrees to indemnify the awarding authority for, from and against any loss, expense, damages, actions or claims, including any expense incurred in connection with any delay or stoppage of the project work arising out of or as a result of (1) the failure of the said bid to be based upon the payment of the said applicable prevailing wage rates or (2) the failure of the bidder, if selected as the contractor, to pay laborers employed on the project the said applicable prevailing wage rates.

Respectfully submitted:

Date: _____

By: _____
(Signature)

(Type Name of Bidder)

(Title)

(Business Address)

(City and State)

(Telephone Number)

SECTION 00500

AGREEMENT

THIS AGREEMENT, made this _____ day of _____,
20____, by and between the party of the first part, the Town of Wilmington, hereinafter called
"OWNER," acting herein through its Town Manager Jeff Hull, and the party of the second part,
_____ doing business as *(an individual) (a
partnership) (a joint venture) (a corporation) located in the *(City) (Town) of
_____, County of
_____, and State of _____, hereinafter called
"CONTRACTOR."

WITNESSETH: That for and in consideration of the payments and agreements
hereinafter mentioned, to be made and performed by the OWNER, the CONTRACTOR hereby
agrees with the OWNER to commence and complete the project described as follows:

Middlesex Avenue / Jefferson Road Pump Station, Sanitary Sewer Extension and Force Main
Project

hereinafter called the project, for the sum of _____
_____ Dollars
(\$ _____) and all extra work in connection therewith, under the terms as stated in
the Contract Documents; and at his (its or their) own proper cost and expense to furnish all the
materials, supplies, machinery equipment, tools, superintendence, labor, insurance, and other
accessories and services necessary to complete the said project in accordance with the conditions
and prices stated in Section 00300 FORM OF GENERAL BID, Section 00700 GENERAL
CONDITIONS, Section 00750 SUPPLEMENTARY GENERAL CONDITIONS and Section
00800 SUPPLEMENTAL GENERAL CONDITIONS, the plans, which include all maps, plates,
blue prints, and the specifications and Contract Documents as prepared by the Owner.

*Strike out inapplicable term.

The CONTRACTOR hereby agrees to commence work under this Contract on or before a date to be specified in written "Notice to Proceed" of the OWNER.

The CONTRACTOR further agrees to fully complete the project within ____ consecutive calendar days of the date of the notice to proceed.

The CONTRACTOR further agrees to pay as liquidated damages the sum of \$. for each consecutive calendar day thereafter as provided in the Liquidated Damages Paragraph of Section 00700 GENERAL CONDITIONS.

The goal for minority business enterprise (MBE) participation for this contract is a minimum of _____ percent MBE participation, on the basis of the total dollars paid. The CONTRACTOR agrees to take all affirmative steps necessary to achieve this goal, and shall provide reports documenting the portion of contract and subcontract dollars paid to minority and women-owned businesses, and its efforts to achieve the goals, with each invoice submitted or at such greater intervals as specified by the Owner. The CONTRACTOR shall require similar reports from its subcontractors.

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

The CONTRACTOR agrees not to participate in or cooperate with an international boycott, as defined in Section 999 (b)(3) and (4) of the Internal Revenue Code of 1954, as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Massachusetts General Laws.

The OWNER agrees to pay the CONTRACTOR in current funds for the performance of the contract, subject to additions and deductions, as provided in Section 00700 GENERAL CONDITIONS as amended by the supplementary general conditions, and to make payments on account thereof as provided in Section 00700 GENERAL CONDITIONS.

IN WITNESS WHEREOF, the parties to these presents have executed this contract in counterparts, each of which shall be deemed an original, in the year and day first above mentioned.

AGREED:

Town of Wilmington, Massachusetts
(Owner)

By _____

(Name)

(Title)

(Contractor)

By _____

(Name)

(Title)

(Address)

(City and State)

Approved as to Form:

By _____
(Owner's Counsel)

(Name)

In accordance with M.G.L. C.44, Section 31C, this is to certify that an appropriation in the amount of this contract is available therefor and that the _____ has been authorized to execute the contract and approve all requisitions and change orders.

By _____
(Owner's Accountant)

(Name)

CERTIFICATE OF VOTE
(to be filed if Contractor is a Corporation)

I, _____, hereby certify that I am the duly qualified
(Secretary of the Corporation)

and acting Secretary of _____ and I further certify that a meeting of the

(Name of Corporation)

Directors of said Company, duly called and held on _____, at which
(Date of Meeting)

all Directors were present and voting, the following vote was unanimously passed:

VOTED: To authorize and empower

Anyone acting singly, to execute Forms of General Bid, Contracts or Bonds on behalf of the Corporation.

I further certify that the above vote is still in effect and has not been changed or modified in any respect.

By: _____
(Secretary of Corporation)

A True Copy:

Attest: _____
(Notary Public)

My Commission Expires: _____
(Date)

**CERTIFICATIONS REQUIRED BY LAW
FOR PUBLIC CONSTRUCTION CONTRACTS**

You must COMPLETE and SIGN the following certifications. You must also print, at the bottom of this page, the name of the contractor for whom these certifications are submitted.

TAX COMPLIANCE

Pursuant to Chapter 62C of the Massachusetts General Laws, Section 49A(b), I, the undersigned, authorized signatory for the below named contractor, do hereby certify under the pains and penalties of perjury that said contractor has complied with all laws of the Commonwealth of Massachusetts relating to taxes, reporting of employees and contractors, and withholding and remitting child support.

NON-COLLUSION

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

PUBLIC CONTRACTOR DEBARMENT

The undersigned certifies under penalty of perjury that the below named contractor is not presently debarred from doing public construction work in the commonwealth under the provisions of section twenty-nine F of chapter twenty-nine, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

OSHA TRAINING

Pursuant to G.L. c. 30, §39S, the Contractor hereby certifies under penalties of perjury as follows:

- (1) 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;
- (2) All employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and they shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and
- (3) All employees to be employed in the work subject to this contract 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.

COMPLETE AND SIGN BELOW:

Authorized Person's Signature

Date

Print Name & Title of Signatory

Name of Contractor

SECTION 00610

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That we _____
(Name of Contractor)

a _____ hereinafter called "Principal" and
(Corporation, Partnership, Joint Venture or Individual)

_____ of _____, State of _____
(Surety) (City & State)

_____ hereinafter called the "Surety" and licensed by the State
Division of Insurance to do business under the laws of the Commonwealth of Massachusetts, are
held and firmly bound to the City/Town of _____, Massachusetts, hereinafter called
"Owner", in the penal sum of

_____ Dollars
(\$ _____) in lawful money of the United States, for the payment of which
sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and
successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that Whereas, the Principal entered
into a certain contract with the Owner, dated the _____ day of _____,
20__ (the "Construction Contract"), for the construction described as follows: _____
_____.

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties,
all the undertakings, covenants, terms, conditions, and agreements of the Construction Contract
during the original term thereof, and any extensions thereof which may be granted by the Owner,
with or without notice to the Surety, and if he shall satisfy all claims and demands incurred under
the Construction Contract, and shall fully indemnify and save harmless the Owner from all costs
and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the
Owner all outlay and expense which the Owner may incur in making good any default, then this
obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the Surety's obligation under this Bond shall arise after (1)
the Owner has declared the Principal in default of the Construction Contract or any provision
thereof or (2) has declared that the Principal has failed, or is otherwise unable or unwilling, to
execute the work consistent with, and in conformance to, the Construction Contract (collectively
referred to as a "Contractor Default"). The determination of a Contractor Default shall be made
solely by the Owner. The Owner need not terminate the Construction Contract to declare a
Contractor Default or to invoke its rights under this Bond.

When the Surety's obligation under this Bond arises, the Surety, at its sole expense and at the consent and election of the Owner, shall promptly take one of the following steps: (1) arrange for the Principal to perform and complete the work of the Construction Contract; (2) arrange for a contractor other than the Principal to perform and complete the work of the Construction Contract; (3) reimburse the Owner, in a manner and at such time as the Owner shall decide, for all costs and expenses incurred by the Owner in performing and completing the work of the Construction Contract. Surety will keep Owner reasonably informed of the progress, status and results of any investigation of any claim of the Owner.

If the Surety does not proceed as provided in this Bond with due diligence and all deliberate speed, the Surety shall be deemed to be in default of this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner.

After the Surety's obligation under this Bond arises, the Surety is obligated, to the limit of the amounts of this Bond, for (1) the correction of defective work and completion of the Construction Contract; (2) additional design, professional services, and legal costs, including attorneys' fees, resulting from the Contractor Default or from the default of the Surety under this Bond; (3) any additional work beyond the Construction Contract made necessary by the Contractor Default or default of the Surety under this Bond; (4) indemnification obligation of the Principal, if any, as provided in the Construction Contract; and (5) liquidated damages as provided in the Construction Contract, or if none are so specified, actual and foreseeable consequential damages resulting from the Contractor Default or default of the Surety under this Bond.

Any proceeding, legal or equitable, under this Bond shall be instituted in any court of competent jurisdiction in the Commonwealth of Massachusetts.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Construction Contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this Bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Construction Contract or to the work or to the specifications.

IN WITNESS WHEREOF, this instrument is executed in _____ () counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20____.

ATTEST:

_____	By	_____
(Principal Secretary)		Principal

		(Address-Zip Code)

Witness as to Principal (SEAL)

(Address-Zip Code)

ATTEST:

_____	By	_____
		Surety

		(Attorney-in-Fact)

		(Address-Zip Code)

Witness as to Surety (SEAL)

(Address-Zip Code)

NOTE: Date of Bond must not be prior to date of Contract. If Contractor is a Partnership, all partners should execute Bond.

SECTION 00620

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That we _____

_____ a _____
(Name of Contractor) (Corporation, Partnership, Joint Venture or
Individual)

hereinafter called "Principal" and _____ of _____,
(Surety)

State of _____ hereinafter called the "Surety" and licensed by the State
(City and State)

Division of Insurance to do business under the laws of the Commonwealth of Massachusetts, are held and firmly bound to the City/Town of _____, Massachusetts, hereinafter called "Owner", in the penal sum of _____ Dollars

(\$ _____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that Whereas, the Principal entered into a certain contract with the Owner, dated the _____ day of _____, 20____, for the construction described as follows:

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms, subcontractors, and corporations furnishing materials for or performing labor in the prosecution of the work provided for in such contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such work, and all insurance premiums on said work, and for all labor, performed in such work whether by subcontractor or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of this contract or to the work or to the specifications.

PROVIDED, FURTHER, that no final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in ____ () counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20__.

ATTEST:

		_____ Surety
_____	By	_____ (Attorney-in-Fact)

		_____ (Address-Zip Code)
_____	(SEAL)	
Witness as to Surety		

		_____ (Address-Zip Code)

NOTE: Date of Bond must not be prior to date of Contract. If Contractor is a Partnership, all partners should execute Bond.

GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Adapted from EJCDC C-700, Standard General Conditions
of the Construction Contract (2007 Edition)

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GENERAL CONDITIONS

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.
 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's 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* or *CONTRACTOR* – The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work* – See Paragraph 11.01.A 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. Shop Drawings and other Contractor submittals are not Drawings as so defined.
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* or *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.
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 or 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.
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.
- 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.

1.02 Terminology

- A. The words and terms referenced in this Paragraph 1.02 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 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.

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 of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Before 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 printed or hard copies of the 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 day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, 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;
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. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 Preconstruction Conference; Designation of Authorized Representative

- 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.
 1. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 2. 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.
- 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 conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge 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, 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 Engineer's 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 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. 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 of explorations and tests of subsurface conditions at or contiguous to the Site; that Engineer has used in preparing the Contract Documents; and
 - 2. those drawings of physical conditions in or relating to existing surface or subsurface at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.
- B. Limited Reliance by Contractor on Technical Data Authorized: Contractor may rely on the general 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. *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 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.
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.

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. 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 to Contractor written notice:: (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, 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.G shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's sole negligence.
- H. 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 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 Liability Insurance

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed 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.

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 inclusive, be written on an occurrence basis, include as additional insureds (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 as additional insureds, 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 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);
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 insurance;
 - a. such insurance shall remain in effect for at least two years after final payment, and
 - 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.

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 under the Contract Documents.

5.06 (Not Used)

5.07 (Not Used)

5.08 (Not Used)

5.09 (Not Used)

5.010 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 in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party 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 such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party 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 may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

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. Unless the Owner shall otherwise agree in writing, the superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

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.

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 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; and
 - 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; and
- 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 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 Contractor has submitted a list thereof in accordance with the Supplementary Conditions, 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 anything in the Contract Documents 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. 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.

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, 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.

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 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 primary 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.

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 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 and 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 that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety programs 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 indicated use, 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
 - e. 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 Drawing 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.

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.

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 will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.
- 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.

6.20 Indemnification

- A. 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 the performance of the Work, provided that any such claim, cost, loss, or damage:

1. is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of real or personal property (other than the Work itself), including the loss of use resulting therefrom; and
 2. is caused by any 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, regardless of whether or not caused in part by an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws or Regulations.
- 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.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not be limited in any way by the amount or types of insurance provided by Contractor under Article 5 of the General Conditions.
- D. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the sole negligence or willful misconduct of Owner or Engineer or of the officers, directors, members, partners, employees, agents, and consultants and subcontractors of each and 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 shall 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, Contractor may cut or alter the work of others 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 Legal Relationships

- A. Paragraph 7.01.A is 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 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 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 Furnish Data

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

8.03 Pay When Due

Owner shall make payments to Contractor when they are due as provided in Paragraphs

- A. 14.02.C and 14.07.C.

8.04 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 or contiguous to the Site.

8.05 Insurance

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

8.06 Change Orders

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

8.07 Inspections, Tests, and Approvals

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

8.08 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. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.09 Undisclosed Hazardous Environmental Condition

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

8.10 Evidence of Financial Arrangements

- A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

8.11 Compliance With Safety Programs

- A. While on 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.B.

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 and will not be changed without written consent of Owner and Engineer.

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, or have control over Contractor’s Work, nor shall Engineer have authority over or responsibility for the means, methods, techniques, sequences, or procedures of construction selected by Contractor, for safety precautions and programs incident to Contractor’s Work in progress, nor for any failure of Contractor to comply with Laws and Regulations applicable to Contractor’s furnishing and performing the Work.

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, 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.

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, if any,
 - 1. as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21;
 - 2. as to Change Orders, see Articles 10, 11, and 12; and
 - 3. 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. 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.

9.10 Compliance with Safety Programs

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

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.B.

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:
 - a. ordered by Owner pursuant to Paragraph 10.01.A,
 - b. required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or

- c. 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. 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 days) after the start of the event giving rise thereto. 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 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.

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.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which

Contractor is liable, 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

1. Contractor agrees that:

- a. 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
- b. 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.

C. Contingency Allowance

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

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 allowances, and the Contract Price shall be correspondingly adjusted.

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.
- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
 - 1. 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
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. 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 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 Paragraph 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 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;
 - 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, or acts of God.
- B. 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.
- C. If Owner, Engineer, 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.
- D. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of other contractors or utility owners, 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.D.
- E. Owner and Engineer and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each of them 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.

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 Site 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 said 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. 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.
- 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 (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.
- 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. 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, 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, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to 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;
 - c. there are other items entitling Owner to a set-off against the amount recommended; 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 Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) 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. There shall be attached to the certificate a 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 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.

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, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, 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; and

- d. 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:
 - a. the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and
 - b. 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. 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. 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 disregard of the authority of Engineer; or
 4. Contractor's repeated violation in any substantial way of any provisions of the Contract Documents.
- 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 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 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. Dispute resolution methods and procedures, if any, shall be as set forth in the Supplementary Conditions. If no method and procedure has been set forth, and subject to the provisions of Paragraph 10.05, Owner and Contractor may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

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.

+ + END OF GENERAL CONDITIONS + +

SECTION 00800
SUPPLEMENTAL CONDITIONS

Page

1. Supplementary General Conditions to EJCDC No. C-700, 2007 Edition
2. Prevailing Wage Rates
3. Insurance Requirements

Attachment A - Wage Rates and Certificate of Compliance

**AMENDING THE STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION
CONTRACT PREPARED BY ENGINEERS JOINT CONTRACT DOCUMENTS
COMMITTEE
(EJCDC NO. C-700, 2007 EDITION)**

(Sub) Paragraph

No.

- 2.01B Delete this paragraph and substitute the following:
- Before any Work at the Site is started, CONTRACTOR shall deliver to OWNER, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which OWNER or any additional insured may reasonably request) which CONTRACTOR is required to purchase and maintain in accordance with Article 5.
- 2.03 Delete the last sentence.
- 3.02A.1 Delete the phrase starting “shall mean” through the end of this sentence and substitute the following:
- shall mean the standard, specification, manual, code, or Laws or Regulations in effect and applicable at the time in question, except as may be otherwise specifically stated in the Contract Documents.
- 3.03A.3 Delete this paragraph and replace with the following:
- CONTRACTOR shall be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy if CONTRACTOR knew or reasonably should have known thereof.
- 4.01A Delete the last sentence.
- 4.01B Delete this subparagraph in its entirety.
- 4.03C.3 Delete this subparagraph in its entirety.
- 4.04B.2 Delete the phrase “or not shown or indicated with reasonable accuracy” following the word “indicated.” Delete the last sentence.
- 4.06C Add the following to the first sentence: “unless CONTRACTOR caused or contributed to such Hazardous Environmental Condition.”

- 4.06D Delete the last sentence.
- 4.06E Delete the last sentence.
- 4.06F Delete the second sentence.
- 4.06G Delete this subparagraph in its entirety.
- 4.06H Delete the last sentence.
- 5.03B Delete this subparagraph in its entirety.
- 5.04B.7 Insert the following new subparagraph:
7. “all coverage shall be written on an occurrence basis.
- 5.06A Delete this subparagraph in its entirety and substitute the following:
- Owner may, in its discretion, purchase and maintain property insurance upon the Work at the Site.
- 5.06B Delete this subparagraph in its entirety.
- 5.06D Delete this subparagraph in its entirety and substitute the following:
- The risk of loss within any 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.
- 5.07A Delete all text after the first sentence.
- 5.07B Delete this subparagraph in its entirety.
- 5.07C Delete this subparagraph in its entirety.
- 5.08 Delete this paragraph in its entirety.
- 5.09 Delete this paragraph in its entirety.
- 5.10 Delete this paragraph in its entirety and substitute the following:
- OWNER may occupy or use a portion of the Work prior to Substantial Completion.

- 6.05A Add the following to the second sentence “, and in accordance with G.L. c.30, §39M.”
- 6.06F Insert the following at the beginning of this subparagraph:

“Except as required by and indicated in the specifications and contract documents pursuant to G.L. c.149, §44F,”
- 6.07A Delete the second sentence.
- 6.09C Delete the last sentence.
- 6.13E Delete the text in parentheses at the end of the first sentence.
- 6.20A Delete the parenthetical phrase “(other than the Work itself).”
- 6.20.A Change the phrase “negligent act or omission” to “negligent or wrongful act or omission.”
- 7.01.A.2 Delete this subparagraph in its entirety.
- 7.01.B Delete the last sentence.
- 7.02 Delete this paragraph in its entirety.
- 8.02 Delete the phrase “to whom CONTRACTOR makes no reasonable objection.”
- 8.07 Delete this paragraph in its entirety.
- 8.09 Insert the following after the first sentence: “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.”
- 9.02B Insert the following at the end of this subparagraph: “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 Delete the last sentence.
- 9.04 Delete the last sentence.
- 9.08C Delete the final phrase “subject to the provisions of paragraph 10.05.”
- 9.09B Insert the following after the first sentence:

“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.”

- 10.03A.3 Delete this subparagraph in its entirety.
- 11.01A.5 Delete subparagraphs a, b, d, e, f, g, and h.
- 11.02 Delete this paragraph in its entirety.
- 12.01B.3 Delete the last phrase “(determined as provided in paragraph 12.01.C).”
- 12.01C.2 Delete this subparagraph in its entirety.
- 12.03B Delete this subparagraph in its entirety.
- 12.03F Insert the following new subparagraph:

3. Delays caused by or within the control of the OWNER. In such event, the CONTRACTOR’S sole remedy shall be an extension of the Contract Time. Notwithstanding anything to the contrary in the Contract Documents, Contractor shall not be eligible for any increase in the Contract Price/Sum on account of any delay in the work, no matter by whom such delay is caused, and Contractor shall make no claim for such an increase, whether such claim is styled as a claim for delay damages, acceleration of work, loss of production, or otherwise.
- 13.01 Delete the word “Prompt” at the beginning of the subparagraph.
- 13.03F Delete the balance of this subparagraph after the words “CONTRACTOR’s expense.”
- 13.04D Delete this subparagraph in its entirety.
- 13.08 Delete the fourth sentence.
- 13.09C Delete the second sentence.
- 14.02A.1 Delete the first phrase prior to the words, “Contractor shall” and substitute in place thereof the following: “On a monthly basis and in accordance with G.L. c.30, §39G,”.
- 14.02A.3 Delete this subparagraph and substitute the following: “Retainage shall be in accordance with G.L. c.30, §39G.
- 14.02C Delete this subparagraph and substitute the following:

Payment shall be made in accordance with G.L. c.30, §39G.

14.02D.2 Delete the words “immediate” and “promptly”.

14.02D.3 Delete this subparagraph in its entirety.

14.04C Delete the third sentence and substitute the following:

“OWNER shall review the tentative certificate and make written objection to ENGINEER as to any provisions of the certificate or attached list.”

Delete the phrase “within 14 days after submission of the tentative certificate to OWNER” in the fourth sentence. Delete the phrase “within said 14 days” in the fifth sentence.

14.05 Delete the phrase “subject to the following conditions” at the end of the first sentence and delete subparagraphs 1 and 2 in their entirety.

14.07B.1 Delete the phrase “within ten days after receipt of the final Application for Payment,” in the first sentence.

14.07C Delete this subparagraph in its entirety and substitute the following:

Final payment shall be made in accordance with G.L. c.30, §39G.

14.09A.1 Delete this subparagraph in its entirety.

15.01 Delete this subparagraph in its entirety and substitute the following:

OWNER may suspend the work or any portion thereof in accordance with G.L. c.30, §39O.

15.03A Delete from subparagraph 1 the phrase “including fair and reasonable sums for overhead and profit on such Work;” and from subparagraph 2 the phrase “plus fair and reasonable sums for overhead and profit on such expenses”; and delete subparagraphs 3 and 4 in their entirety.

15.04B Delete the last sentence.

SUPPLEMENTAL CONDITIONS

§ SC 1.1 INTRODUCTION

The following provisions modify, change, delete from or add to Section 00500 Agreement. Where any Subsection of the Agreement is modified or any Article Paragraph, Subparagraph or Clause thereof is modified or deleted by these Supplemental Conditions, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

§ SC 2.1 PREVAILING WAGE

In accordance with General Laws Chapter 149, Section 26 through 27D, the Contractor is obligated to comply with the prevailing wage rates established by the Commissioner of the Department of Labor and Workforce Development for mechanics, apprentices, chauffeurs, teamsters and laborers employed on the Project. The schedule of applicable prevailing wage rates for the Project, together with a Certificate of Compliance therewith, are set forth in Attachment A herein.

§ SC 3.1 CONTRACTOR'S LIABILITY INSURANCE

TOWN OF WILMINGTON

INSURANCE REQUIREMENTS

A. Worker's Compensation and Employers Liability Insurance

Coverage as required by the Worker's Compensation laws of the Commonwealth of Massachusetts, M.G.L. Chapter 149, §34A.

B. General Liability

Bodily Injury each occurrence limit	\$1,000,000
Bodily Injury aggregated limit	\$3,000,000
Property Damage each occurrence limit	\$1,000,000
Project Damage aggregated limit	\$3,000,000

Coverage must include Premises/Operations, Independent Contractors, Contractual Liability Assumed, Products/Completed Operations, Personal Injury, Pollution Liability, and shall not be subject to any of the special property damage liability exclusions commonly referred to as XCU exclusions.

C. Automobile Liability

Bodily Injury each person limit	\$1,000,000
Bodily Injury each occurrence limit	\$3,000,000
Property Damage each occurrence limit	\$1,000,000
Property Damage aggregated limit	\$3,000,000

Coverage must include Owned Vehicles, Leased Vehicles, Hired Vehicles, Non-Owned Vehicles.

D. Umbrella Liability

General aggregate limit	\$2,000,000
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Products - completed operations aggregate	\$2,000,000
Each occurrence limit	\$2,000,000

E. Owner's Protective Liability Insurance

The Contractor shall furnish the Certificates of Insurance naming the Town of Wilmington as additionally insured as their interest may appear, and maintain the require insurances through the life of this Contract.

F. General Requirements for All Lines of Insurance to be Furnishing

All policies shall be written so the Town shall be notified of cancellation or addition of "restrictive amendments" by registered mail or by facsimile not later than ten (10) days prior to the effective date of such cancellation or amendment.

If the initial policy/policies expire prior to the completion of the Work, renewal certificates shall be promptly filed with the Town for extension of said coverage. The full cost of insurance and renewing such coverage for additional amounts of time shall be the sole responsibility of the Contractor.

The Contractor shall require that each subcontractor procure, and maintain, until completion of that subcontractor's work, insurance of the types and to the limits set forth in the above sections. All such coverage by subcontractors shall be in favor of the Contractor, and the Town shall be held harmless from liability in all such policies. Use of subcontractor(s) are subject to the specifications herein.

The policies of insurance required by the General Conditions shall include by endorsement all policies listed above in SC 3.1, that the insurer shall waive all rights of Subrogation in favor of the Owner, Engineer, and any other party named in the written contract against whom the insurer must agree to waive rights of subrogation.

SECTION 00850

Incorporation of Applicable Provisions of the Massachusetts General Laws

Certain provisions of the Massachusetts General Laws are applicable to Construction contracts including, but not limited to, those contained in Chapter 30 and Chapter 149. All applicable provisions of the Massachusetts General Laws are incorporated into the Contract as if fully set forth herein, and shall prevail over any conflicting provisions of the General or Supplemental Conditions.

SECTION 00900

SPECIFICATIONS

SECTION 01 11 13

SUMMARY OF WORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Table of Articles for this Section is:

<u>Article</u>	<u>Title</u>
1.1	Section Includes
1.2	Location and Description of Work
1.3	Other Construction Contracts
1.4	Work By Others
1.5	Work By OWNER
1.6	OWNER-furnished Equipment and Materials
1.7	Assigned Procurement Contracts
1.8	Sequence and Progress of Work
1.9	CONTRACTOR's Use of Site
1.10	Easements and Rights-of-Way
1.11	Notices to owners and Authorities of Properties Adjacent to the Work
1.12	Salvage of Equipment and Materials

1.2 LOCATION AND DESCRIPTION OF WORK

- A. The Work is located along Middlesex Avenue, from Salem Street intersection to the North Wilmington train station (370 Middlesex); and along the entire length of Jefferson Road, in Wilmington, MA.
- B. The Work to be performed under this Contract includes, but is not limited to, the Work described below and all related appurtenances. The Work shall be as follows:
1. Construction of a duplex submersible sanitary pumping station, including but not limited to, precast structures (wetwell and valve vault), duplex submersible pumps, valves, control panel, associated electrical connections, and appurtenances.
 2. Installation of approximately 1,380 linear feet of 8-inch gravity sanitary sewer main by open-cut excavation and/or trenchless methods, including but not limited to, piping, sewer manholes, sewer services, testing, and appurtenances.
 3. Installation of approximately 3,140 linear feet of 6-inch sanitary sewer force main by open-cut excavation and trenchless methods, including but not limited to, piping, air release manholes, testing, and appurtenances.
- C. Contracting Method: Work shall be constructed under one prime contract.

1.3 OTHER CONSTRUCTION CONTRACTS

- A. Other construction contracts have been or will be awarded by OWNER that are in

close proximity to or border on the Work of this Contract. Work under these other contracts is briefly described as follows:

1. Lubbers Brook / Middlesex Avenue Culvert Replacement.

1.4 WORK BY OTHERS

- B. Other construction contracts that are in close proximity to or border on the Work of this Contract are briefly described as follows:

1. Princeton Properties Development on Jefferson Street.

1.5 WORK BY OWNER

- A. OWNER will perform the following in connection with the Work:

1. Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect OWNER's operation, unless otherwise specified or indicated.

1.6 OWNER-FURNISHED EQUIPMENT AND MATERIALS

- A. None.

1.7 ASSIGNED PROCUREMENT CONTRACTS

- A. None.

1.8 SEQUENCE AND PROGRESS OF WORK

- A. Sequencing:

1. Incorporate sequencing of the Work into the Progress Schedule.
2. Sequencing Requirements:
 - a. Gravity sewer main, pump station and force main along Middlesex Ave and Jefferson Road shall be substantially complete no later than November 1, 2022.

1.9 CONTRACTOR'S USE OF SITE

- A. CONTRACTOR shall share use of the Site with other contractors and others specified in Article 1.3 of this Section and others as specified in Article 1.4 of this Section.
- B. Move stored products that interfere with operations of OWNER, other contractors, and others performing work for OWNER.

1.10 EASEMENTS AND RIGHTS-OF-WAY

- A. Easements and rights-of-way will be provided by OWNER in accordance with the General Conditions and Supplementary Conditions. Confine construction operations within OWNER's property, public rights-of-way, easements obtained by OWNER, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid

damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

- B. Within Highway and Railroad Rights-of-Way: Permits will be obtained by OWNER, other than work permits to be obtained by CONTRACTOR. All Work performed and all operations of CONTRACTOR within the limits of railroad and highway rights-of-way shall conform to requirements of railroad or highway owner and applicable work permits, or authority having jurisdiction over right-of-way. Comply with Section 01 14 33, Work in Highway Rights-of-Way.

1.11 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK

- A. Notify owners of adjacent property and utilities when prosecution of the Work may affect their property, facilities, or use of property.
- B. When it is necessary to temporarily obstruct access to property, or when utility service connection will be interrupted, provide written notices at least 72 hours in advance to enable affected persons to provide for their needs. Conform notices to Laws and Regulations and, include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby. Provide reminder notice, either delivered orally or written 24 hours in advance of the anticipated work.
- C. Notify Dig Safe, the Town of Wilmington Water & Sewer Department, other utility owners, and other concerned entities at least 72 hours prior to cutting or closing streets or other traffic areas or excavating near Underground Facilities or exposed utilities.

1.12 SALVAGE OF EQUIPMENT AND MATERIALS

- A. Existing equipment and materials removed and not shown or specified to be reused in the Work will become CONTRACTOR's property, except the following items that shall remain OWNER's property:
 - 1. Hydrants in working condition.
- B. Existing equipment and materials removed by CONTRACTOR shall not be reused in the Work, except where so specified or indicated.
- C. Carefully remove in manner to prevent damage all equipment and materials specified or indicated to be salvaged and reused or to remain property of OWNER. Store and protect salvaged items specified or indicated to be used in the Work. Replace in kind or with new items equipment, materials, and components damaged in removal, storage, or handling through carelessness or improper procedures.
- D. CONTRACTOR may furnish and install new items, with ENGINEER's approval, instead of those specified or indicated to be salvaged and reused, in which case such

removed items will become CONTRACTOR's property.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 14 33

WORK IN HIGHWAY RIGHTS-OF-WAY

PART 1 – GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall obtain necessary permits, arrange inspections required by the highway owner, and pay all charges for the Work in the associated highway right-of-way. Comply with applicable rules and regulations of highway owner.
- B. Highway owners having jurisdiction over the Work include:
 - 1. Middlesex Avenue (Route 62):
 - a. Jurisdiction: Town of Wilmington Department of Public Works, Highway Division.
 - b. Method: The Work shall be installed by a combination of open cut method and/or trenchless method, including horizontal directional drilling.
 - c. Whenever feasible, CONTRACTOR shall maintain not less than one lane of traffic in each direction during the Work. At a minimum, CONTRACTOR shall maintain not less than one lane of traffic in either direction during the Work.
- C. Related Sections:
 - 1. Section 01 55 26, Maintenance and Protection of Traffic.
 - 2. Section 31 23 16.13, Trenching.
 - 3. Section 32 12 00, Flexible Paving.

1.2 HIGHWAY OWNER REQUIRED PERMITS

- A. CONTRACTOR shall obtain and pay all charges for the following permits:
 - 1. Road Opening Permit.
 - 2. Trench Permit (Jackie's Law).

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION AND PROTECTION

- A. CONTRACTOR shall implement means necessary to prevent accidents caused or influenced by the Work. Provide flagmen, temporary barricades, lights, signs, and other precautions to provide safe conditions during the Work.

3.2 INSTALLATION

- B. Work shall be located as shown on the Drawings. Install materials, equipment, piping, and appurtenances required for crossings of existing Underground Facilities and above-ground utilities and structures. Furnish and maintain at the Site a supply of pipe fittings, adapters, and short lengths of pipe to expedite utility crossings required.
- C. Pavement: When fill is stabilized in accordance with requirements of highway owner and the Contract Documents, replace highway subbase material and pavement with pavement of similar type and equal thickness to the pavement in place prior to start of the Work. Pavement shall comply with requirements of highway owner and the Contract Documents.

3.3 PERMITS

- A. Permits listed below, following the “End of Section” designation, are part of this Specification section.
 - 1. Road Opening Permit – Department of Public Works Street (Right of Way) Opening Application.
 - 2. Trench Permit (Jackie’s Law) – Application for Trench Permit.

+ + END OF SECTION + +

**Town of Wilmington Department of Public Works**

115 Andover Street

Wilmington MA 01887

T: (978)658-4481 F: (978)694-2003

STREET (RIGHT OF WAY) OPENING APPLICATION**APPLICANT INFORMATION**

Applicant Name: _____

Date: _____

Address: _____

Email: _____

Phone: _____

PERMIT INFORMATION

Permit Address: _____

Start Date: _____ Expected Completion Date: _____ Dig Safe Number: _____

Reason for Opening: _____

PLEASE ATTACH DRAWING SHOWING THE LOCATION AND EXTENT OF THE PROPOSED WORK

- The Town of Wilmington requires a copy of this permit to be with the operator or foreman on site at all times.
- A moratorium is in place for all roads which have been paved within the last five years.
- When the terms of this conditional permit have been satisfactorily completed and approved by the Director of Public Works, the Town will, upon request, refund said applicant for the amount of the initial deposit **12** months from the date of completion of permanent patching.
- NO PERSONAL CHECKS ACCEPTED.
- **CONTACT THE ENGINEERING DIVISION (978-658-4499) WITH AT LEAST 24-HOUR NOTICE FOR INSPECTION PRIOR TO COMMENCEMENT OF CONSTRUCTION**

The applicant hereby agrees to conform to the statutes, bylaws and/or other specifications and rules and regulations of the Commonwealth of Massachusetts and the Town of Wilmington in particular as defined on the back of this application now and hereafter in force relative to restoring the right of way to a satisfactory condition and to protecting the public by adequate lights and safeguards. The licensee further agrees to indemnify and save harmless the Town of Wilmington from any and all loss, damage and expense sustained by reason of any act or omission by the permit hereunder.

Applicant Signature: _____ Date: _____

BELOW TO BE FILLED OUT BY TOWNPermit #: _____ Expiration Date: _____ Surety Amount: _____ ☐ PaidSpecial Requirements: ☐ Flowable Fill ☐ Infrared☐ Other _____

A permit is hereby granted to open, occupy, use, obstruct and close the location described above, and subject to all conditions therein set forth.

Signature: _____ Date: _____

Director of Public WorksExtended pursuant to said terms and conditions to _____
Date Director of Public Works

Sufficient sureties in the amount of \$ _____ /check # _____ have this day been deposited at the Office of the Treasurer/Collector, Town Hall.

DATE _____

BY _____
Treasurer/Collector

TERMS & CONDITIONS

The applicant shall conform to all the requirements of the Laws of the Commonwealth and the By-Laws* & regulations of the Town of Wilmington, now or hereafter in force, and subject to the right of the Town of Wilmington to revoke the same without hearing.

The applicant shall maintain from the beginning of twilight through the whole of every night, over or near the place so excavated, occupied, opened, obstructed or used and over or near any dirt, gravel or other materials taken therefrom or to be used by him, a light or lights sufficient to protect travelers from injury. He shall place and maintain a safe and convenient way for the use of foot travelers and vehicles to travel around or over such a place.

The applicant shall procure at his expense a sufficient police detail furnished by the Police Dept. as the granting authority may require in order to insure the reasonable unimpeded flow of pedestrian and vehicular traffic.

The applicant shall deliver up and surrender the conditional permit to the granting authority on or before the expiration time specified in the conditional permit for completion of the aforesaid restoration.

The applicant will ensure that all excavations made and obstructions erected be properly fenced during the whole time the street is opened, occupied or obstructed.

The applicant will restore that portion of the street which is opened, occupied or obstructed under this conditional permit, to a condition satisfactory to the Director of Public Works.

The applicant shall pay to the Town Treasurer whatever sum the Director of Public Works shall expend for labor, materials, equipment, time and other contractual services to restore the street to good and safe condition & full unobstructed use to the satisfaction of said Director, if the applicant fails to complete said restoration to the satisfaction of the Director within the time specified in said conditional permit.

The applicant will indemnify and save harmless the said Town of Wilmington from any and all loss, damage and expense which it may sustain by reason of any act of omission or commission suffered or done by the applicant hereunder.

Before placing any obstruction in the street or before performing any work authorized by this conditional permit, the applicant will execute and deliver to the said Town of Wilmington, care of Town Treasurer, a bond in such amount and in such form and with such surety or sureties as may be required by the Director of Public Works for the faithful performance and observance of the requirements, terms and conditions of this conditional permit.

No wires, pipes, conduits or structures now in or under the public ways referred to, shall be disturbed by the applicant without the consent of the board, department or officer of the Town or owner having charge of or supervision over the same and in any case such wires, pipes, conduits or structures are disturbed or injured by the applicant, they shall be replaced, and/or repaired at the expense of the applicant and in a manner satisfactory to such board, department or office of the Town or owner.

Cutting pavement – before commencing with trench excavation, the contractor shall pre-cut the pavement with abrasive saws, wheel cutters, or paving spades.

Temporary Trench Patching – after the foundation material has been spread, graded, compacted and approved by the Director of Public Works, the contractor shall place a 1 ½ inch thick course of Class 1 – I bituminous concrete (hot top).

Permanent Bituminous Concrete Trench Resurfacing – the permanent patching shall be deferred for a period of one year after completion of construction of work specified to be done under this permit. Patch must consist of 3.5 inches of bituminous concrete Type I – 1, laid in two courses, 2 inches of binder course and 1.5 inches top course. When patch has been completed, joints shall be painted with tack coat and sealed with sand.

Bituminous Concrete Overlay Gutter to Gutter – the 3.5 inch thick bituminous concrete overlay shall consist of one 2 inch binder course and 1.5 inch top course. The overlay shall be deferred for a period of 1 year after completion of the construction of work specified to be done under this permit.

Permanent patching will not be approved between November 15th and April 15th.

*See By-Laws of the Inhabitants of the Town of Wilmington, Chapter 5 Section 6.

By signing the application, the Applicant acknowledges the requirements set forth by the Town of Wilmington and agrees to comply with these requirements.



Town of Wilmington

Board of Health

121 Glen Road
Wilmington, Massachusetts 01887

PERMIT NO:

APPLICATION FOR TRENCH PERMIT

Excavation & Trench Permit Regulation
520CMR 14.00

Name & Address of Applicant/Excavator

Competent Licensed Person Performing Work

Name of Owner(s) of Property

MA Hoisting License #

Dig Safe #

Date of Work

Cell #

Address/Location of Trench

Description, location and purpose of proposed trench

BY SIGNING THIS FORM, THE APPLICANT, OWNER, AND EXCAVATOR ALL ACKNOWLEDGE AND CERTIFY THAT THEY ARE FAMILIAR WITH, OR, BEFORE COMMENCEMENT OF THE WORK, WILL BECOME FAMILIAR WITH, ALL LAWS AND REGULATIONS APPLICABLE TO WORK PROPOSED, INCLUDING OSHA REGULATIONS, G.L. c. 82A, 520 CMR 7.00 et seq., AND ANY APPLICABLE MUNICIPAL ORDINANCES, BY-LAWS AND REGULATIONS AND THEY COVENANT AND AGREE THAT ALL WORK DONE UNDER THE PERMIT ISSUED FOR SUCH WORK WILL COMPLY THEREWITH IN ALL RESPECTS AND WITH THE CONDITIONS SET FORTH BELOW.

THE UNDERSIGNED OWNER AUTHORIZES THE APPLICANT TO APPLY FOR THE PERMIT AND THE EXCAVATOR TO UNDERTAKE SUCH WORK ON THE PROPERTY OF THE OWNER, AND ALSO, FOR THE DURATION OF CONSTRUCTION, AUTHORIZES PERSONS DULY APPOINTED BY THE MUNICIPALITY TO ENTER UPON THE PROPERTY TO MONITOR AND INSPECT THE WORK FOR CONFORMITY WITH THE CONDITIONS ATTACHED HERETO AND THE LAWS AND REGULATIONS GOVERNING SUCH WORK.

THE UNDERSIGNED APPLICANT, OWNER AND EXCAVATOR AGREE JOINTLY AND SEVERALLY TO REIMBURSE THE MUNICIPALITY FOR ANY AND ALL COSTS AND EXPENSES INCURRED BY THE MUNICIPALITY IN CONNECTION WITH THIS PERMIT AND THE WORK CONDUCTED THEREUNDER, INCLUDING BUT NOT LIMITED TO ENFORCING THE REQUIREMENTS OF STATE LAW AND CONDITIONS OF THIS PERMIT, INSPECTIONS MADE TO ASSURE COMPLIANCE THEREWITH, AND MEASURES TAKEN BY THE MUNICIPALITY TO PROTECT THE PUBLIC WHERE THE APPLICANT OWNER OR EXCAVATOR HAS FAILED TO COMPLY THEREWITH INCLUDING POLICE DETAILS AND OTHER REMEDIAL MEASURES DEEMED NECESSARY BY THE MUNICIPALITY.

THE UNDERSIGNED APPLICANT, OWNER AND EXCAVATOR AGREE JOINTLY AND SEVERALLY TO DEFEND, INDEMNIFY, AND HOLD HARMLESS THE MUNICIPALITY AND ALL OF ITS AGENTS AND EMPLOYEES FROM ANY AND ALL LIABILITY, CAUSES OR ACTION, COSTS, AND EXPENSES RESULTING FROM OR ARISING OUT OF ANY INJURY, DEATH, LOSS, OR DAMAGE TO ANY PERSON OR PROPERTY DURING THE WORK CONDUCTED UNDER THIS PERMIT.

CONDITIONS AND REQUIREMENTS PURSUANT TO G.L.C.82A AND 520 CMR 7.00 et seq. (as amended)

By signing the application, the applicant understands and agrees to comply with the following:

- i. No trench may be excavated unless the requirements of sections 40 through 40D of chapter 82, and any accompanying regulations, have been met and this permit is invalid unless and until said requirements have been complied with by the excavator applying for the permit including, but not limited to, the establishment of a valid excavation number with the underground plant damage prevention system as said system is defined in section 76D of chapter 164 (DIG SAFE);
- ii. Trenches may pose a significant health and safety hazard. Pursuant to Section 1 of Chapter 82 of the General Laws, an excavator shall not leave any open trench unattended without first making every reasonable effort to eliminate any recognized safety hazard that may exist as a result of leaving said open trench unattended. Excavators should consult regulations promulgated by the Department of Public Safety in order to familiarize themselves with the recognized safety hazards associated with excavations and open trenches and the procedures required or recommended by said department in order to make every reasonable effort to eliminate said safety hazards which may include covering, barricading or otherwise protecting open trenches from accidental entry.
- iii. Persons engaging in any in any trenching operation shall familiarize themselves with the federal safety standards promulgated by the Occupational Safety and Health Administration on excavations: 29 CFR 1926.650 et.seq., entitled Subpart P "Excavations".
- iv. Excavators engaging in any trenching operation who utilize hoisting or other mechanical equipment subject to chapter 146 shall only employ individuals licensed to operate said equipment by the Department of Public Safety pursuant to said chapter and this permit must be presented to said licensed operator before any excavation is commenced;
- v. By applying for, accepting and signing this permit, the applicant hereby attests to the following: (1) that they have read and understands the regulations promulgated by the Department of Public Safety with regard to construction related excavations and trench safety; (2) that he has read and understands the federal safety standards promulgated by the Occupational Safety and Health Administration on excavations: 29 CMR 1926.650 et.seq., entitled Subpart P "Excavations" as well as any other excavation requirements established by this municipality; and (3) that he is aware of and has, with regard to the proposed trench excavation on private property or proposed excavation of a city or town public way that forms the basis of the permit application, complied with the requirements of sections 40-40D of chapter 82A.
- vi. This permit shall be posted in plain view on the site of the trench.

APPLICANT SIGNATURE

DATE

EXCAVATOR SIGNATURE (IF DIFFERENT)

DATE

OWNER'S SIGNATURE (IF DIFFERENT)

DATE

TOWN OF WILMINGTON TRENCH PERMIT

No: _____

PROPERTY LOCATION: _____

Approved by: _____
Shelly Newhouse, RS, Director of Public Health

Date: _____

SECTION 01 22 13

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The items listed starting with Article 1.5 of this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, CONTRACTOR's or ENGINEER's field offices, layout surveys, topographic surveys in accordance with the Wilmington Order of Conditions, project signs, sanitary requirements, testing, safety provisions and safety devices, submittals and record drawings, water supplies, power and fuel, traffic maintenance, removal of waste, security, coordination with OWNER's operations, dewatering, bypass pumping, backfill, dust control (calcium chloride), removing and disposing of pavement, excavation, trench shoring, clearing and grubbing, information technology (including hardware, software, and services) required during construction, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, General Requirements, and other requirements of the Contract Documents. Compensation for all services, items, materials, and equipment shall be included in prices stipulated for the lump sum and unit price pay items listed in this Section and included in the Contract.
- B. Each lump sum and unit price shall include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

1.2 ENGINEER'S ESTIMATE OF QUANTITIES

- A. ENGINEER's estimated quantities for items of Unit Price Work, as included in the Contract, are approximate only and are included solely for purpose of comparing Bids and pricing. OWNER does not expressly or by implication agree that nature of materials encountered below the ground surface or actual quantities of material encountered or required will correspond with the quantities included in the Contract at the time of award and reserves right to increase or decrease quantities or to eliminate quantities as OWNER may deem necessary. Unless indicated otherwise in the Supplementary Conditions, CONTRACTOR or OWNER will not be entitled to adjustment in price of Unit Price Work items as a result of change in estimated quantity and agree to accept the unit prices accepted in the Bid as complete and total compensation for additions caused by changes or alterations in the Unit Price Work directed by OWNER.

1.3 ADJUSTMENT OF UNIT PRICES FOR INCREASE OR DECREASE OF ESTIMATED QUANTITIES

- A. Increases or decreases in the quantity of an item of Unit Price Work will be determined by comparing total payable quantity of Unit Price Work with ENGINEER's estimated quantity indicated in the Contract Documents.
- B. Notwithstanding other provision of the Contract Documents, if total payable quantity of unit price item of Work that has an as-bid computed total value of five percent or more of the sum of the as-bid computed total values of all items bid, varies from ENGINEER's estimated of quantity by more than 25 percent above or below ENGINEER's estimated quantity, unit price of that item will be subject to review by ENGINEER. If warranted, an equitable adjustment will be made by Change Order to credit OWNER with reduction in cost or compensate CONTRACTOR for increase in cost resulting from the change in quantity. The unit price adjustment, if any, will be based on cost increase or decrease due solely to variation above 125 percent or below 75 percent of ENGINEER's estimated quantity.
- C. Permanent pavement shall be at the discretion of the OWNER.

1.4 RELATED PROVISIONS

- A. Payments to CONTRACTOR: Refer to General Conditions, Supplementary Conditions, Agreement, and Section 01 29 76, Progress Payment Procedures.
- B. Changes in Contract Price: Refer to General Conditions, Supplementary Conditions, and Section 01 26 00, Contract Modification Procedures.
- C. Schedule of Values: Refer to General Conditions, Supplementary Conditions, and Section 01 29 73, Schedule of Values.
- D. Phasing of Bid Items: Refer to Section 00 41 13, Bid Form, Article 5 – Basis of Bid.

1.5 BID ITEMS

- A. Item 1 – Sanitary Sewer Pump Station and Appurtenances:
 - 1. Measurement: Work under Item 1 will include but is not limited to all precast concrete structures, piping, valves, pumps, electrical and instrumentation, layout survey to locate pump station, backfill and compaction, dewatering and sediment control, labor and materials and appurtenances necessary to construct the pump station as shown on the Contract Drawings, and specified herein. Measurement shall be made based on proposed phasing.

Contractor shall be responsible for pump station control panel electric diagrams and schematics.

2. Payment: The lump sum payment for Item 1 will be full compensation for completing the work, as shown on the Contract Drawings and as specified.

B. Items 2a, 2b, 2c – Installation of 6-inch PVC Sanitary Sewer Force Main and Fittings

1. The quantity of force main, which will be included under Items 2a, 2b and 2c, will be the total length of force mains measured per linear foot, including interconnection piping, transition pieces, specials, accessories, harnessing or restraining equipment, thrust blocks and appurtenances after the pipe is laid as measured horizontally along the centerline of the piping, with no deduction made for the length of the fittings, or specials. All fittings and specials, and jointing accessories will be included in the unit prices bid. All work for furnishing, installing, testing, and cleaning the new force main will be included in the unit price bid for this Item. Measurement shall be made based on proposed phasing.
2. Payment: The unit price for Items 2a, 2b and 2c will be based on actual linear feet of installed force main. Payment for force main installation will be full compensation for constructing the force mains, complete in place, as shown on the Contract Drawings and as specified, including furnishing and installing pipe and fittings, excavation, backfill, pavement subbase, and compaction, bedding, select material, clearing, grubbing, testing, and removal and replacement of sidewalks and curbing.

C. Items 2d, 2e, 2f – Installation of Force Main Cleanout and Air Release Valve Manholes

1. Measurement: The quantity of air release manholes, which will be included under Items 2d, 2e and 2f will be measured for payment per completed set of check valves, cleanout or air release valves and manholes installed in place including furnishing and installing manholes, valves, fittings, gaskets, sealants, connections, frames, covers, access manhole rungs and all incidental work necessary to construct the air release manholes as shown on the Contract Drawings, and specified herein. Measurement shall be made based on proposed phasing.
2. Payment: The payment for installing each cleanout manhole and air release manhole shall be based on the unit price per actual manhole installed. The unit price shall be based on full compensation for providing all labor, materials, equipment, tools and incidentals required to complete the work as specified herein.

D. Items 3a, 3b – Installation of 8-inch PVC Sanitary Gravity Sewer Main and Fittings

1. The quantity of gravity sewer main, which will be included under Items 3a and 3b, will be the total length of gravity sewer mains measured per linear foot, including interconnection piping, transition pieces, specials, accessories, harnessing or restraining equipment, thrust blocks and appurtenances after the pipe is laid as measured horizontally along the centerline of the piping, with no deduction made for the length of the fittings, or specials. All fittings and specials, and jointing accessories

will be included in the unit prices bid. All work for furnishing, installing, testing, and cleaning the new force main will be included in the unit price bid for this Item. Measurement shall be made based on proposed phasing.

2. Payment: The unit price for Items 3a and 3b will be based on actual linear feet of installed force main. Payment for force main installation will be full compensation for constructing the force mains, complete in place, as shown on the Contract Drawings and as specified, including furnishing and installing pipe and fittings, excavation, backfill, pavement subbase, and compaction, bedding, select material, clearing, grubbing, testing, and removal and replacement of sidewalks and curbing.

E. Item 3c – Installation of 6-inch PVC Service Connections and Appurtenances

1. The quantity of sewer service connections, which will be included under Item 3c, will be the total length of sewer service connections measured per linear foot, including interconnection piping, chimney sewer connections, transition pieces, specials, accessories, harnessing or restraining equipment, thrust blocks and appurtenances after the pipe is laid as measured horizontally along the centerline of the piping, with no deduction made for the length of the fittings, or specials. All fittings and specials, and jointing accessories will be included in the unit prices bid. All work for furnishing, installing, testing, and cleaning the new force main will be included in the unit price bid for this Item. Measurement shall be made based on proposed phasing.
2. Payment: The unit price for Item 3c will be based on actual linear feet of installed sewer service connection. Payment for sewer service connection installation will be full compensation for constructing the sewer service connections, complete in place, as shown on the Contract Drawings and as specified, including furnishing and installing pipe and fittings, excavation, backfill, pavement subbase, and compaction, bedding, select material, clearing, grubbing, testing, and removal and replacement of sidewalks and curbing.

F. Items 3d, 3e, 3f, 3g – Installation of Sewer Manholes

1. Measurement: The quantity of sewer manholes, which will be included under Items 3d, 3e, 3f and 3g, will be measured for payment per completed manhole installed in place including furnishing and installing manholes, fittings, gaskets, sealants, connections, frames, covers, access manhole rungs and all incidental work necessary to construct the sewer manholes as shown on the Contract Drawings, and specified herein. Measurement shall be made based on proposed phasing.
2. Payment: The payment for installing each sewer manhole shall be based on the unit price per actual manhole installed. The unit price shall be based on full compensation for providing all labor, materials, equipment, tools and incidentals required to complete the work as specified herein.

G. Item 4 – Erosion and Sediment Controls

1. Measurement: Work under Item 4 will include but is not limited to installation of catch basin inlet filters, compost filter socks, temporary sediment basins, and silt fencing necessary to construct required erosion and sediment controls before construction commences as shown on the Contract Drawings, and specified herein. Measurement shall be made based on proposed phasing.
2. Payment: The lump sum payment for Item 1 will be full compensation for furnishing, installing each item, including maintenance, removal and disposal of sediment, repair and replacement and removal and disposal at completion of the work as specified herein or directed by the ENGINEER.

H. Item 5a – Temporary Pavement, Trench Width

1. Measurement: The quantity of temporary pavement, which will be included under Item 5a, will be measured per square foot and shall include furnishing, preparation and installation of temporary trench pavement as shown on the Contract Drawings and specified herein. Pavement disturbed by the CONTRACTOR's operations outside of payment limits shall not be paid for under these items, but shall be repaired to its original condition by the CONTRACTOR at no additional cost to the OWNER. Measurement shall be made based on proposed phasing.
2. Payment: The unit price per square foot for Item 5a will be full compensation for all labor, equipment, tools and materials necessary to complete the work specified which shall include cleaning and priming the edges of existing pavement, removing and disposing of specified inches of subbase material to install pavement, preparing the surface of subbase material, furnishing, placing and maintaining the temporary pavement, including labor, materials and all other work for which payment is not provided under other items. Payment shall include all costs for restoring pavement markings after the installation of temporary pavement patching. Raising and adjusting of new and existing castings shall be incidental to pavement replacement and not included separately for payment.

I. Item 5b – Permanent Pavement, Trench Width

1. Measurement: The quantity of permanent pavement, which will be included under Item 5b, will be measured per square foot and shall include furnishing, preparation and installation of permanent trench pavement as shown on the Contract Drawings and specified herein. Pavement disturbed by the CONTRACTOR's operations outside of payment limits shall not be paid for under these items, but shall be repaired to its original condition by the CONTRACTOR at no additional cost to the OWNER. Measurement shall be made based on proposed phasing.
2. Payment: The unit price per square foot for Item 5b will be full compensation for all labor, equipment, tools and materials necessary to complete the work specified which

shall include saw cutting edges of trench, removing existing pavement and patch, removing the specified inches of subbase below permanent patch for gravel borrow, cleaning and priming the edges of existing pavement, tack coat, compacting and preparing the surface of the subbase material, furnishing, placing and compacting the pavement material, including labor, materials and all other work for which payment is not provided under other items. Payment shall include all costs for restoring pavement markings after the installation of permanent pavement. Raising and adjusting of new and existing castings shall be incidental to pavement replacement and not included separately for payment.

J. Item 5c – Permanent Pavement, Full Width (ADDITIVE ALTERNATIVE BID ITEM)

1. Measurement: The quantity of permanent pavement, which will be included under Item 5c, will be measured per square foot and shall include furnishing, preparation and installation of curb-to-curb top course pavement, including milling, leveling course within trench limits, keyways, joint sealant, pavements markings, raising and adjusting new and existing castings, as shown on the Contract Drawings and specified herein. Pavement disturbed by the CONTRACTOR's operations outside of payment limits shall not be paid for under these items, but shall be repaired to its original condition by the CONTRACTOR at no additional cost to the OWNER. Measurement shall be made based on proposed phasing.
2. Payment: The unit price per square foot for Item 5c will be full compensation for all labor, equipment, tools and materials necessary to complete the work specified which shall includes milling, removing existing pavement and patch, cleaning and priming the edges of existing pavement, cleaning, tack coat, furnishing, placing and compacting the pavement material, including labor, materials and all other work for which payment is not provided under other items. Payment shall include all costs for restoring pavement markings after the installation of permanent pavement. Raising and adjusting of new and existing castings shall be incidental to pavement replacement and not included separately for payment.

K. Item 6 – Mobilization and Demobilization

1. Measurement: The lump sum price for this item shall constitute full compensation for initiating the contract, exclusive of the cost of materials, including all insurance, bonds, site preparation, furnishing of temporary facilities, any permitting required of CONTRACTOR and in general the costs associated with establishing the work on site to assure it is proceeding in a continuous manner. Demobilization shall include complete cleanup and removal of all materials, supplies, equipment, debris and temporary structures or utilities to the satisfaction of the OWNER and ENGINEER. Measurement shall be made based on proposed phasing.
2. Payment: The lump sum for the item shall not exceed five percent (5%) of the total amount for bid Items 1 through 5, inclusive. Payment for mobilization and demobilization shall be payable as follows: (a) up to 75% of the total bid item price

when the CONTRACTOR is operational on the site and (b) the remaining 25% of the total bid item price after project acceptance by the OWNER and complete demobilization by the CONTRACTOR, including removal of all equipment, materials and debris and site clean-up and restoration. For purposes of this policy, operational shall mean substantial commencement of work on site.

L. Items 7a, 7b – Uniformed Police Details (Standard and Overtime Rates)

1. Measurement: The services of Uniformed Police Officers shall be measured per hour worked and paid at the contract unit prices as outlined in Section 01 55 26, Maintenance and Protection of Traffic. The unit prices under this item include administrative charges by the Wilmington Police Department. Measurement shall be made based on proposed phasing.
2. Payment: The set prices for Uniformed Police Officers are based on the prevailing hourly wage rates. Payment will be made based on invoices submitted by the traffic authority to the CONTRACTOR. The CONTRACTOR shall forward copies of these invoices to the ENGINEER and include the cost in his Application for Payment. Actual payment to the traffic authority shall be made by the CONTRACTOR and the CONTRACTOR shall be reimbursed by the OWNER through the payment estimate. The CONTRACTOR shall not include any markup on the invoices and if wages change during the Contract, the unit prices under this item will be changed accordingly. No payment will be made for police details ordered but not utilized due to cancellation of work by the contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 23 00

ALTERNATIVES

PART 1 – GENERAL

1.1 SCOPE

- A. This Section identifies each alternative and describes the basic changes that shall be incorporated into the Work when that alternative is made part of the Work.
- B. Coordination:
 - 1. CONTRACTOR shall coordinate related Work as required to complete the Work under each alternative included in the Contract. Include as part of each alternative miscellaneous devices, accessories, and similar items incidental to or required for a complete installation whether or not shown or indicated as part of the alternative.
 - 2. Notification: Immediately following award of the Contract, notify in writing each entity involved of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

1.2 DESCRIPTION

- A. No Additive Alternate Bids

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope: Section includes:
1. Administrative and procedural requirements for selecting products for the Project.
 2. Procedural requirements for product substitutions.
 3. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified.

1.2 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:
1. “Products” includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include OWNER-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.

1.3 PRODUCT SUBSTITUTIONS

- A. Procedure:
1. Submit number of copies of request for substitution as specified for Shop Drawings and other submittals in Section 01 33 00, Submittal Procedures.
 2. Submit separate request for each substitution.
 3. Submit substitution request using forms attached to this Section by completing all information requested on the forms, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:
 - a. Product identification, including manufacturer’s name and address.
 - b. Manufacturer’s literature with product description, performance and test data, and reference standards with which product complies.
 - c. Samples, if appropriate.
 - d. Name and address of similar projects on which product was used, and date of installation.

1.4 SUBSTITUTE CONSTRUCTION METHODS OR PROCEDURES

- A. Procedure:
1. Submit number of copies of request for substitution as specified for Shop Drawings and other submittals in Section 01 33 00, Submittal Procedures.
 2. Submit separate request for each substitution.
 3. Submit substitution request using forms attached to this Section by completing all applicable information requested on the forms, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:
 - a. Detailed description of proposed method or procedure.
 - b. Itemized comparison of the proposed substitution with the specified method or procedure.
 - c. Drawings illustrating method or procedure.
 - d. Other data required by ENGINEER to establish that proposed substitution is equivalent to specified method or procedure.

1.5 CONTRACTOR'S REPRESENTATION AND ACCEPTANCE

- A. In submitting request for substitution, CONTRACTOR represents that:
1. CONTRACTOR has investigated proposed substitution and determined that it is equivalent to item, product, method, or procedure specified, as applicable.
 2. CONTRACTOR will provide the same or better guarantees or warranties for proposed substitution as for the specified product, manufacturer, method, or procedure, as applicable.
 3. CONTRACTOR waives all Claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.
- B. A proposed substitution will not be accepted for review if:
1. Approval would require changes in design concept or a substantial revision of the Contract Documents.
 2. Approval would delay completion of the Work or the work of other contractors.
 3. Substitution request is indicated or implied on a Shop Drawing or other submittal, or on a request for interpretation or clarification, and is not accompanied by CONTRACTOR's formal request for substitution.
- C. If ENGINEER does not approve the proposed substitute, CONTRACTOR shall provide the specified product, manufacturer, method, or procedure, as applicable.
- D. Approval of a substitution request will not relieve CONTRACTOR from requirement for submitting Shop Drawings as set forth in the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SUPPLEMENTS

- A. The forms listed below, following the “End of Section” designation, are part of this Specification Section:
1. Substitution Request Form (two pages).
 2. Product Substitution Checklist (one page).

+ + END OF SECTION + +

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

Engineer Proj. No. _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No.: _____
Installer: _____ Address: _____ Phone: _____
History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached — REQUIRED BY THE CONTRACT DOCUMENTS

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Engineer: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____)
(attach detailed, itemized estimate)

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.
(clarify whether change is to Substantial Completion, Milestone, or time for readiness for final payment)

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST

(Continued)

☐ Substitute product, method, or procedure is subject to payment of licensing fee or royalty (check if "yes" and attach information)

☐ Substitute product, method, or procedure is patented or copyrighted (check if "yes" and attach information)

The undersigned certifies:

- Representations in the General Conditions and in Section 01 25 00, Substitution Procedures, regarding substitutions are valid.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for Engineer's review and changes, if any, to the design and Contract Documents, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: ☐

ENGINEER'S REVIEW AND ACTION (FOR ENGINEER'S USE ONLY)

☐ Substitution approved.

☐ Substitution approved as noted.

☐ Substitution rejected - Use specified materials.

☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Engineer
☐ Other:

PRODUCT SUBSTITUTION CHECKLIST

Date: _____

Re: _____

Engineer Proj No.: _____

Manufacturer's Project No.: _____

Filing No.: _____

Contract For: _____

Product Equivalence:

☐ Is the submitted product equivalent to the specified item? _____

☐ Does it serve the same function? _____

☐ Does it have the same dimensions? _____

☐ Does it have the same appearance? _____

☐ Will it last as long? _____

☐ Does it comply with the same codes, and standards and performance requirements? _____

☐ Has the product been used locally, and where are the projects? _____

☐ Has a problem occurred with the product, and what was the remedy? _____

Effect on the Project:

☐ Will the substitution affect other aspects of the construction? _____

☐ Are any details affected and are changes required? _____

☐ What is the cost of the changes? _____

☐ Who pays for the required changes? _____

☐ Is construction time affected? _____

Effect on the Warranty:

☐ How does the proposed warranty differ from the specified warranty? _____

☐ Does the manufacturer have a track record of standing behind the warranty? _____

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope.
 - 1. This Section expands upon provisions of the General Conditions and Supplementary Conditions, and includes:
 - a. Requests for interpretation.
 - b. Clarification notices.
 - c. Minor changes in the Work and Field Orders.
 - d. Work Change Directives.
 - e. Proposal requests.
 - f. Change Order proposals.
 - g. Change Orders.
- B. Submit Contract modification documents to ENGINEER's contact person and address in Section 01 33 00, Submittal Procedures.
- C. Retain at CONTRACTOR's office and at the Site complete copy of each Contract modification document and related documents, and ENGINEER's response.

1.2 REQUESTS FOR INTERPRETATION

- A. General.
 - 1. Submit written requests for interpretation to ENGINEER. CONTRACTOR and OWNER may submit requests for interpretation.
 - 2. Submit request for interpretation to obtain clarification or interpretation of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents using requests for interpretation.
 - 3. Do not submit request for interpretation when other form of communication is appropriate, such as submittals, requests for substitutions or "or equals", notices, ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action.
- B. Procedure.
 - 1. Submit one original and two copies of each request for interpretation. Submit each request for interpretation with separate letter of transmittal.
 - 2. ENGINEER will provide timely review of requests for interpretation. Allow sufficient time for review and response.
 - 3. ENGINEER will maintain log of requests for interpretation. Copy of log will be provided upon request.

4. ENGINEER will provide written response to each request for interpretation. One copy of ENGINEER's response will be distributed to:
 - a. CONTRACTOR.
 - b. OWNER.
 - c. Resident Project Representative (RPR).
 - d. ENGINEER.
 5. If ENGINEER requests additional information to make an interpretation, provide information requested within ten days, unless ENGINEER allows additional time, via correspondence referring to request for interpretation number.
 6. If CONTRACTOR or OWNER believes that a change in the Contract Price or Contract Times or other change to the Contract is required, notify ENGINEER in writing before proceeding with the Work associated with the request for interpretation.
- C. Submit each request for interpretation on the request for interpretation form included with this Section, or other form acceptable to ENGINEER.
1. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First request for interpretation on the general contract for project titled, "Contract MP15" would be, "RFI No. MP15-GC-001".
 2. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail for ENGINEER's response.
 3. When applicable, request for interpretation shall include CONTRACTOR's recommended resolution.

1.3 CLARIFICATION NOTICES

- A. General:
1. Clarification notices, when required, will be initiated and issued by ENGINEER.
 2. Clarification notices do not change the Contract Price or Contract Times, and do not alter the Contract Documents.
 3. Clarification notices will be issued as correspondence or using clarification notice form, with additional information as required.
- B. Procedure.
1. One copy of each written clarification notice will be distributed to:
 - a. CONTRACTOR.
 - b. OWNER.
 - c. Resident Project Representative.
 - d. ENGINEER.
 2. If CONTRACTOR or OWNER believes that a change in the Contract Price or the Contract Times or other change to the Contract is required, notify

ENGINEER in writing before proceeding with the Work associated with clarification notice.

3. If clarification notice is unclear, submit request for interpretation.

1.4 MINOR CHANGES IN THE WORK AND FIELD ORDERS

A. General:

1. Field Orders, when required, will be initiated and issued by ENGINEER.
2. Field Orders authorize minor variations in the Work but do not change the Contract Price or Contract Times.
3. Field Orders will be in the form of Engineers Joint Contract Documents Committee (EJCDC) document C-942, "Field Order".
4. ENGINEER will maintain a log of Field Orders issued.

B. Procedure.

1. One copy of each Field Order will be distributed to:
 - a. CONTRACTOR.
 - b. OWNER.
 - c. Resident Project Representative.
 - d. ENGINEER.
2. If CONTRACTOR or OWNER believes that a change in the Contract Price or the Contract Times or other change to the Contract is required, immediately notify ENGINEER in writing before proceeding with the Work associated with the Field Order.
3. If the Field Order is unclear, submit request for interpretation.

1.5 WORK CHANGE DIRECTIVES

A. General:

1. Work Change Directives, when required, order additions, deletions, or revisions to the Work.
2. Work Change Directives do not change the Contract Price or Contract Times but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times..
3. Work Change Directives will be in the form of EJCDC document C-940, "Work Change Directive".

B. Procedure.

1. Three originals of Work Change Directive signed by OWNER and ENGINEER will be furnished to CONTRACTOR, who shall promptly sign each original Work Change Directive and, within five days of receipt, return all originals to ENGINEER.
2. Original, signed Work Change Directives will be distributed as follows:
 - a. CONTRACTOR: One original.
 - b. OWNER: One original.

- c. ENGINEER: One original.
- 3. One copy of each Work Change Directive will be distributed to:
 - a. Resident Project Representative.
- 4. When required by ENGINEER, document for the Work performed under each separate Work Change Directive, for each day, the number and type of workers employed and hours worked; equipment used including manufacturer, model, and year of equipment, and number of hours; materials used, receipts for and descriptions of materials and equipment incorporated into the Work, invoices and labor and equipment breakdowns for Subcontractors and Suppliers, and other information required by OWNER or ENGINEER, in a format acceptable to ENGINEER. Submit this documentation to ENGINEER as a Change Order proposal.

1.6 PROPOSAL REQUESTS

- A. General:
 - 1. Proposal requests may be initiated by ENGINEER or OWNER.
 - 2. Proposal requests are for requesting the effect on the Contract Price and the Contract Times and other information relative to contemplated changes in the Work. Proposal requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.
 - 3. Proposal requests will be furnished using the proposal request form included with this Section.
- B. Procedure.
 - 1. One copy of each signed proposal request will be furnished to CONTRACTOR with one copy each to:
 - a. OWNER.
 - b. Resident Project Representative.
 - c. ENGINEER.
 - 2. Submit request for interpretation to clarify conflicts, errors, ambiguities, and discrepancies in proposal request.
 - 3. Upon receipt of proposal request, CONTRACTOR shall prepare and submit a Change Order proposal, in accordance with this Section, for the proposed Work described in the proposal request.

1.7 CHANGE ORDER PROPOSALS

- A. General.
 - 1. Submit written Change Order proposal to ENGINEER in response to each proposal request, and when CONTRACTOR believes a change in the Contract Price or Contract Times or other change to the terms of the Contract is required.
- B. Procedure.

1. Submit to ENGINEER one original and three copies of each Change Order proposal with accompanying documentation, and simultaneously submit two copies to OWNER. Submit each Change Order proposal with separate letter of transmittal.
 2. ENGINEER will review Change Order proposal and either request additional information from CONTRACTOR or provide to OWNER recommendation regarding approval of the Change Order proposal.
 3. When, ENGINEER requests additional information to render a decision, submit required information within five days of receipt of ENGINEER's request, unless ENGINEER allows more time. Submit the required information via correspondence that refers to Change Order proposal number.
 4. Upon completing review, one copy of ENGINEER's written response, if any, will be distributed to:
 - a. CONTRACTOR.
 - b. OWNER.
 - c. Resident Project Representative.
 - d. ENGINEER.
 5. If Change Order proposal is recommended for approval by ENGINEER and approved by OWNER, a Change Order will be issued.
 6. If parties do not agree on terms for the change, OWNER or CONTRACTOR may file a Claim against the other, in accordance with the General Conditions and the Supplementary Conditions.
- C. Each Change Order proposal shall be submitted on the Change Order proposal form included with this Section, or other form acceptable to ENGINEER.
1. Number each Change Order proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Order proposal for the general contract for project named "Contract MP15" would be, "Proposal No. MP15-GC-001".
 2. In space provided on form:
 - a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for ENGINEER's review and response. If a change item is submitted in response to proposal request, write in as scope, "In accordance with Proposal Request No." followed by the proposal request number. Provide written clarifications, if any, to scope of change.
 - b. Provide justification for each proposed change. If change is in response to proposal request, write in as justification, "In accordance with Proposal Request No." followed by the proposal request number.
 - c. List the total change in the Contract Price and Contract Times for each proposed change.
 3. Unless otherwise directed by ENGINEER, attach to the Change Order proposal detailed breakdowns of pricing (Cost of the Work and CONTRACTOR's fee) including:
 - a. List of Work tasks to accomplish the change.

- b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification.
- b. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each.
- c. Detailed breakdown of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier's written quotations.
- d. Breakdowns of the Cost of the Work and fee for Subcontractors, including labor, construction equipment and machinery, and materials and equipment incorporated into the Work, other costs, and Subcontractor fees.
- e. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions.
- f. Other information required by ENGINEER.
- g. CONTRACTOR's fees applied to eligible CONTRACTOR costs and eligible Subcontractor costs.

1.8 CHANGE ORDERS

A. General:

- 1. Change Orders will be recommended by ENGINEER and signed by OWNER and CONTRACTOR, to authorize additions, deletions, or revisions to the Work, or changes to the Contract Price or Contract Times.
- 2. Change Orders will be in the form of EJCDC document C-941, "Change Order".

B. Procedure.

- 1. Three originals of each Change Order will be furnished to CONTRACTOR, who shall sign each original Change Order and return all originals to ENGINEER within five days of receipt.
- 2. ENGINEER will sign each original Change Order and forward them to OWNER.
- 3. After approval and signature by OWNER, original Change Orders will be distributed as follows:
 - a. CONTRACTOR: One original.
 - b. OWNER: One original.
 - c. ENGINEER: One original.
- 4. One copy of each Change Order will be distributed to:
 - a. Resident Project Representative.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below, following the “End of Section” designation, are part of this Specification Section:
1. Request for Interpretation form (one page).
 2. Proposal Request form (one page).
 3. Change Order Proposal form (one page).

+ + END OF SECTION + +

[OWNER]
[PROJECT NAME/NUMBER]

REQUEST FOR INTERPRETATION

Contractor: _____ RFI No. _____
Date Transmitted: _____ Date Received: _____
Date Response Requested: _____ Date Response Transmitted: _____

Subject: _____
Specification Section and Paragraph: _____

Drawing References: _____

INTERPRETATION REQUESTED:

Signature: _____ Date: _____

ENGINEER'S RESPONSE:

Signature: _____ Date: _____

[OWNER]
[PROJECT NAME/NUMBER]

PROPOSAL REQUEST

Proposal Request No.: _____ Date: _____

Contract Name and No.: _____

Contractor: _____

Other Contracts Involved in Proposed Change: _____

TO CONTRACTOR: Please submit a complete Change Order proposal for the proposed modifications described below. If the associated Change Order proposal is approved, a Change Order will be issued to authorize adjustment so the scope of the Work. This Proposal Request is not a Change Order, Work Change Directive, or an authorization to proceed with the proposed Work described below.

SCOPE OF PROPOSED WORK:

1. *Item:*
2. *Item:*
3. *Item:*

Proposal Requested By: _____

Signature of Requestor: _____

[OWNER]
[PROJECT NAME/NUMBER]

CHANGE ORDER PROPOSAL

Change Order Proposal No.: _____ Date: _____

Submitted in Response to Proposal Request No.: _____

Contract Name and No.: _____

Contractor: _____

Subject: _____

The following changes to the Contract are proposed:

SCOPE OF WORK: *(attach and list supporting information as required)*

1. *Item:*
2. *Item:*

JUSTIFICATION:

1. *Item:*
2. *Item:*

CHANGES IN CONTRACT PRICE AND CONTRACT TIMES:

We propose that the Contract Price and Contract Times be changed as follows:

For Contract Price, when requested by Engineer, attach detailed cost breakdowns for Contractor and Subcontractors, Supplier quotations, and other information required.

For the Contract Times, state increase, decrease, or no change to Contract Times for Substantial Completion, readiness for final payment, and Milestones, if any. If increase or decrease, state specific number of days for changes to the Contract Times.

Description	Amount	Contract Times (days)	
		Substantial	Final
1. Item	\$0.00	0	0
2. Item	\$0.00	0	0
Total This Change Order Proposal	\$0.00	0	0

Changes to Milestones, if any: _____

The adjustment proposed is the entire adjustment to the Contract to which the proposer believes it is entitled as a result of the proposed change.

Change Order Proposal By: _____

Signature of Proposer: _____

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Submit to ENGINEER for acceptance a Schedule of Values that allocates cost to each item of the Work. Schedule of Value list of line items shall correspond to each aspect of the Work, establishing in detail the portion of the Contract Price allocated to each major component of the Work.
- B. Upon request of ENGINEER, support values with data that substantiate their correctness.
- C. Submit preliminary Schedule of Values to ENGINEER for initial review. CONTRACTOR shall incorporate ENGINEER's comments into the Schedule of Values and resubmit to ENGINEER. ENGINEER may require corrections and re-submittals until Schedule of Values is acceptable.
- D. Schedule of Values and the Progress Schedule updates specified in Section 01 32 16, Progress Schedule, shall be basis for preparing each Application for Payment. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.
- E. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by ENGINEER.
- F. Requirements for preliminary Schedule of Values and Schedule of Values are:
 - 1. Schedule of Values shall show division of Work between CONTRACTOR and Subcontractors. Line items for Work to be done by Subcontractor shall include the word, "(SUBCONTRACTED)".
 - 2. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by CONTRACTOR and each Subcontractor. List purchase and delivery costs for materials and equipment for which CONTRACTOR may apply for payment as stored materials.
 - 3. Identify each line item with number corresponding to the associated Specification Section number. List sub-items of major products or systems, as appropriate or when requested by ENGINEER.
 - 4. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.

5. Include in each line item a directly proportional amount of CONTRACTOR's overhead and profit. Do not include overhead and profit as separate item(s).
6. Include separate line item for each allowance, and for each unit price item
7. Include line item for bonds and insurance in amount not exceeding 2.0 percent of the Contract Price. This may be applied for in the first Application for Payment.
8. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for ENGINEER the activities included in mobilization and demobilization line items.
 - a. Mobilization will be as identified in section 01 2213, Measurement and Payment.
 - b. Demobilization shall be as identified in section 01 2213, Measurement and Payment and shall be included with the Application for Payment following Substantial Completion, or other schedule accepted by ENGINEER.
9. Submit Schedule of Values on 8.5-inch by 11-inch white paper, using the continuation sheets of the Application for Payment form specified in Section 01 29 76, Progress Payment Procedures.

1.2 SUBMITTALS

- A. Informational Submittals: Submit the following:
 1. Submit to ENGINEER six copies of Schedule of Values.
 2. Content of Schedule of Values submittals shall conform to Article 1.1 of this Section.
 3. Time Frames for Submittals:
 - a. Submit preliminary Schedule of Values within time frame specified in the General Conditions.
 - b. Submittal of the Schedule of Values shall be in accordance with the General Conditions. ENGINEER will not accept Applications for Payment without an acceptable Schedule of Values.
 - c. When required by ENGINEER, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 29 76

PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 PROGRESS PAYMENTS

- A. General.
 - 1. CONTRACTOR's requests for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.
 - 2. Applications for Payment shall be in the form of Engineers Joint Contract Documents Committee (EJCDC) document C-620, "Contractor's Application for Payment".
- B. Procedure:
 - 1. Review with Resident Project Representative (RPR) quantities and the Work proposed for inclusion in each progress payment. Application for Payment shall cover only the Work and quantities recommended by the RPR.
 - 2. Submit to ENGINEER six originals of each complete Application for Payment and other documents to accompany the Application for Payment.
 - 3. ENGINEER will act on request for payment in accordance with the General Conditions and Supplementary Conditions.
- C. Each request for progress payment shall include:
 - 1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.
 - 2. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions. Legibly indicate on invoice or bill of sale the specific materials or equipment included in the payment request and corresponding bid/payment item number for each.
 - 3. Certified Payrolls for the CONTRACTOR and subcontractor(s).
 - 4. For payment requests that include payment for Work under an allowance, submit documentation acceptable to OWNER of the authorization of allowance Work.
 - 5. For payment requests (other than request for final payment) that include reduction or payment of retainage in an amount greater than that required in the Contract Documents, submit on form acceptable to OWNER consent of surety to partial release or reduction of retainage.
- D. Requirements for request for final payment are in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19, Closeout Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below, following the “End of Section” designation, are part of this Specification Section:
 - 1. EJCDC document C-620, “Contractor’s Application for Payment” (four pages).

+ + END OF SECTION + +

SECTION 01 31 13

PROJECT COORDINATION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall coordinate the Work, including testing agencies whether hired by CONTRACTOR, OWNER, or others; Subcontractors, Suppliers, and others with whom coordination is necessary, in accordance with the General Conditions, Supplementary Conditions, and this Section, to complete the Work within the Contract Times and in accordance with the Contract Documents.
- B. In accordance with the General Conditions as may be modified by the Supplementary Conditions, CONTRACTOR shall cooperate with and coordinate the Work with other contractors, utility service companies, OWNER's employees working at the Site, and other entities working at the Site, in accordance with Section 01 11 13, Summary of Work.
- C. CONTRACTOR will not be responsible or liable for damage unless damage is through negligence of CONTRACTOR, or Subcontractors, Supplier, or other entity employed by CONTRACTOR.
- D. Attend and participate in all project coordination and progress meetings, and report on the progress of the Work and compliance with the Progress Schedule.
- E. It is the responsibility of the CONTRACTOR to coordinate specifically with the gas utility company when coordinating work to install new utilities on Church Street.
- F. It is the responsibility of the CONTRACTOR to coordinate pump station work and appurtenances with the general contractor of the new high school work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 19.13

PRE-CONSTRUCTION CONFERENCE

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. A pre-construction conference will be held for the Project.
 - 2. CONTRACTOR shall attend the conference prepared to discuss all items on the agenda.
 - 3. ENGINEER will distribute an agenda, preside at conference, and prepare and distribute minutes to all conference participants and others as requested.
- B. Purpose of conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by CONTRACTOR, and review administrative and procedural requirements for the Project. Matters requiring coordination will be discussed and procedures for handling such matters will be established.
- C. Date, Time and Location: Conference will be held after execution of the Contract and before Work starts at the Site. ENGINEER will establish the date, time, and location of conference and notify the interested and involved parties.
- D. Prior to the conference, submit the following preliminary schedules in accordance with the General Conditions:
 - 1. Progress Schedule.
 - 2. Schedule of Submittals.
 - 3. Schedule of Values.
- E. CONTRACTOR shall provide information required and contribute appropriate items for discussion. CONTRACTOR shall bring to the conference the following, with sufficient number of copies for each attendee:
 - 1. Preliminary Progress Schedule, as submitted to ENGINEER.
 - 2. Preliminary Schedule of Submittals, as submitted to ENGINEER.
 - 3. Preliminary Schedule of Values, as submitted to ENGINEER.
 - 4. List of emergency contact information, in accordance with Article 1.4 of this Section.

1.2 REQUIRED ATTENDANCE

- A. Representative of each entity attending the conference shall be authorized to act on that entity's behalf.

- B. Contractor Attendance: Conference shall be attended by CONTRACTOR's project manager, Site superintendent, project managers for major Subcontractors, and major equipment Suppliers as CONTRACTOR deems appropriate.
- C. Other attendees will be representatives of:
 - 1. OWNER.
 - 2. ENGINEER.
 - 3. Others as requested by OWNER, CONTRACTOR, or ENGINEER.

1.3 AGENDA

- A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revisions to this agenda, if any, will be furnished to CONTRACTOR prior to conference.
 - 1. Procedural and Administrative:
 - a. Personnel and Teams:
 - 1) Designation of roles and personnel.
 - 2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
 - 3) Lists of proposed Subcontractors and manufacturers (where applicable).
 - 4) Authorities having jurisdiction.
 - b. Procedures for communications and correspondence.
 - c. Copies of the Contract Documents and availability.
 - d. Subcontractors.
 - e. The Work and Scheduling:
 - 1) Scope of the Work.
 - 2) Contract Times, including Milestones (if any).
 - 3) Phasing and sequencing.
 - 4) Preliminary Progress Schedule.
 - 5) Critical path activities.
 - f. Safety:
 - 1) Responsibility for safety.
 - 2) Designation of Contractor's safety representative.
 - 3) Emergency procedures and accident reporting.
 - 4) Emergency contact information.
 - 5) Confined space entry procedures.
 - 6) Hazardous materials communication program.
 - 7) Impact of Project on public safety.
 - g. Permits.
 - h. Review of insurance requirements and insurance claims.
 - i. Coordination:
 - 1) Project coordination, and coordination among contractors.
 - 2) Coordination with Owner's operations.
 - 3) Progress meetings.
 - j. Products and Submittals:

- 1) Preliminary Schedule of Submittals.
- 2) Shop Drawings, Samples, and other submittals.
- 3) Product options, “or equals”, and substitutions.
- 4) Construction photographic documentation.
- k. Contract Modification Procedures
 - 1) Requests for interpretation
 - 2) Clarification notices
 - 3) Field Orders
 - 4) Proposal requests
 - 5) Change Order proposals
 - 6) Work Change Directives.
 - 7) Change Orders.
 - 8) Procedure for filing Claims.
- l. Payment:
 - 1) Owner’s Project financing and funding, as applicable.
 - 2) Owner’s tax-exempt status.
 - 3) Preliminary Schedule of Values, and procedures for measuring for payment.
 - 4) Retainage.
 - 5) Progress payment procedures.
 - 6) Prevailing wage rates and payrolls.
- m. Testing and inspections, including notification requirements.
- n. Disposal of demolition materials.
- o. Record documents.
- p. Preliminary Discussion of Contract Closeout:
 - 1) Procedures for Substantial Completion.
 - 2) Contract closeout requirements.
 - 3) Correction period.
 - 4) Duration of bonds and insurance.
2. Site Mobilization (if not covered in a separate meeting):
 - a. Working hours and overtime.
 - b. Field offices, trailers, and staging areas.
 - c. Temporary facilities.
 - d. Temporary utilities and limitations on utility consumption (where applicable).
 - e. Utility company coordination (if not done as a separate meeting).
 - f. Access to Site, access roads, and parking for construction vehicles.
 - g. Maintenance and protection of traffic.
 - h. Use of premises.
 - i. Protection of existing property.
 - j. Security.
 - k. Temporary controls, such as sediment and erosion control, noise control, dust control, storm water control, and other such measures.
 - l. Site barriers and temporary fencing.
 - m. Storage of materials and equipment.
 - n.. Reference points and benchmarks; surveys and layouts.

- o. Site maintenance during the Project.
 - p. Cleaning and removal of trash and debris.
 - q. Restoration.
- 3. General discussion and questions.
- 4. Next meeting.
- 5. Site visit, if required.

1.4 EMERGENCY CONTACT INFORMATION

- A. CONTRACTOR shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list at the next progress meeting.
- B. CONTRACTOR's list of emergency contact information shall include:
 - 1. CONTRACTOR's project manager's office, field office, cellular, and home telephone numbers.
 - 2. CONTRACTOR's Site superintendent's office, field office, cellular, and home telephone numbers.
 - 3. CONTRACTOR's foreman's field office, cellular (if available), and home telephone numbers.
 - 4. Major Subcontractors' and Suppliers' office, cellular, and home telephone numbers of project manager and foreman (when applicable).

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 19.23

PROGRESS MEETINGS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Progress meetings will be held throughout the Project. CONTRACTOR shall attend each progress meeting prepared to discuss in detail all items on the agenda.
 - 2. ENGINEER will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.
- B. Date and Time:
 - 1. Regular Meetings: Every two weeks on a day and time agreeable to OWNER, ENGINEER, and CONTRACTOR.
 - 2. Other Meetings: As required.
- C. Place: CONTRACTOR's field office at the Site or other location mutually agreed upon by OWNER, CONTRACTOR, and ENGINEER.
- D. Handouts: CONTRACTOR shall bring to each progress meeting a minimum of six copies of each of the following:
 - 1. List of Work accomplished since the previous progress meeting.
 - 2. Up-to-date Progress Schedule.
 - 3. Up-to-date Schedule of Submittals.
 - 4. Detailed "look-ahead" schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the OWNER, Project, and Site.
 - 5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.2 REQUIRED ATTENDANCE

- A. Representatives present for each entity shall be authorized to act on that entity's behalf.
- B. Required Attendees:
 - 1. CONTRACTOR:
 - a. Project manager.

- b. Site superintendent.
- c. Safety representative.
- d. When needed for the discussion of a particular agenda item, representatives of Subcontractors and Suppliers shall attend meetings.
- 2. ENGINEER:
 - a. Project manager or designated representative
 - b. Resident Project Representative (if any).
 - c. Others as required by ENGINEER.
- 3. OWNER's representative(s), as required.
- 4. Testing and inspection agencies, as required.
- 5. Others, as appropriate.

1.3 AGENDA

- A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revised agenda, if any, will be furnished to CONTRACTOR prior to first progress meeting. Progress meeting agenda may be modified by ENGINEER during the Project as required.
 - 1. Review, comment, and amendment (if required) of minutes of previous progress meeting.
 - 2. Review of progress since the previous progress meeting.
 - 3. Planned progress through next progress meeting.
 - 4. Review of Progress Schedule
 - a. Contract Times, including Milestones (if any)
 - b. Critical path.
 - c. Schedules for fabrication and delivery of materials and equipment.
 - d. Corrective measures, if required.
 - 5. Submittals:
 - a. Review of status of critical submittals.
 - b. Review revisions to Schedule of Submittals.
 - 6. Contract Modifications
 - a. Requests for interpretation
 - b. Clarification notices
 - c. Field Orders
 - d. Proposal requests
 - e. Change Order proposals
 - f. Work Change Directives.
 - g. Change Orders.
 - h. Claims.
 - 7. Applications for progress payments.
 - 8. Problems, conflicts, and observations.
 - 9. Quality standards, testing, and inspections.
 - 10. Coordination between parties.
 - 11. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
 - 12. Safety.

13. Permits.
14. Construction photographic documentation.
15. Record documents status.
16. Punch list status, as applicable.
17. Other business.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 32 16.00.10

PROGRESS SCHEDULE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Prepare and submit Progress Schedules in accordance with the General Conditions and this Section, unless otherwise accepted by ENGINEER.
2. Maintain and update Progress Schedules. Submit updated Progress Schedules as specified in this Section unless otherwise directed by ENGINEER.
3. ENGINEER's acceptance of the Progress Schedule, and comments or opinions concerning the activities in the Progress Schedule shall not control CONTRACTOR's independent judgment relative to means, methods, techniques, sequences, and procedures of construction. CONTRACTOR is solely responsible for complying with the Contract Times.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Progress Schedules:
 - a. Submit six copies of preliminary Progress Schedule in accordance with Paragraph 2.05 of the General Conditions. Submit in accordance with Section 01 33 00, Submittal Procedures.
 - b. After making revisions in accordance with ENGINEER's comments on the preliminary Progress Schedule, submit six copies of Progress Schedule in accordance with Paragraph 2.07 of the General Conditions. Submit in accordance with Section 01 33 00, Submittal Procedures.
 - c. Submit updated Progress Schedule at each progress meeting. If a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect. For monthly Progress Schedule submittals, bring to progress meeting the number of copies of the updated Progress Schedule specified in Section 01 31 19.23, Progress Meetings.
 - d. Submit each Progress Schedule submittal with letter of transmittal complying with requirements of Section 01 33 00, Submittal Procedures, and specifically indicating the following:
 - 1) Listing of activities and dates that have changed since the previous Progress Schedule submittal.
 - 2) Discussion of problems causing delays, anticipated duration of delays, and proposed countermeasures.
2. Recovery Schedules: Submit in accordance with this Section.

1.3 PROGRESS SCHEDULE FORMAT AND CONTENT

- A. Format:
 - 1. Type:
 - a. Horizontal bar chart or Gantt chart.
 - 2. Sheet Size: 11 inches by 17 inches, unless otherwise accepted by ENGINEER.
 - 3. Time Scale: Indicate first date of each work week.
 - 4. Organization:
 - a. Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, Samples, and other submittals.
 - b. Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
 - c. Group construction into a separate sub-schedule (that is part of the Progress Schedule) by activity.
 - d. Group critical activities that dictate the rate of progress (the “critical path”) into a separate sub-schedule that is part of the Progress Schedule. Clearly indicate the critical path on the Progress Schedule.
 - e. Organize each sub-schedule by Specification Section number.
 - 5. Activity Designations: Indicate title and related Specification Section number.
- B. Content: Progress Schedules shall indicate the following:
 - 1. Dates for shop-testing.
 - 2. Delivery dates for materials and equipment to be incorporated into the Work.
 - 3. Dates for beginning and completing each phase of the Work by activity and by trade.
 - 4. Dates for start-up and check-out, field-testing, and instruction of OWNER’s personnel.
 - 5. Dates corresponding to the Contract Times, and planned completion date associated with each Milestone (if any), Substantial Completion, and readiness for final payment.
- C. Coordinate the Progress Schedule with the Schedule of Submittals.

1.4 RECOVERY SCHEDULES

- A. Recovery Schedules, General:
 - 1. When updated Progress Schedule indicates that the ability to comply with the Contract Times falls five or more days behind schedule, and there is no excusable delay, Change Order, or Work Change Directive to support an extension of the Contract Times, CONTRACTOR shall prepare and submit a Progress Schedule demonstrating CONTRACTOR’s plan to accelerate the Work to achieve compliance with the Contract Times (“recovery schedule”) for ENGINEER’s acceptance.
 - 2. Submit recovery schedule within two days after submittal of updated Progress Schedule where need for recovery schedule is indicated.

B. Implementation of Recovery Schedule:

1. At no additional cost to OWNER, do one or more of the following: furnish additional labor, provide additional construction equipment, provide suitable materials, employ additional work shifts, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.
2. Upon acceptance of recovery schedule by ENGINEER, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action:

1. CONTRACTOR's refusal, failure, or neglect to take appropriate recovery action, or to submit a recovery schedule, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide submittals in accordance with the General Conditions as modified by the Supplementary Conditions, and this Section.
2. Provide submittals well in advance of need for the material or equipment, or procedure (as applicable), in the Work and with ample time required for delivery of material or equipment and to implement procedures following ENGINEER's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.
3. CONTRACTOR is responsible for dimensions to be confirmed and corrected at the Site, for information pertaining solely to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. CONTRACTOR's signature of submittal's stamp and letter of transmittal shall be CONTRACTOR's representation that CONTRACTOR has met his obligations under the Contract Documents relative to that submittal.

1.2 TYPES OF SUBMITTALS

- ###### A. Submittal types are classified as follows: 1) Action Submittals, 2) Informational Submittals, 3) Closeout Submittals, and 4) Maintenance Material submittals. Type of each required submittal is designated in the respective Specification Sections; when type of submittal is not specified in the associated Specification Section, submittal will be classified as follows:

1. Action Submittals include:
 - a. Shop Drawings.
 - b. Product data.
 - c. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary construction unless specified otherwise in the related Specification Section. Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.
 - d. Samples.
 - e. Testing plans, procedures, and testing limitations.

2. Informational Submittals include:
 - a. Certificates.
 - b. Design data not sealed and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier.
 - c. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Condition, and similar reports.
 - d. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
 - e. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.
 - f. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.
 - g. Supplier reports.
 - h. Sustainable design submittals (other than sustainable design closeout documentation).
 - i. Special procedure submittals, including health and safety plans and other procedural submittals.
 - j. Qualifications statements.
 3. Closeout Submittals include:
 - a. Maintenance contracts.
 - b. Operations and maintenance data.
 - c. Bonds, such as maintenance bonds and bonds for a specific product or system.
 - d. Warranty documentation.
 - e. Record documentation.
 - f. Sustainable design closeout documentation.
 - g. Software.
 4. Maintenance Material Submittals include:
 - a. Spare parts.
 - b. Extra stock materials.
 - c. Tools.
 5. When type of submittal is not specified and is not included in the list above, ENGINEER will determine the type of submittal.
- B. Not Included in this Section: Administrative and procedural requirements for following are covered elsewhere in the Contract Documents:
1. Requests for interpretations of the Contract Documents.
 2. Change Orders, Work Change Directives, and Field Orders.
 3. Applications for Payment
 4. Progress Schedules.
 5. Reports and documentation required in accordance with applicable permits
 6. Site survey data.

1.3 SUBMITTALS REQUIRED IN THIS SECTION

A. Informational Submittals: Provide the following:

1. Schedule of Submittals:

a. Timing:

1) Provide submittal within time frames specified in the Contract Documents.

2) Provide updated Schedule of Submittals with each submittal of the updated Progress Schedule.

b. Content: In accordance with the General Conditions as modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical. Identify on Schedule of Submittals all submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project's critical path. Indicate the following for each submittal:

1) Date by which submittal will be provided to ENGINEER.

2) Whether submittal will be for a substitution or "equal". Procedures for substitutions and "or equals" are specified in the General Conditions and the Division 01 Specifications

3) Date by which ENGINEER's response is required. At least seven days shall be allowed from ENGINEER's receipt of each submittal. Allow increased time for large or complex submittals.

4) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors.

c. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules.

d. Coordinate Schedule of Submittals with the Progress Schedule.

e. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project's critical path, or that places extraordinary demands on ENGINEER for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.

f. In preparing Schedule of Submittals:

1) Considering the nature and complexity of each submittal, allow sufficient time for review and revision.

2) Reasonable time shall be allowed for: ENGINEER's review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to CONTRACTOR.

3) Identify and accordingly schedule submittals that are expected to have long anticipated review times.

1.4 PROCEDURE FOR SUBMITTALS

- A. Submittal Identification System: Use the following submittal identification system, consisting of submittal number and review cycle number.
1. Submittal Number: Shall be separate and unique number correlating to each individual submittal required. CONTRACTOR shall assign submittal number as follows:
 - a. First part of submittal number shall be the applicable Specification Section number, followed by a hyphen.
 - b. Second part of submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate and unique submittal provided under the associated Specification Section.
 - c. Typical submittal number for the third submittal provided for Section 40 05 19, Ductile Iron Process Pipe, would be "40 05 19-003".
 2. Review Cycle Number: Shall be a letter designation indicating the initial submittal or re-submittal associated with each submittal number:
 - a. "A" = Initial (first) submittal.
 - b. "B" = Second submittal (e.g., first re-submittal).
 - c. "C" = Third submittal (e.g., second re-submittal).
 3. Examples:

Example Description	Submittal Identification	
	Submittal No.	Review Cycle
Initial (first) review cycle of the third submittal provided under Section 40 05 19, Ductile Iron Process Pipe	40 05 19-003-	A
Second review cycle (first re-submittal) of third submittal provided under Section 40 05 19, Ductile Iron Process Pipe	40 05 19-003-	B

- B. Letter of Transmittal for Submittals:
1. Provide separate letter of transmittal with each submittal. Each submittal shall be for one Specification Section.
 2. At beginning of each letter of transmittal, provide a reference heading indicating: CONTRACTOR's name, OWNER's name, Project name, Contract name and number, transmittal number, and submittal number.
 3. For submittals with proposed deviations from requirements of the Contract Documents, letter of transmittal shall specifically describe each proposed variation.
- C. Contractor's Review and Stamp:
1. Contractor's Review: Before transmitting submittals to ENGINEER, review submittals to:
 - a. assure proper coordination of the Work;
 - b. determine that each submittal is in accordance with CONTRACTOR's desires;

- c. verify that submittal contains sufficient information for ENGINEER to determine compliance with the Contract Documents.
2. Incomplete or inadequate submittals will be returned without review.
3. Contractor's Stamp and Signature:
 - a. Each submittal provided shall bear CONTRACTOR's stamp of approval and signature, as evidence that submittal has been reviewed by CONTRACTOR and verified as complete and in accordance with the Contract Documents.
 - b. Submittals without CONTRACTOR's stamp and signature will be returned without review. Signatures that appear to be computer-generated will be regarded as unsigned and the associated submittal will be returned without review.
 - c. CONTRACTOR's stamp shall contain the following:

"Project Name: _____

Contractor's Name: _____

Date: _____

----- *Reference* -----

Item/Submittal Title: _____

Specifications:

Section: _____

Page No.: _____

Paragraph No.: _____

Drawing No.: _____ of _____

Location of Work: _____

Submittal No. and Review Cycle: _____

Coordinated by Contractor with Submittal Nos.: _____

I hereby certify that the Contractor has satisfied Contractor's obligations under the Contract Documents relative to Contractor's review and approval of this submittal.

Approved By (for Contractor): _____"

D. Submittal Marking and Organization:

1. Mark on each page of submittal and each individual component submitted with submittal number and applicable Specification paragraph. Mark each page of each submittal with the submittal page number.
2. Arrange submittal information in same order as requirements are written in the associated Specification Section.
3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to ENGINEER.

4. Package together submittals for the same Specification Section. Do not provide required information piecemeal.
- E. Format of Submittal and Recipients:
1. Action Submittals and Informational Submittals: Furnish in accordance with Table 01 33 00-A, except that submittals of Samples shall be as specified elsewhere in this Section:

**TABLE 01 33 00-A: SUBMITTAL CONTACTS
AND REQUIRED COPIES**

	Address for Deliveries	Contact Person	E-mail Address	No. of Hard-copies	Remarks
a.	Engineer: XXXXXX	TBD	TBD	Six	
b.	Resident Project Representative: At the Site.	TBD	TBD	One	
Notes: TBD = To Be Determined					

2. Closeout Submittals:
 - a. Provide the following Closeout Submittals in accordance with Table 01 33 00-A: maintenance contracts; bonds for specific products or systems; warranty documentation; and sustainable design closeout documentation. On documents such as maintenance contracts and bonds, include on each document furnished original signature of entity issuing the document.
 - b. Operations and Maintenance Data: Submit in accordance with Section 01 78 23, Operations and Maintenance Data.
 - c. Record Documentation: Submit in accordance with Section 01 78 39, Project Record Documentation.
 - d. Software: Submit number of copies required in Specification Section where the software is specified. If number of copies is not specified, provide two copies on compact disc in addition to software loaded on to OWNER's computer(s) or microprocessor(s).
 3. Maintenance Material Submittals: For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section. Furnish in accordance with Section 01 78 43, Spare Parts and Extra Materials.
- F. Distribution:
1. Distribution of Hardcopies: ENGINEER will distribute each reviewed submittal requiring ENGINEER's written response as follows:
 - a. CONTRACTOR: Two copies (except closeout submittals and maintenance material submittals).
 - b. OWNER: Two copies.

- d. Resident Project Representative: One copy (except closeout submittals and maintenance material submittals).
 - e. ENGINEER's File: One copies.
- G. Resubmittals: Refer to the General Conditions for requirements regarding resubmitting required submittals.

1.5 ENGINEER'S REVIEW

- A. Timing: ENGINEER's review will conform to timing accepted by ENGINEER in the accepted Schedule of Submittals.
- B. Submittals not required in the Contract Documents will not be reviewed by ENGINEER and will not be recorded in ENGINEER's submittal log. All hardcopies of such submittals will be returned to CONTRACTOR.
- C. Action Submittals, Results of ENGINEER's Review: Each submittal will be given one of the following dispositions:
1. Approved: Upon return of submittal marked "Approved", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents.
 2. Approved as Corrected: Upon return of submittal marked "Approved as Corrected", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, provided it is in accordance with corrections indicated.
 3. Approved as Corrected – Resubmit: Upon return of submittal marked "Approved as Corrected – Resubmit", order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER's approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, provided it is in accordance with corrections indicated. Provide to ENGINEER record re-submittal with all corrections made. Receipt of corrected re-submittal is required before materials or equipment covered in the submittal will be eligible for payment.
 4. Revise and Resubmit: Upon return of submittal marked "Revise and Resubmit", make the corrections indicated and re-submit to ENGINEER for approval.
 5. Not Approved: This disposition indicates material or equipment that cannot be approved. Upon return of submittal marked "Not Approved", repeat initial submittal procedure utilizing approvable material or equipment.
- D. Informational Submittals, Results of ENGINEER's Review:
1. Each submittal will be given one of the following dispositions:

- a. Accepted: Information included in submittal conforms to the applicable requirements of the Contract Documents, and is acceptable. No further action by CONTRACTOR is required relative to this submittal, and the Work covered by the submittal may proceed, and products with submittals with this disposition may be shipped or operated, as applicable.
 - b. Not Accepted: Submittal does not conform to applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-submit to indicate acceptability and conformance with the Contract Documents.
- E. Closeout Submittals, Results of ENGINEER's Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Closeout Submittals will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When Closeout Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR.
- F. Maintenance Material Submittals, Results of ENGINEER's Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Maintenance Material Submittals will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When Maintenance Material Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR, and CONTRACTOR is responsible for costs associated with transporting and handling of maintenance materials until compliance with the Contract Documents is achieved.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 42 00

REFERENCES

PART 1 – GENERAL

1.1 DEFINITIONS

- A. Definitions and terminology applicable to all the Contract Documents are included in the General Conditions and Supplementary Conditions.
- B. Terminology used in the Specifications includes:
 - 1. “Indicated” refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs or schedules in the Specifications and similar locations in the Contract Documents. Terminology such as “shown”, “noted”, “scheduled”, and “specified” are used to help the user locate the reference without limitation on the location.
 - 2. “Installer”, “applicator”, or “erector” is CONTRACTOR or another entity engaged by CONTRACTOR, either as an employee or Subcontractor, to perform a particular construction activity, including installation, erection, application or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.
 - a. The term “experienced”, when used with the term “installer” means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; being familiar with Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with requirements of the Supplier of the material or equipment being installed.
 - 3. Trades: Use of a term such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter”, unless otherwise indicated in the Contract Documents or required by Laws or Regulations. Such terminology also does not imply that specified requirements apply exclusively to trade personnel of the corresponding generic name.

1.2 APPLICABLE CODES

- A. References in the Contract Documents to local code(s) shall mean the following:
 - 1. Massachusetts Department of Environmental Protection, Wastewater and Sewer Regulations and Standards.
 - 2. Town of Wilmington Master Plan.

1.3 OWNER'S REFERENCED SPECIFICATIONS

- A. Except as otherwise specified, the Work shall comply with the Contract Documents and the following referenced specifications that can be reviewed and obtained at Massachusetts Department of Transportation website (www.massdot.state.ma.us):
1. Construction Standard Details.
 2. Manual of Uniform Traffic Control Devices.
- B. Maintain complete copy of referenced specifications at the Site.

1.4 ABBREVIATIONS

- A. Common abbreviations that may be found in the Contract Documents are listed below, alphabetically by their written-out meaning:

alternating current		a-c
ampere		A
Architectural Barriers Act		ABA
Americans with Disabilities Act		ADA
Americans with Disabilities Act Accessibility Guidelines		ADAAG
ante meridian		a.m.
average		avg
biochemical oxygen demand		BOD
brake horsepower		bhp
British thermal unit		Btu
Centigrade (or Celsius)		C
chlorinated polyvinyl chloride		CPVC
chlorofluorocarbons		CFC
Code of Federal Regulations		CFR
cubic inch		cu in
cubic foot		cu ft
cubic yard		cu yd, or CY
cubic feet per minute		cfm
cubic feet per second		cfs
decibel		db
degree Centigrade (or Celsius)	(Write)	degrees C or °C
degrees Fahrenheit		degrees F or °F
diameter		dia

direct current	d-c
dollars	\$
each	ea
efficiency	eff
Fahrenheit	F
feet	ft
feet per hour	fph
feet per minute	fpm
feet per second	fps
figure	Fig
flange	flg
foot-pound	ft-lb
gallon	gal
gallons per hour	gph
gallons per minute	gpm
gallons per second	gps
gram	g
grams per liter	g/L
Hertz	Hz
horsepower	hp or HP
hour	hr
human-machine interface	HMI
inch	in.
inches water gage	in. w.g.
inch-pound	in.-lb
inside diameter	ID
iron pipe size	IPS
thousand pounds	kips
thousand pounds per square inch	ksi
kilovolt-ampere	kva
kilowatt	kw
kilowatt-hour	kwhr or kwh
linear foot	lin ft or LF
liter	L
Leadership in Energy and Environmental Design (USGBC)	LEED
maximum	max

mercury	Hg
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallon	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nitrogen oxide (total concentration of mono-nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO ₂))	NO _x
nominal pipe size	NPS
number	no.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	pph
parts per million	ppm
parts per billion	ppb
polyvinyl chloride	PVC
post meridian	p.m.
pound	lb
pounds per square inch	psi
pounds per square inch absolute	psia
pounds per square inch gauge	psig
pounds per square foot	psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	rpm
second	sec
specific gravity	sp gr, or SG
square	sq

square foot	sq ft, or sf
square inch	sq in.
square yard	sq yd, or SY
standard	std
standard cubic feet per minute	scfm
total dynamic head	TDH
totally-enclosed fan-cooled	TEFC
volt	V
volts alternating current	vac
volts direct current	vdc
volatile organic compounds	VOC

1.5 REFERENCE STANDARDS

- A. Refer to Article 3 of the General Conditions, as may be modified by the Supplementary Conditions, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents. Provisions of reference standards are in effect in accordance with the Specifications.
- B. Copies of Standards: Each entity engaged in the Work shall be familiar with reference standards applicable to its construction activity. Copies of applicable reference standards are not bound with the Contract Documents. Where reference standards are needed for a construction activity, obtain copies of standards from the publication source.
- C. Abbreviations and Names: Where reference standards, specifications, codes, manuals, Laws or Regulations, or other published data of international, national, regional or local organizations are referred to in the Contract Documents, the organization issuing the standard may be referred to by their acronym or abbreviation only. Following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACS	American Chemical Society
ADSC- IAFD	International Association of Foundation Drilling.

AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
ABMA	American Bearing Manufacturers Association (formerly Anti-Friction Bearing Manufacturers Association (AFBMA))
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
ANSI	American National Standards Institute
APA	The Engineered Wood Association
API	American Petroleum Institute
APHA	American Public Health Association
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASQ	American Society for Quality
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association

BIA	Brick Industry Association
CBMA	Certified Ballast Manufacturers Association
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DIN	Deutsches Institut für Normung eV (German Institute for Standardization)
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society (formerly Instrument Society of America)

ISO	Insurance Services Office
ISO	International Organization for Standardization
LPI	Lightning Protection Institute
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MMA	Monorail Manufacturers Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MUTCD	Manual on Uniform Traffic Control Devices
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NBHA	National Builders Hardware Association
NBS	United States Department of Commerce, National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NIST	United States Department of Commerce, National Institute of Standards and Technology
NLGA	National Lumber Grades Authority
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration

PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
WDMA	Window and Door Manufacturers Association

WWEMA Water and Wastewater Equipment Manufacturers Association
WWPA Western Wood Products Association

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 45 29.13

TESTING LABORATORY SERVICES FURNISHED BY CONTRACTOR

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall employ and pay for services of independent testing laboratory to perform specified services.
2. Inspection, sampling, and testing shall be as specified in the Specifications including but not limited to:
 - a. Section 03 00 05, Concrete.
 - b. Section 31 23 16.13, Trenching.
 - c. Section 33 05 05, Buried Piping Installation.
 - d. Other tests in the Contract Documents that are not specifically assigned to others.
3. CONTRACTOR shall pay for:
 - a. Tests not specifically indicated in the Contract Documents as being OWNER's responsibility.
 - b. Tests made for CONTRACTOR's convenience.
 - c. Repeat tests required because of CONTRACTOR's negligence or defective Work, and retesting after failure of test for the same item to comply with the Contract Documents.
4. Testing laboratory is not authorized to approve or accept any portion of the Work or defective Work; rescind, alter, or augment requirements of Contract Documents; and perform duties of CONTRACTOR.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
2. ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.
3. NIST SRM, Standard Reference Materials.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory:
 - a. Comply with applicable requirements of ASTM E329.
 - b. Testing laboratory shall be licensed to operate in the same state as the Site. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.

- c. Testing equipment used by laboratory shall be calibrated at maximum intervals of twelve months by devices of accuracy traceable to one of the following: NIST SRM, ISO/IEC 17025, certified by state or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

1.4 SUBMITTALS

- A. Informational Submittals: Submit the following:
 - 1. Quality Control Submittals and Test Reports: Testing laboratory shall promptly submit to CONTRACTOR results of testing and inspections, including:
 - a. Date issued.
 - b. Project title, number, and name of the Site.
 - c. Testing laboratory name and address.
 - d. Name and signature of inspector or person obtaining samples.
 - e. Date of inspection or sampling.
 - f. Record of temperature and weather.
 - g. Date of test.
 - h. Identification of material or product tested, and associated Specification Section.
 - i. Location in the Project.
 - j. Type of inspection or test.
 - k. Results of tests and observations regarding compliance with the Contract Documents.
 - 2. Qualifications Statements:
 - a. Testing Laboratory:
 - 1) Qualifications statement indicating experience and facilities for tests required under the Contract Documents.
 - 2) Copy of report of inspection of facilities during most recent NIST inspection tour. Include memorandum of remedies of deficiencies reported during inspection.
 - 3) Copy of certificate of calibration for each instrument or measuring device proposed for use, by accredited calibration agency.

1.5 TESTING LABORATORY DUTIES

- A. Testing laboratory shall:
 - 1. Cooperate with CONTRACTOR and provide qualified personnel promptly on notice.
 - 2. Perform required inspections, sampling, and testing of materials and methods of construction; comply with applicable reference standards and the Contract Documents; and ascertain compliance with requirements of the Contract Documents.
 - 3. Promptly notify ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work that are observed during performance of services.
 - 4. Promptly submit to CONTRACTOR copies of reports of inspections and tests.
 - 5. Perform additional tests and services, as required by CONTRACTOR.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. CONTRACTOR shall:

1. Cooperate with testing laboratory personnel.
2. Provide to testing laboratory preliminary representative samples of materials and products to be tested, in required quantities.
3. Promptly submit to ENGINEER copies of results of tests and inspections received from testing laboratory.
4. Provide to laboratory the preliminary design mix proposed for concrete and other material mixes to be tested by testing laboratory.
5. Provide labor and facilities:
 - a. For access to the Work to be tested, and where required, to Suppliers' operations.
 - b. For obtaining and handling samples at the Site.
 - c. For facilitating inspections and tests.
 - d. For testing laboratory's exclusive use for storing and curing of test samples.
 - e. Forms for preparing concrete test beams and cylinders.
6. Notify laboratory and ENGINEER sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
7. Arrange with laboratory and pay for additional services, sampling, and testing required for CONTRACTOR's convenience.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 51 05

TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall provide all temporary utilities required for the Project.
 - 1. Make all arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.
 - 2. Pay all utility service costs, including cost of electricity, water, fuel, and other utility services required for the Work.
 - 3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.
 - 4. Should OWNER occupy part of the Project prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by OWNER will be shared proportionately between OWNER and CONTRACTOR as mutually agreed to by the parties.
 - 5. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.
 - 6. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.
 - 7. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.
- B. Provide the following temporary utilities:
 - 1. Electricity.
 - 2. Lighting.
 - 3. Telephone and communications.
 - 4. Water.
 - 5. Sanitary facilities.
 - 6. First-aid facilities.

1.2 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

- A. Electrical:
 - 1. Provide temporary electrical service required for the Work, including continuous power for temporary field offices and sheds. Provide temporary outlets with circuit breaker protection and ground fault protection.

- B. Lighting.
 - 1. Minimum lighting shall be five foot-candles for open areas and ten foot-candles for stairs and shops. Provide minimum of one, 300-watt lamp every 15 feet in indoor Work areas. Provide night security lighting of five foot-candles, minimum, within 50 feet of all parts of the Site during hours of darkness, controlled by photocell.
- C. Telephone and Communications.
 - 1. Provide temporary telephone and communications required for CONTRACTOR's operations at the Site and for summoning emergency medical assistance.
- D. Water.
 - 1. Provide temporary water facilities including piping, valves, meters if not provided by owner of existing waterline, backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as required.
 - 2. Provide water for temporary sanitary facilities, field offices, Site maintenance and cleaning and, when applicable, disinfecting and testing of systems.
 - 3. Continuously maintain adequate water flow and pressure for all purposes during the Project, until removal of temporary water system.
- E. Sanitary Facilities.
 - 1. Provide suitably-enclosed chemical or self-contained toilets for CONTRACTOR's employees and visitors to the Site. Location of temporary toilets shall be acceptable to OWNER.
 - 2. Provide supply of potable drinking water and related facilities and consumables for all personnel using the Site.
 - 3. Provide suitable temporary washing facilities for employees and visitors.
- F. First-aid Facilities.
 - 1. Provide temporary first-aid stations inside CONTRACTOR's temporary field office.
 - 2. Provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 31 19.13, Pre-Construction Conference.

1.3 USE OF OWNER'S SYSTEM

- A. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without OWNER's written permission and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between OWNER and CONTRACTOR.
- B. Use of Permanent Utility Systems Provided Under the Project:

1. CONTRACTOR shall provide temporary power for the Work including startup and testing. CONTRACTOR shall be aware that permanent power may not be available for use.
2. If available for use, permanent electrical, lighting, and water may be used to provide temporary utilities and temporary facilities if the following are met:
 - a. Obtain OWNER's written permission to use permanent systems.
 - b. Permanent systems to be used for temporary utilities or temporary facilities shall have achieved Substantial Completion, including complete functionality of all controls.
 - c. CONTRACTOR shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.
3. Do not use the following permanent facilities:
 - a. Telephone and communication facilities.
 - b. Sanitary facilities.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for temporary systems may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.
- B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.
- B. Location of Temporary Utilities and Temporary Facilities:
 1. Locate temporary systems for proper function and service.
 2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.
 3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.
- C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

- A. Maintain temporary systems to provide safe, continuous service as required.
- B. Properly supervise operation of temporary systems:
 - 1. Enforce compliance with Laws and Regulations.
 - 2. Enforce safe practices.
 - 3. Prevent abuse of services.
 - 4. Prevent nuisances and hazards caused by temporary systems and their use.
 - 5. Prevent damage to finishes.
 - 6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.
- C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

- A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.
- B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.
- C. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

+ + END OF SECTION + +

SECTION 01 52 13

CONTRACTOR'S FIELD OFFICE AND SHEDS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR may provide field office for CONTRACTOR's use at CONTRACTOR's discretion.
 - 2. Provide required storage and work sheds.
 - 3. Pay for required permits and utilities. Field offices and sheds shall comply with Laws and Regulations.
- B. Location:
 - 1. Locate field offices and sheds in accordance with the Contract Documents and in accordance with the Site mobilization discussions at the preconstruction conference.
 - 2. Location of field offices shall be coordinated with OWNER and high school CONTRACTOR.
- C. Furnish in field office one complete set of the Contract Documents for ready reference by interested parties. In addition to the reference set, comply with Section 01 78 39, Project Record Documents.

PART 2 – PRODUCTS

2.1 FIELD OFFICE AND SHEDS, FURNISHINGS, AND EQUIPMENT

- A. Field Office and Furnishings:
 - 1. Construction: As required by CONTRACTOR and sufficient for Project meetings.
 - 2. Utilities and Services: Provide the following:
 - a. Telephone service.
 - b. Computer network and related facilities as required for CONTRACTOR needs.
 - c. Utilities and related facilities for lighting and maintaining temperature.
 - 2. Furnishings:
 - a. Furnishings required by CONTRACTOR.
 - 3. Provide on field office an exterior identification sign displaying CONTRACTOR's company name. Maximum size of sign shall be four feet by eight feet. Sign shall be suitable for outdoor use for the duration of the Project.
 - 4. Furnish and maintain at CONTRACTOR's field office five protective helmets for use by visitors to the Site.

B. Storage and Work Sheds:

1. Provide storage and work sheds sized, furnished, and equipped to accommodate personnel, materials, and equipment involved in the Work, including temporary utility services and facilities required for environmental controls sufficient for personnel, materials, and equipment.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation:

1. Install field offices, sheds, and related facilities in accordance with Laws and Regulations.
2. Install materials and equipment, including prefabricated structures, in accordance with manufacturer's instructions.

3.2 MAINTENANCE AND REMOVAL

A. Maintenance:

1. Clean and maintain field offices and sheds as required.
2. Provide consumables as required.

B. Removal:

1. Do not remove field offices and sheds until after Substantial Completion of the entire Work, unless otherwise approved by ENGINEER.
2. Remove field offices and sheds and restore areas prior to final inspection.

+ + END OF SECTION + +

SECTION 01 55 26

MAINTENANCE AND PROTECTION OF TRAFFIC

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall keep all streets and traffic ways open for passage of traffic and pedestrians during the Work, unless otherwise approved by owner of the street, traffic way, or right-of-way, as applicable.
2. Unless otherwise shown or indicated in the Contract Documents, maintenance and protection of traffic shall be in accordance with the Manual of Uniform Traffic Control Devices and MassDOT regulations.

B. Coordination:

1. Coordinate with owner of the highway or street right-of-way, as applicable, for maintenance and protection of traffic requirements.
2. Give required advance notice to fire departments, police departments, and other emergency services as applicable of proposed construction operations.
3. Give reasonable notice to owners or tenants of private property who may be affected by construction operations. Give such notice not less than 3 days prior to when such property will or may be affected by construction operations.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Procedure Submittals: Detailed plan, procedures, and sequencing for maintaining and protecting traffic in accordance with the Contract Documents and requirements of authorities having jurisdiction. Include in the submittal the following:
 - a. Traffic staging plan, and construction sequencing as applicable to maintenance and protection of traffic.
 - b. Product data, including manufacturer's catalog information and specifications, for temporary signage, temporary signals, temporary illumination devices, and other products to be utilized in maintaining and protecting traffic.
 - c. Indication of number and types of personnel dedicated to maintaining and protecting traffic during construction.
 - d. Indication of plan acceptance from authorities having jurisdiction.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment used for maintenance and protection of traffic shall comply with the reference specification indicated in Paragraph 1.1.A.2 of this Section.

PART 3 – EXECUTION

3.1 GENERAL PROVISIONS

- A. When required to cross, obstruct or temporarily close a street or traffic way, provide and maintain suitable bridges, detours, or other acceptable temporary expedient for the accommodation of traffic. Closings shall be for shortest duration practical, and passage shall be restored immediately after completion of filling and temporary paving or bridging.
- B. Provide signs, signals, barricades, flares, lights and other equipment, service, and personnel required to regulate and protect all traffic and warn of hazards. Such Work shall comply with requirements of OWNER and authorities having jurisdiction at the Site. Remove temporary equipment and facilities when no longer required, and restore grounds to original or to specified conditions, as applicable.
- C. Hydrants, valves, fire alarm boxes, postal boxes and delivery service boxes, and other facilities that may require access during construction shall be kept accessible for use.

3.2 TRAFFIC SIGNALS AND SIGNS

- A. Provide and operate traffic control and directional signals required to direct and maintain an orderly flow of traffic in areas under CONTRACTOR's control, and areas affected by construction operations.
- B. Provide traffic control and directional signs, mounted on temporary barriers or standard posts, at the following locations:
 - 1. Each change of direction of a roadway and at each crossroad.
 - 2. Detours and areas of hazard.
 - 3. Parking areas.
 - 4. Traffic entrance to and exit from each construction area.

3.3 UNIFORMED POLICE OFFICERS

- A. When construction operations encroach on traffic lanes, CONTRATOR shall make all arrangements with the Wilmington Chief of Police for the services of Uniformed Police Officers.

- B. The Chief of Police will assign Uniformed Police Officers from his department in the quantity and at the location(s) as determined to be necessary by the Chief of Police and as Uniformed Police Officers are available.
- C. The OWNER shall pay for all Uniformed Police Officers in accordance with Section 01 22 13, Measurement and Payment.

3.4 FLARES AND LIGHTS

- A. During periods of low visibility provide flares and lights for the following:
 - 1. To clearly delineate traffic lanes, to guide traffic, and to warn of hazardous areas.
 - 2. For use by Uniformed Police Officers directing traffic.
- B. Provide adequate illumination of critical traffic and parking areas.

3.5 PARKING CONTROL

- A. Control all CONTRACTOR-related vehicular parking at the Site to preclude interfering with: traffic and parking, access by emergency vehicles, OWNER's operations, and construction operations. Provide temporary parking facilities for the public, as required because of construction or operations.
- B. Control parking of construction and private vehicles at the Site as follows:
 - 1. Maintain free vehicular access to and through parking areas.
 - 2. Prohibit parking on or adjacent to access roads, and in non-designated areas.
 - 3. Construction vehicles shall possess current vehicle registration.
 - 4. Private vehicles shall park only in designated areas.

3.6 HAUL ROUTES

- A. Consult with authorities having jurisdiction to establish thoroughfares that will be used as haul routes and Site access.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to expedite traffic flow, and to minimize interference with normal traffic.

3.7 REMOVAL

- A. Maintain and protect traffic throughout the Project. Provide maintenance and protection of traffic measures at the Site until no longer required due to the progress of the Work. When no longer required, completely remove maintenance and protection of traffic measures and restore the Site to pre-construction condition or to condition required by the Contract Documents, as applicable.

+ + END OF SECTION + +

SECTION 01 57 05

TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide and maintain methods, equipment, and temporary construction as required to control environmental conditions at the Site and adjacent areas. Controls shall be in accordance with the Town's order of conditions. See Appendix A.
2. Maintain controls until no longer required.
3. Temporary controls include, but are not limited to, the following:
 - a. Erosion and sediment controls.
 - b. Dust control.
 - c. Control of water, including storm water runoff.
 - d. Pollution control.

B. Related Sections:

1. Section 31 23 16.13, Trenching.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions and recommendations of the following:

1. Wilmington Conservation Commission.
 - a. Order of Conditions
2. Massachusetts Department of Environmental Protection.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Erosion and sediment control plan.
2. Product Data:
 - a. Compost Filter Sock.
 - b. Inlet Filter Bag.
 - c. Dewatering Pump Discharge Filter Bag.

B. Informational Submittals: Submit the following:

1. Procedural Submittals:
 - a. Proposed dust control measures.

PART 2 – PRODUCTS

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

A. General:

1. Materials utilized for erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, and as shown or indicated in the Contract Documents.

B. Compost Filter Sock:

1. Filtration Media:
 - a. Compost used for compost filter sock filler material (filtration media) shall be sanitized, weed free, mature compost and derived from a well-decomposed source of organic matter.
 - b. Compost shall have no identifiable feedstock constituents or offensive odors. Compost shall be free of any refuse, contaminants or other materials toxic to plant growth.
 - c. Compost shall be produced using aerobic composting process and shall meet all local, state, and Federal quality requirements. Biosolids compost shall meet Code of Federal Regulations (CFR) 503, including time and temperature data.
 - d. Compost used for filtration media shall comply with the following. Test methods for the items below shall follow US Composting Council Test Methods for the Examination of Composting and Compost guidelines for laboratory procedures:
 - 1) pH: 5.0-8.0
 - 2) Particle Size: 99% passing a 2-inch sieve and a minimum of 70% greater than the 3/8-inch sieve.
 - 3) Moisture content of less than 60%.
 - 4) Material shall be relatively free (<1% by dry weight) of inert or foreign man made materials.
2. Compost Filter Sock:
 - a. Filter Sock shall utilize an outer layer of filtration mesh, and an inner layer of containment netting.
 - b. All layers shall collectively enclose the compost filtration media.
 - c. Product and Manufacturer:
 - 1) BioSock, by EnviroTech BioSolutions.
 - 2) FilterSoxx, by Filtrexx.
 - 3) Silt Sock, by Silt Sock Erosion Control Products.
 - 4) Or equal.
3. Wood Anchor Stakes:
 - a. Length: Three feet, minimum.
 - b. Material: 2-inch by 2-inch hardwood.

C. Protection of Storm Water Drainage Inlets and Catch Basins:

1. Inlet Filter Bag:
 - a. Product and Manufacturer: Provide one of the following for each drainage inlet or catch basin to be protected:
 - 1) Silt Sack, by Atlantic Construction Fabrics (ACF) Environmental
 - 2) Or equal.
 - b. Inlet filter bag permeability shall be not less than 40 gallons per square foot of bag area exposed to the flow. Fabric shall be woven polypropylene with double stitching to prevent bursting.
 - c. Inlet filter bags shall fit inside the drainage inlet or catch basin and shall be secured by the structure's grate or by other acceptable means.
- d. Inlet filter bags shall have means of removing inlet filter bag and the silt and sediment collected in the bag, without dumping filter bag's contents into the drainage inlet or catch basin.

D. Filter Bag on Dewatering Pump Discharge:

1. Provide filter bag on discharge of each dewatering pump drawing from an excavation. Filter bag is not required on pumps associated with dewatering wells.
2. Products and Manufacturers: Provide one of the following:
 - a. UltraTech Dewatering Bag, by Interstate Products.
 - b. Filter Bag, by US Fabrics.
 - c. Dewatering (Filter) Bag, Indian Valley Industries.
 - d. Or equal.
3. Size filter bags for maximum flow of the pump. Filter bags shall be specifically fabricated for use as a dewatering pump filter bag.
4. Provide sufficient spare filter bags for continuous dewatering operations.

PART 3 – EXECUTION

3.1 DUST CONTROL

A. Dust Control – General:

1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to acceptance of ENGINEER and approval of authorities having jurisdiction.
2. CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce on- and off-Site damage, nuisances, and health hazards associated with dust emissions. Control may be achieved by irrigation in which the Site shall be sprinkled with water until the surface is moist. Apply dust controls as frequently as required without creating nuisances such as excessive mud and ponding of water at the Site.
3. Remove dust from roadways and access roads at maximum intervals of seven days by mechanical brooming or other method acceptable to ENGINEER.

3.2 WATER CONTROL

- A. Water Control – General:
 - 1. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, and adjoining properties.
 - 2. Control fill, grading, and ditching to direct water away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff courses to prevent erosion, damage, or nuisance.
- B. Equipment and Facilities for Water Control: Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- C. Discharge and Disposal: Dispose of drainage water in manner to prevent flooding, erosion, and other damage to any and all parts of the Site and adjoining areas, and that complies with Laws and Regulations.

3.3 POLLUTION CONTROL

- A. Pollution Control – General:
 - 1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from construction operations.
 - 2. Equipment used during construction shall comply with Laws and Regulations.
- B. Spills and Contamination:
 - 1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.
 - 2. Excavate contaminated material and properly dispose of off-Site, and replace with suitable compacted fill and topsoil.
- C. Protection of Surface Waters: Implement special measures to prevent harmful substances from entering surface waters. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers.
- D. Atmospheric Pollutants:
 - 1. Provide systems for controlling atmospheric pollutants related to the Work.
 - 2. Prevent toxic concentrations of chemicals and vapors.
 - 3. Prevent harmful dispersal of pollutants into atmosphere.
- E. Solid Waste:
 - 1. Provide systems for controlling and managing solid waste related to the Work.
 - 2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
 - 3. Properly handle and dispose of solid waste.

3.4 EROSION AND SEDIMENT CONTROL

A. Installation and Maintenance of Erosion and Sediment Controls – General:

1. General:
 - a. Provide erosion and sediment controls as shown and indicated on the Drawings and elsewhere in the Contract Documents. Provide erosion and sediment controls as the Work progresses into previously undisturbed areas.
 - b. Installation of erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, unless otherwise shown or indicated in the Contract Documents.
 - c. Use necessary methods to successfully control erosion and sedimentation, including ecology-oriented construction practices, vegetative measures, and mechanical controls. Use best management practices (BMP) in accordance with Laws and Regulations, and regulatory requirements indicated in Article 1.2 of this Section, to control erosion and sedimentation during the Project.
 - d. Plan and execute construction, disturbances of soils and soil cover, and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation. Provide temporary measures for controlling erosion and sedimentation, as indicated in the Contract Documents and as required for the Project.
 - e. Where areas must be cleared for storage of materials or equipment, or for temporary facilities, provisions shall be made for regulating drainage and controlling erosion and sedimentation, subject to the ENGINEER'S approval.
 - f. Provide erosion and sediment controls, including stabilization of soils, at the end of each workday.
2. Coordination:
 - a. Coordinate erosion and sediment controls with this Section's requirements on water control.
 - b. Coordinate temporary erosion and sediment controls with construction of permanent drainage facilities and other Work to the extent necessary for economical, effective, and continuous erosion and sediment control.
3. Before commencing activities that will disturb soil or soil cover at the Site, provide all erosion and sediment control measures required by the Contract Documents for the areas where soil or soil cover will be disturbed.
4. In general, implement construction procedures associated with, or that may affect, erosion and sediment control to ensure minimum damage to the environment during construction. CONTRACTOR shall implement any and all additional measures required to comply with Laws and Regulations.
5. Vegetation Removal: Remove only those shrubs, grasses, and other vegetation that must be removed for construction. Protect remaining vegetation.
6. Access Roads and Parking Areas: When possible, access roads and temporary roads shall be located and constructed to avoid adverse effects on the

environment. Provisions shall be made to regulate drainage, avoid erosion and sedimentation, and minimize damage to vegetation.

7. Earthwork and Temporary Controls:
 - a. Perform excavation, fill, and related operations in accordance with Section 31 23 16.13, Trenching.
 - b. Control erosion to minimize transport of silt from the Site into existing waterways and surface waters. Such measures shall include, but are not limited to, using berms, silt fencing, baled straw silt barriers, gravel or crushed stone, mulching and soil stabilization, slope drains, and other methods. Apply such temporary measures to erodible materials exposed by activities associated with the construction of the Project.
 - c. Hold to a minimum the areas of bare soil exposed at one time.
 - d. Construct fills and waste areas by selectively placing fill and waste materials to eliminate surface silts and clays that will erode.
 - e. In performing earthwork, eliminate depressions that could serve as mosquito pools.
 - f. CONTRACTOR shall provide special care in areas with steep slopes, where disturbance of vegetation shall be minimized to maintain soil stability.
8. Inspection and Maintenance:
 - a. Periodically inspect areas of earthwork and areas where soil or soil cover are disturbed to detect evidence of the start of erosion and sedimentation; apply corrective measures as required to control erosion and sedimentation. Continue inspections and corrective measures until soils are permanently stabilized and permanent vegetation has been established
 - b. Inspect not less often than the frequency specified in Section 01 41 26, Stormwater Pollution Prevention Plan and Permit.
 - c. Repair or replace damaged erosion and sediment controls within 24 hours of CONTRACTOR becoming aware of such damage.
 - d. Periodically remove silt and sediment that has accumulated in or behind sediment and erosion controls. Properly dispose of silt and sediment.
9. Duration of Erosion and Sediment Controls:
 - a. Maintain erosion and sediment controls in effective working condition until the associated drainage area has been permanently stabilized.
 - b. Maintain erosion and sediment controls until the Site is restored and site improvements including landscaping, if any, are complete with underlying soils permanently stabilized.
10. Work Stoppage: If the Work is temporarily stopped or suspended for any reason, CONTRACTOR shall provide additional temporary controls necessary to prevent environmental damage to the Site and adjacent areas while the Work is stopped or suspended.
11. Failure to Provide Adequate Controls: In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and siltation, OWNER reserves the right to employ outside assistance or to use OWNER's own forces for erosion and sediment control. Cost of such work, plus engineering and inspection costs, will be deducted from monies due CONTRACTOR.

- B. Erosion and Sediment Control:
 - 1. Perform erosion and sediment control in accordance with Wilmington Conservation Commission Order of Conditions.
- C. Compost Filter Socks:
 - 1. Install compost filter socks in accordance with the requirements of this section and at the location(s) shown or indicated on the Drawings.
 - 2. Installation:
 - a. Install parallel to the base of the slope or other disturbed area. For slopes of 2:1, a second compost filter sock shall be installed at the top of the slope.
 - b. Stakes shall be installed through the middle of the compost filter sock on ten foot centers, using wooden stakes. When compost filter socks are used on pavement, heavy concrete blocks shall be used behind the compost filter sock to stabilize.
 - c. Embed wooden stakes in the ground to the depth necessary for proper controls; embed stakes to at least 16 inches below ground.
 - d. Where multiple sections of compost filter socks are required to form a continuous run, sections shall have a minimum overlap of 12 inches.
 - e. Loose compost may be backfilled along the upslope side of the compost filter sock, filling the seam between the soil surface and the sock.
 - 3. Inspection and Maintenance:
 - a. Inspect compost filter socks when rain is forecasted, following rain events, and daily during prolonged rainfall.
 - b. Maintain compost filter socks to provide adequate sediment holding capacity. Sediment shall be removed when sediment accumulation reaches one-half the original height of the barrier.
 - c. Repair, modify, or supplement compost filter sock installations as needed or as required by the ENGINEER.
- D. Protection of Storm Water Drainage Inlets and Catch Basins:
 - 1. Protect each drainage inlet and catch basin that has the potential to receive storm water runoff from exposed soils, and does not discharge into a storm water settlement basin.
 - 2. Install inlet filter bags inside of drainage inlet or catch basin in accordance with manufacturer's instructions. Secure inlet filter bag with the structure's grate or by other acceptable means.
 - 3. Inlet filter bags shall not pose any obstruction above the elevation of the drainage inlet or catch basin grate requiring barricades or flashers.
 - 4. When removing silt and sediment from inlet filter bag, do not dump filter bag's contents into the drainage inlet or catch basin.
 - 5. Remove silt and sediment from inlet filter bag, or replace inlet filter bag, when inlet filter bag is not more than half full.
- E. Filter Bag on Dewatering Pump Discharge:
 - 1. Provide dewatering of excavations in compliance with Division 31 Sections on earthmoving, excavation, and fill.

2. Locate filter bags and temporary pump discharge lines to avoid interfering with the public, use of private property, and OWNER's operations. Relocate filter bags and appurtenances when required.
3. Filter bag discharge shall be directed to appropriate storm water drainage route. Do not discharge into roadways, driveways, access roads, and overland. When temporary settlement basin is used, locate filter bags to discharge to temporary settlement basin when practicable.
4. Provide filter bag on discharge of each dewatering pump drawing from an excavation.
5. Securely attach filter bag to pump discharge pipe or hose.
6. Maintain, clean out, and replace filter bags as required.

3.7 REMOVAL OF TEMPORARY CONTROLS

A. Removals – General:

1. Upon completion of the Work, remove temporary controls and restore Site to specified condition; if condition is not specified, restore Site to pre-construction condition.
2. After soils are permanently stabilized, remove from the Site temporary erosion and sediment controls.

+ + END OF SECTION + +

SECTION 01 71 23

FIELD ENGINEERING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall provide field engineering services and professional services of the types indicated for the Project, including:
1. Furnishing civil, structural, and other professional engineering services specified or required to execute CONTRACTOR's construction methods.
 2. Developing and making all detail surveys and measurements required for construction; including slope stakes, batter boards, and all other working lines, elevations, and cut sheets.
 3. Providing materials required for benchmarks, control points, batter boards, grade stakes, structure and pipeline elevation stakes, and other items.
 4. Keeping a transit, theodolite, or total station (theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work.
 5. Being solely responsible for all locations, dimensions and levels. No data other than Change Order, Work Change Directive, or Field Order shall justify departure from dimensions and levels required by the Contract Documents.
 6. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.
 7. Providing such facilities and assistance necessary for ENGINEER to check lines and grade points placed by CONTRACTOR. Do not perform excavation or embankment work until all cross-sectioning necessary for determining payment quantities for Unit Price Work have been completed and accepted by ENGINEER.

1.2 CONTRACTOR'S SURVEYOR

- A. Employ or retain the services, as needed, at the Site a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work. Surveyor's tasks include, but are not necessarily limited to, the following:
1. Providing required surveying equipment, including transit or theodolite, level, stakes, and surveying accessories.
 2. Establishing required lines and grades for constructing all facilities, structures, pipelines, and site improvements.
 3. Preparing and maintaining professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the Work.

4. Prior to backfilling operations, survey, locate, and record on a copy of the Contract Documents accurate representation of buried Work and Underground Facilities encountered.
5. Complying with requirements of the Contract Documents relative to surveying and related work.

1.3 SUBMITTALS

- A. Informational Submittals: Submit the following:
 1. Surveying:
 - a. Complete plan for conducting survey work, submitted ten days prior to beginning survey Work.
 - b. Submit original field books within two days after completing survey Work.
 - c. Submit certified survey in accordance with this Section.
 2. Certificates: When requested by ENGINEER, submit certificate signed by surveyor certifying that elevations and locations of the Work comply with the Contract Documents. Explain all deviations, if any.
 3. Qualifications Statements:
 - a. Surveyor: Name and address of firm, and resumes of each surveyor and crew chief conducting the survey Work. Submit at least ten days prior to beginning survey Work. During the Project, submit resume for each new surveyor and crew chief employed by or retained by CONTRACTOR at least ten days prior to starting on the survey Work.

1.4 RECORDS

- A. Maintain at the Site a complete and accurate log of control and survey Work as it progresses.
 1. Survey data shall be in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in the locality where the Site is located. Original field notes, computations, and other surveying data shall be recorded by CONTRACTOR's surveyor in CONTRACTOR-furnished hard-bound field books. Completeness and accuracy of survey Work, and completeness and accuracy of survey records, including field books, shall be responsibility of CONTRACTOR. Failure to organize and maintain survey records in an appropriate manner that allows reasonable and independent verification of calculations, and to allow identification of elevations, dimensions, and grades of the Work, shall be cause for rejecting the survey records, including field books.
 2. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by ENGINEER.

- B. Upon completion of precast structures and major Site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of construction and locations and elevations of Underground Facilities encountered during the Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SURVEYING

- A. Reference Points:
 - 1. Refer to the General Conditions, as may be modified by the Supplementary Conditions, regarding reference points.
 - 2. OWNER's established reference points damaged or destroyed by CONTRACTOR will be re-established by OWNER at CONTRACTOR's expense.
 - 3. From OWNER-established reference points, establish lines, grades, and elevations necessary to control the Work. Obtain measurements required for executing the Work to tolerances specified in the Contract Documents.
 - 4. Establish, place, and replace as required, such additional stakes, markers, and other reference points necessary for control, intermediate checks, and guidance of construction operations.
- B. Surveys to Determine Quantities for Payment:
 - 1. For each application for progress payment, perform such surveys and computations necessary to determine quantities of Work performed or placed. Perform surveys necessary for ENGINEER to determine final quantities of Work in place.
 - 2. Notify ENGINEER at least 24 hours before performing survey services for determining quantities. Unless waived in writing by ENGINEER, perform quantity surveys in presence of ENGINEER.
- C. Construction Surveying: Comply with the following:
 - 1. Alignment Staking: Provide alignment stakes at 50-foot intervals on tangent, and at 25-foot intervals on curves.
 - 2. Slope Staking: Provide slope staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Re-stake at every ten-foot difference in elevation.
 - 3. Structure: Stake out structures, including elevations, and check prior to and during construction.
 - 4. Pipelines: Stake out pipelines including elevations, and check prior to and during construction.
 - 5. Road: Stake out roadway elevations at 50-foot intervals on tangent, and at 25-foot intervals on curves.
 - 6. Cross-sections: Provide original, intermediate, and final staking as required, for site work other locations as necessary for quantity surveys.

7. Easement Staking: Provide easement staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Also provide wooden laths with flagging at 100-foot maximum intervals.
8. Record Staking: Provide permanent stake at each blind flange and each utility cap is provided for future connections. Stakes for record staking shall be material acceptable to ENGINEER.

D. Accuracy:

1. Establish CONTRACTOR's temporary survey references points for CONTRACTOR's use to at least second-order accuracy (e.g., 1:10000). Construction staking used as a guide for the Work shall be set at least third-order accuracy (e.g., 1:5000). Basis on which such orders are established shall provide the absolute margin for error specified below.
2. Horizontal accuracy of easement staking shall be plus or minus 0.1 feet. Accuracy of other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.
3. Survey calculations shall include an error analysis sufficient to demonstrate required accuracy.

+ + END OF SECTION + +

SECTION 01 71 33

PROTECTION OF THE WORK AND PROPERTY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage, as specified in the General Conditions, Supplementary Conditions, and this Section.
2. To prevent damage, injury, or loss, CONTRACTOR's actions shall include the following:
 - a. Storing apparatus, materials, supplies, and equipment in an orderly, safe manner that does not unduly interfere with progress of the Work or work of other contractors or utility companies.
 - b. Providing suitable storage facilities for materials and equipment subject to damage or degradation by exposure to weather, theft, breakage, or other cause.
 - c. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work and existing construction.
 - d. Frequently removing and disposing of refuse, rubbish, scrap materials, and debris caused by CONTRACTOR's operations so that, at all times, the Site is safe, orderly, and workmanlike in appearance.
 - e. Providing temporary barricades and guard rails around the following: openings, scaffolding, temporary stairs and ramps, around excavations, for elevated walkways, and other hazardous areas.
3. Do not, except after written consent from proper parties, enter or occupy privately-owned land with personnel, tools, materials or equipment, except on lands and easements provided by OWNER.
4. CONTRACTOR has full responsibility for preserving public and private property and facilities on and adjacent to the Site. Direct or indirect damage done by, or on account of, any act, omission, neglect, or misconduct by CONTRACTOR in executing the Work, shall be restored by CONTRACTOR, at his expense to condition equal to that existing before damage was done.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 BARRICADES AND WARNING SIGNALS

A. Barricades and Warning Signals – General:

1. Where the Work is performed on or adjacent to roadway, access road, right-of-way, or public place:
 - a. Provide barricades, fences, lights, warning signs, danger signals, watchmen, and take other precautionary measures for protecting persons, property, and the Work.
 - b. Paint barricades to be visible at night.
 - c. From sunset to sunrise, furnish and maintain at least one light at each barricade.
 - d. Erect sufficient barricades to keep vehicles from being driven on or into Work under construction.
 - e. Furnish watchmen in sufficient numbers to protect the Work.
2. Provide temporary barricades to protect personnel and property for Work not in or adjacent to vehicular travel areas, including indoor work, in accordance with Laws and Regulations.
3. CONTRACTOR's responsibility for maintaining temporary barricades, signs, lights, and for providing watchmen shall continue until the Work is accepted in accordance with the Contract Documents.

3.2 TREE AND PLANT PROTECTION

- A. Tree and Plant Protection – General:
 1. Protect existing trees, shrubs, and plants on or adjacent to the Site, as directed by the ENGINEER, against unnecessary cutting, breaking, or skinning of trunk, branches, bark, and roots.
 2. Do not store materials or equipment or park construction equipment and vehicles within the foliage drip line.
 3. In areas subject to traffic, provide temporary fencing or barricades to protect trees and plants.
 4. Fires are not allowed.
 5. If branches or trunks are damaged, prune branches immediately and protect cut or damaged areas with emulsified asphalt compounded specifically for horticultural use, in manner acceptable to ENGINEER.

3.3 PROTECTION OF EXISTING STRUCTURES

- A. Underground Facilities:
 1. Underground Facilities known to OWNER and ENGINEER, except water, gas, sewer, electric, and communications services to individual buildings and properties, are shown. Information shown for Underground Facilities is the best available to OWNER and ENGINEER but, in accordance with the General Conditions, is not guaranteed to be correct or complete.

2. CONTRACTOR shall explore ahead of trenching and excavation Work and shall uncover obstructing Underground Facilities sufficiently to determine their location, to prevent damage to Underground Facilities, and to prevent service interruption to building or parcels served by Underground Facilities. If CONTRACTOR damages an Underground Facility, CONTRACTOR shall restore it to original condition, in accordance with requirements of the owner of the damaged facility and the General Conditions.
3. Necessary changes in the location of the Work may be directed by ENGINEER to avoid Underground Facilities not shown or indicated on the Contract Documents.
4. If permanent relocation of an existing Underground Facilities is required and is not otherwise shown or indicated in the Contract Documents, CONTRACTOR will be directed in writing to perform the Work. When the relocation Work results in a change in the Contract Price, Contract Time, contract modification procedures and payment for such Work shall be in accordance with the Contract Documents.

B. Surface Structures:

1. Surface structures are existing buildings, structures, and other facilities at or above ground surface, including their foundations or any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage, exposed piping and utilities, poles, exposed wires, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.
2. Existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, curbs, and fencing, that are temporarily removed to facilitate the Work shall be replaced and restored to their original condition at CONTRACTOR's expense.

C. Protection of Underground Facilities and Surface Structures:

1. CONTRACTOR shall sustain in their places and protect from direct or indirect injury all Underground Facilities and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility. Before proceeding with the Work of sustaining and supporting such structure or facility, CONTRACTOR shall satisfy ENGINEER that methods and procedures to be used have been approved by party owning same.
2. CONTRACTOR shall bear all risks attending the presence or proximity of all Underground Facilities and surface structures within or adjacent to limits of the Work, in accordance with the Contract Documents. CONTRACTOR shall be responsible for damage and expense for direct or indirect injury caused by his Work to structures and facilities. CONTRACTOR shall repair immediately damage caused by his Work, to the satisfaction of owner of damaged structure or facility.

3.4 PROTECTION OF INSTALLED MATERIALS, EQUIPMENT, AND LANDSCAPING

- A. Protect installed materials and equipment to prevent damage from subsequent operations. Remove protection facilities when no longer needed prior to completion of the Work.
- B. Control traffic to prevent damage to equipment, materials, and surfaces.
- C. Coverings:
 - 1. Provide coverings to protect materials and equipment from damage.
 - 2. Cover projections, wall corners and jambs, sills, and soffits of openings, in areas used for traffic and for passage of materials and equipment in subsequent work.

+ + END OF SECTION + +

SECTION 01 73 19

INSTALLATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section describes general requirements for installing materials and equipment. Additional installation requirements are included in the Specification Sections in Divisions 02 through 49.

1.2 QUALITY ASSURANCE

A. General:

1. Provide appropriate quality assurance for installing materials and equipment, and provide quality control over Suppliers, materials and equipment, services, Site conditions, and workmanship, to provide Work of the required quality.

B. Qualifications:

1. Installer: Installers shall be experienced in the types of Work required.

C. Regulatory Requirements: Comply with the following:

1. 29 CFR 1910, OSHA.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:

1. Installation Instructions and Requirements:

- a. Install materials and equipment in accordance with approved Shop Drawings and other approved CONTRACTOR submittals, the Contract Documents, and manufacturer's installation instructions. When manufacturer's installation instructions conflict with the Contract Documents, obtain interpretation or clarification from ENGINEER before proceeding.
- b. Manufacturer's installation instructions includes manufacturer's written instructions; drawings; illustrative, wiring and schematic diagrams; diagrams identifying external connections, terminal block numbers and internal wiring; and other such information pertaining to installation of

materials and equipment. Included are all of manufacturer's printed installation instructions, including those that may be attached to equipment.

2. Prior to installing materials and equipment, complete preparation of surfaces on which materials and equipment are to be installed. Prior to installing materials and equipment on new concrete, concrete shall achieve sufficient compressive strength to support the materials and equipment.
3. Maintain the work area in a broom-clean condition while installing materials and equipment.
4. Use proper tools to assemble materials and equipment. Do not deform or mar surface of shafts, nuts, and other parts.
5. Do not support rigging from building or structure without written permission of ENGINEER. CONTRACTOR is responsible for and shall repair damage to building or structure resulting from CONTRACTOR's operations.
6. During installation, maintain materials and equipment in neutral position and do not exert undue stress on materials and equipment.
7. Tighten connections requiring gaskets evenly all around to ensure uniform stress over entire gasket.
8. Use only an oil bath heater to expand couplings, gears, and other mechanical components to be expanded for installation. Do not force or drive couplings, gears, and other mechanical components onto equipment shafts, or subject such items to open flame or torch.
9. Do not alter or repair materials and equipment and do not burn or weld materials and equipment unless required in the Contract Documents or allowed by ENGINEER.
10. Provide plugs in lubrication holes to prevent entry of foreign matter.

B. Setting and Erection:

1. Wedging is not allowed. During installation, use the minimum number of shims required in leveling equipment. Provide shims, filling pieces, keys, packing, grout of the type required by the Contract Documents, and other materials and equipment necessary to properly align, level, and secure apparatus in place. Install materials and equipment plumb, level, true, and free of rack unless otherwise specified, and demonstrate plumbness and level to ENGINEER. Bring parts to proper bearing after installation and erection.
2. Using experienced millwrights, carefully set and align equipment on foundations, after equipment soleplates or baseplates, as applicable, have been shimmed to true alignment at anchorages. Set anchorages in place and tighten nuts against shims. Check bedplates or wing feet of equipment after securing to foundations and, after confirming alignments, grout soleplates or baseplates, as applicable, in place in accordance with the Contract Documents.
3. Anchorages:
 - a. Provide anchorage setting drawings in time to coordinate with fabrication of materials and equipment and the Work.
4. Ream misaligned holes. Do not "force" bolts or keys.
5. Where applicable, properly align equipment with associated piping and utility connections, without exerting undue stress on connecting piping and utilities.

C. Alignment and Leveling:

1. Verify that all shafts, couplings, and sheaves are properly aligned and adjust to required tolerances.
2. Align couplings while equipment is free from external loads.
3. Check angular and parallel alignment and record actual alignment and submit to ENGINEER. Alignment shall be within tolerances specified in Contract Documents and as recommended by Supplier of the material or equipment item.
4. Use laser indicators or dial indicators for checking angular and parallel alignment. Using dial indicators requires that, during rotation of half couplings in performance of test, dial indicator shall be maintained in same relative position, and dial indicator readings taken at same place on circumference of coupling.

D. Threaded Connections:

1. Apply a molybdenum disulfide, anti-seize compound to threads in mechanical connections such as bolts, studs, cap screws, tubing, and other threads, unless otherwise shown or indicated.

3.2 FIELD QUALITY CONTROL

A. Supplier's Services:

1. When specified, provide competent, qualified representatives of material or equipment Supplier to provide services required, including: supervising installation, checking the completed installation, adjusting, testing of materials and equipment, and where required instructing operations and maintenance personnel in the use and care of materials and equipment.

+ + END OF SECTION + +

SECTION 01 73 24

CONNECTIONS TO EXISTING FACILITIES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. This Section includes requirements for connections to existing facilities.
 - 2. CONTRACTOR shall provide labor, materials, tools, equipment, and incidentals shown, specified, and required for connections to existing facilities.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate Work that must be performed with or before the Work specified in this Section.
 - 2. Notify other contractors in advance of Work for connections to existing facilities to provide other contractors sufficient time for work included in their contracts that must be installed with or before Work specified in this Section.
- C. Related Sections:
 - 1. Section 01 73 29, Cutting and Patching.
- D. General:
 - 1. Requirements for cutting and patching are in Section 01 73 29, Cutting and Patching.
 - 2. To extent possible, materials, equipment, systems, piping, and appurtenances that will be placed into service upon completion of connection to existing facilities shall be checked, successfully tested, and in condition for operation prior to making connections to existing facilities, if valves, gates, or similar watertight and gastight isolation devices are not provided at the connection point.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
2. Provide cutting, coring, fitting and patching, including attendant excavation and fill, required to complete the Work, and to:
 - a. remove and replace defective Work;
 - b. remove samples of installed Work as specified or required for testing;
 - c. remove construction required to perform required alterations or additions to existing work;
 - d. uncover the Work for ENGINEER's observation of covered Work or observation by authorities having jurisdiction;
 - e. connect to completed Work not performed in proper sequence;
 - f. remove or relocate existing utilities and pipes that obstruct the Work in locations where connections must be made;
 - g. make connections or alterations to existing or new facilities.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:

1. Cutting and Patching Request:
 - a. Submit written request to ENGINEER, well in advance of executing cutting or alteration that affects one or more of the following:
 - 1) Design function or intent of Project.
 - 2) Work of OWNER or other contractors.
 - 3) Structural value or integrity of an element of the Project.
 - 4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 5) Efficiency, operational life, maintenance, or safety of operational elements.
 - 6) Visual qualities of sight-exposed elements.
 - b. Request shall include:
 - 1) Identification of Project and contract name and number.
 - 2) Description of affected Work of CONTRACTOR and work of others (if any).
 - 3) Necessity for cutting.

- 4) Effect on work of OWNER, other contractors (if any), and on structural or weatherproof integrity of Project.
 - 5) Description of proposed Work, describing: scope of cutting and patching; trades who will be executing the Work; products proposed to be used; extent of refinishing; schedule of operations; alternatives to cutting and patching, if any.
 - 7) Designation of entity responsible for cost of cutting and patching, when applicable.
 - 8) Written permission of other contractors (if any) whose work will be affected.
2. Recommendation Regarding Cutting and Patching:
 - a. Should conditions of work, or schedule, indicate a change of materials or methods, submit written recommendation to ENGINEER including:
 - 1) Conditions indicating change.
 - 2) Recommendations for alternative materials or methods.
 - 3) Items required with substitution request, in accordance with the substitution request requirements of the Contract Documents.
 3. Product Data:
 - a. Submit manufacturer's product data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
- B. Informational Submittals: Submit the following:
1. Submit written indication designating the day and time that the construction associated with cutting and patching will be uncovered, to provide for observation. Do not begin cutting or patching operations until submittal is accepted by ENGINEER.
- C. Comply with submittal requirements in the Division 02 through Division 49 Specifications for patching materials.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials - General:
1. Use materials in conformance with the Contract Documents.
 2. If not shown or indicated in the Contract Documents, use materials and products that are identical to existing materials and products affected by cutting and patching Work.
 3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, use materials whose installed performance will equal or surpass that of existing materials.

4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.
- B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
 1. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with solvent-free, two-component, epoxy protective coating.
 2. Product and Manufacturer: Provide one of the following:
 - a. Sikagard 62, by Sika Corporation.
 - b. Or equal.
- C. Mechanical Seals:
 1. Mechanical seals shall be modular, adjustable, bolted, mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. The seal shall be rated by the manufacturer for 40 feet of head or 20 psig. Mechanical seals shall be Link-Seal, manufactured by Thunderline Corp., Wayne, MI., or approved equal.

PART 3 – EXECUTION

3.1 GENERAL

- A. Perform cutting and coring in such manner that limits extent of patching.
- B. Structural Elements: Do not cut or patch structural elements in manner that would change structural element's load-carrying capacity as load deflection ratio.
- C. Operating Elements: Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.
- D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.

3.2 INSPECTION

- A. Examine surfaces to be cut or patched and conditions under which cutting or patching are to be performed before starting cutting or patching work.
- B. Report unsatisfactory or questionable conditions to ENGINEER in writing. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.3 PREPARATION

- A. Provide temporary support required to maintain structural integrity of Project, to protect adjacent Work from damage during cutting, and to support the element(s) to be cut.
- B. Protection of Existing Construction During Cutting and Patching:
 - 1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that will be exposed during cutting and patching operations.
 - 2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 - 3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.4 CORING

- A. Core-drill holes to be cut through concrete and masonry walls, slabs, or arches, unless otherwise accepted by ENGINEER in writing.
- B. Coring:
 - 1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
 - 2. Do not core-drill through electrical conduit or other utility lines embedded in walls or slabs without approval of ENGINEER. To extent possible, avoid cutting reinforcing steel in slabs and walls.
- C. Protection:
 - 1. Protect existing equipment, utilities, and adjacent areas from water and other damage covered by core-drilling operations.
 - 2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Section. Apply protective coating in accordance with manufacturer's instructions.
- D. Cleaning:
 - 1. Vacuum or otherwise remove slurry and tailings from the work area following core-drilling.

3.5 CUTTING

A. Cutting – General:

1. Cut existing construction using methods least likely to damage elements retained or adjoining construction, and that provide proper surfaces to receive installation or repair.
2. In general, use hand or small power tools suitable for sawing or grinding. Avoid using hammering and chopping when possible.
3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
4. Provide adequate bracing of area to be cut prior to start of cutting.
5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
6. Provide equipment of adequate size to remove cut panel.
7. Provide temporary covering over cut openings where not in use.

B. Cutting – Concrete and Masonry:

1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
2. On both the element being cut, provide for control of slurry generated during sawing.
3. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Section. Apply protective coating in accordance with manufacturer's instructions.

3.6 PATCHING

A. Patching – General:

1. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
2. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents.
3. Patch to provide airtight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
4. Where feasible, test patched areas to demonstrate integrity of installation.

B. Restoration:

1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
2. For continuous surfaces, refinish to nearest intersection.
3. For an assembly, refinish the entire unit that was patched.

4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

A. Cleaning and Restoration:

1. Clean areas and spaces where cutting, coring, or patching were performed.
2. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
3. Restore damaged coverings of pipe and other utilities to original condition.

+ + END OF SECTION + +

SECTION 01 75 11

CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall initially start up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.
2. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.
3. Provide chemicals, lubricants, and other required operating fluids.
4. Provide fuel, electricity, water, filters, and other expendables required for start-up of equipment, unless otherwise specified.
5. General Activities Include:
 - a. Cleaning, as required under other provisions of the Contract Documents.
 - b. Removing temporary protective coatings.
 - c. Flushing and replacing lubricants, where required by manufacturer.
 - d. Lubrication.
 - e. Checking shaft and coupling alignments and resetting where required.
 - f. Checking and setting motor, pump, and other equipment rotation, safety interlocks, and belt tensions.
 - g. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.
 - h. All adjustments required.
6. CONTRACTOR shall assume responsibility for providing temporary power in order to start up and initially operate the pump station, in accordance with Section 01 51 05 – Temporary Utilities.

B. Coordination:

1. Coordinate checkout and start-up with other contractors, as necessary.
2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
3. OWNER will provide sufficient personnel to assist CONTRACTOR in starting up equipment, but responsibility for proper operation is CONTRACTOR's.
4. Supplier shall be present during checkout, start-up, and initial operation, unless otherwise acceptable to ENGINEER.
5. Start-up of heating and air conditioning equipment and systems is dependent upon the time of year. Return to the Site at beginning of next heating or air

conditioning season (as applicable) to recheck and start the appropriate systems.

6. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by CONTRACTOR, in accordance with Section 01 78 23, Operations and Maintenance Data.

C. OWNER's Assumption of Responsibility for Equipment and Systems:

1. OWNER will assume responsibility for the equipment upon Substantial Completion.
2. Prior to turning over to OWNER responsibility for operating and maintaining system or equipment:
 - a. Provide training of operations and maintenance personnel in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 - b. Complete system field quality control testing in accordance with the Contract Documents.
 - c. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
 - d. Obtain from ENGINEER final certificate of Substantial Completion for either entire Work or the portion being turned over to OWNER.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:

1. Certifications:
 - a. Supplier's certification of installation in accordance with Paragraph 3.1.B of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SERVICES OF SUPPLIER

- A. When specified, furnish services of competent, qualified representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, start-up, and testing of materials and equipment.
- B. Certification:
 1. When services by Supplier are required at the Site, within 14 days after first test operation of equipment, submit to ENGINEER a letter from Supplier, on Supplier's letterhead, stating that materials and equipment are installed in accordance with Supplier's requirements and installation instructions, and in accordance with the Contract Documents.

2. In lieu of Supplier letter, submit completed form attached to this Section.
3. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.

3.2 MINIMUM START-UP REQUIREMENTS

- A. Motors:
 1. Check each motor for comparison to amperage nameplate value.
 2. Correct conditions that produce excessive current flow and conditions that exist due to equipment malfunction.
- B. Pumps:
 1. Check glands and seals for cleanliness and adjustment before running pump.
 2. Inspect shaft sleeves for scoring.
 3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
 4. Verify that piping system is free of dirt and scale before circulating liquid through pump.
- C. Valves:
 1. Inspect manual and automatic control valves, and clean bonnets and stems.
 2. Tighten packing glands to ensure no leakage, but allow valve stems to operate without galling.
 3. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
 4. Replace packing on valves that continue to leak.
 5. Remove and repair bonnets that leak.
 6. After cleaning, coat packing gland threads and valve stems with surface preparation of "Molycote" or "Fel-Pro".
- D. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.
- E. Tighten flanges and other pipe joints after system has been placed in operation. Replace gaskets that show signs of leakage after tightening.
- F. Inspect all joints for leakage:
 1. Promptly remake each joint that appears to be faulty; do not wait for rust or other corrosion to form.
 2. Clean threads on both parts, and apply compound and remake joints.
- G. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats, and headers in fluid system to ensure freedom from foreign matter.
- H. Open steam traps and air vents, where used, and remove operating elements. Clean thoroughly, replace internal parts, and place back into operation.

- I. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.
- J. Check each electrical control circuit to verify that operation complies with the Contract Documents.
- K. Inspect each pressure gauge, thermometer, and other instruments for calibration. Replace items that are defaced, broken, or that read incorrectly.
- L. Repair damaged insulation.

3.3 ATTACHMENTS

- A. The attachment listed below, following the “End of Section” designation, is a part of this Specification Section.
 - 1. Supplier’s Installation Certification Form (one page).

+ + END OF SECTION + +

SUPPLIER'S INSTALLATION CERTIFICATION

Contract No. and Name: _____

Equipment Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment: _____

The undersigned Supplier of the equipment described above hereby certifies that Supplier has checked the equipment installation and that the equipment, as specified in the Contract Documents, has been provided in accordance with the manufacturer's recommendations and the Contract Documents, and that the trial operation of the equipment has been satisfactory.

Comments: _____

Date

Supplier Name (print)

Signature of Supplier

Date

Contractor Name (print)

Signature of Contractor

SECTION 01 77 19

CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.1 GENERAL

- A. Scope:
 - 1. Section Includes.
 - a. Substantial Completion.
 - b. Final inspection.
 - c. Request for final payment.

1.2 SUBSTANTIAL COMPLETION

- A. Procedures for requesting and documenting Substantial Completion are in the General Conditions, as may be modified by the Supplementary Conditions.

1.3 FINAL INSPECTION

- A. Procedures for requesting and documenting the final inspection are in the General Conditions, as may be modified by the Supplementary Conditions.

1.4 REQUEST FOR FINAL PAYMENT

- A. Procedure:
 - 1. Submit request for final payment in accordance with the Agreement and General Conditions, as may be modified by the Supplementary Conditions, using procedure specified in Section 01 29 76, Progress Payment Procedures.
- B. Request for final payment shall include:
 - 1. Documents required for progress payments in Section 01 29 76, Progress Payment Procedures.
 - 2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.
 - 3. Releases or Waivers of Lien Rights:
 - a. When submitting releases or waivers of Lien rights, provide release or waiver by CONTRACTOR and each Subcontractor and Supplier that provided CONTRACTOR with labor, material, or equipment totaling \$1,000 or more.
 - b. Provide list of Subcontractors and Suppliers for which release or waiver of Lien is required.
 - c. Each release or waiver of Lien shall be signed by an authorized representative of the entity submitting release or waiver to

CONTRACTOR, and shall include Subcontractor's or Supplier's corporate seal, when applicable.

- d. Release or waiver of Lien may be conditional upon receipt of final payment.
4. In addition to documents required in the General Conditions and Supplementary Conditions regarding final payment, submit the following

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 23

OPERATIONS AND MAINTENANCE DATA

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.
2. Required operation and maintenance data groupings are listed in table(s) in Article 1.2 of this Section. At minimum, submit operation and maintenance data for:
 - a. All equipment and systems.
 - b. Valves, gates, actuators, and related accessories.
 - c. Instrumentation and control devices.
 - d. Electrical gear.
3. For each operation and maintenance manual, submit the following:
 - a. Preliminary Submittal: Printed and bound copy of entire operation and maintenance manual, except for test data, service reports by Supplier, and electronic copies.
 - b. Final Submittal: Printed and bound copy of complete operations and maintenance manual, including test data and service reports by Supplier, with electronic copies.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:

1. Operation and maintenance Data
 - a. Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as indicated in Table 01 78 23-A:

TABLE 01 78 23-A, REQUIRED OPERATIONS AND MAINTENANCE DATA

Name of O&M Manual/Data	For Materials or Equipment Specified in Section(s)
Sump Pump	22 13 33
Electrical Work	26 00 05
Process Valves, Four-inch Diameter and Larger	40 05 53
Submersible End Suction Pumps and Controls	43 21 39.13
Pump Control and Alarm Panel	40 60 05

B. Quantity Required and Timing of Submittals:

1. Preliminary Submittal:
 - a. Printed Copies: Three copies, exclusive of copies required by CONTRACTOR.
 - b. Electronic Copies: Two copies.
 - c. Submit to ENGINEER by the earlier of: ninety days following approval of Shop Drawings and product data submittals, or ten days prior to starting training of operations and maintenance personnel, or ten days prior to field quality control testing at the Site.
2. Final Submittal: Provide final submittal prior to Substantial Completion, unless submittal is specified as required prior to an interim Milestone.
 - a. Printed Copies: Three copies.
 - b. Electronic Copies: Two copies.

1.3 FORMAT OF PRINTED COPIES

A. Binding and Cover:

1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.
2. Binders shall be locking three-ring/"D"-ring type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front of each volume.
3. Do not overfill binders.
4. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
5. Provide the following information on cover of each volume:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - b. Name or type of material or equipment covered in the manual.
 - c. Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.
 - d. Name of Project and, if applicable, Contract name and number.
 - e. Name of building or structure, as applicable.
6. Provide the following information on spine of each volume:
 - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - b. Name or type of material or equipment covered in the manual.
 - c. Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.
 - d. Project name and building or structure name.

B. Pages:

1. Print pages in manual on 30-pound (minimum) paper, 8.5 inches by 11 inches in size.
2. Reinforce binding holes in each individual sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of the

manual, reinforcing of pages within booklet or pamphlet is not required.

3. Provide each page with binding margin at least one inch wide. Punch each page with holes suitable for the associated binding.

C. Drawings:

1. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing specified for pages.
2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.

D. Copy Quality and Document Clarity:

1. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals that contain copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable. Faxed copies are unacceptable.
2. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.

E. Organization:

1. Table of Contents:
 - a. Provide table of contents in each volume of each operations and maintenance manual.
 - b. In table of contents and at least once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identification is unacceptable.
2. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.4 FORMAT OF ELECTRONIC COPIES

A. Electronic Copies of Operation and Maintenance Manuals:

1. Each electronic copy shall include all information included in the corresponding printed copy.
2. Submit each electronic copy on a separate compact disc (CD), unless another electronic data transfer method or format is acceptable to ENGINEER.
3. File Format:

- a. Files shall be in “portable document format” (PDF). Files shall be electronically searchable.
- b. Submit separate file for each separate document in the printed copy.
- c. Within each file, provide bookmarks for the following:
 - 1) Each chapter and subsection listed in the corresponding printed copy document’s table of contents.
 - 2) Each figure.
 - 3) Each table.
 - 4) Each appendix.

B. Copies of Programming and Configuration Files:

1. Provide on CD copy of all software programming, such as programmable logic controller programs, prepared specifically for the Project. Third-party, licensed, commercially available software is excluded from requirements of this Article; submit copies of commercially-available, licensed, third-party software, where required, in accordance with the Contract Documents.
2. Submit on CD copies of system configuration prepared specifically for the Project, such as plant monitoring system and SCADA display configurations.
3. Submit programming and configuration files together with electronic copies of operation and maintenance data.

1.5 CONTENT

A. General:

1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
2. Completeness and Accuracy:
 - a. Operation and maintenance manuals that include language stating or implying that the manual’s content may be insufficient or stating that the manual’s content is not guaranteed to be complete and accurate are unacceptable.
 - b. Operations and maintenance manuals shall be complete and accurate.
 - c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.
3. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment

and proper responses to such alarm conditions.

- B. Submit written explanations of all safety considerations relating to operation and maintenance procedures.
- C. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
 - 1. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.
 - 2. Recommended schedule for each preventive maintenance task.
 - 3. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
 - 4. Table of alternative lubricants.
 - 5. Troubleshooting instructions.
 - 6. List of required maintenance tools and equipment.
- D. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
 - 1. Manufacturer's name, address, telephone number, fax number, and Internet website address.
 - 2. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
 - 3. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
 - 4. For each part or piece include the following information:
 - a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
 - b. Part name or description.
 - c. Manufacturer's part number.
 - d. Quantity of each part used in each assembly.
 - e. Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.
- E. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.
- F. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation.

Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

- G. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
- H. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.
- I. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
- J. Submit copy of warranty bond and service contract as applicable.
- K. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall maintain and submit to ENGINEER with record documents in accordance with the Specifications, General Conditions, and Supplementary Conditions.
- B. Maintenance of Record Documents:
 - 1. Maintain in CONTRACTOR's field office, in clean, dry, legible condition, complete sets of the following record documents: Drawings, Specifications, and Addenda; Shop Drawings, Samples, and other CONTRACTOR submittals, including records of test results, approved or accepted as applicable, by ENGINEER; Change Orders, Work Change Directives, Field Orders, photographic documentation, survey data, and all other documents pertinent to the Work.
 - 2. Provide files and racks for proper storage and easy access to record documents. File record documents in accordance with the edition of the Construction Specification Institute's "MasterFormat" used for organizing the Project Manual, unless otherwise accepted by ENGINEER.
 - 3. Make record documents available for inspection upon request of ENGINEER or OWNER.
 - 4. Do not use record documents for purpose other than serving as Project record. Do not remove record documents from CONTRACTOR's field office without ENGINEER's approval.
- C. Submittal of Record Documents:
 - 1. Submit to ENGINEER the following record documents:
 - a. Drawings.
 - b. Project Manual including Specifications and Addenda (bound).
 - 2. Prior to readiness for final payment, submit to ENGINEER one copy of final record documents. Submit complete record documents; do not make partial submittals.
 - 3. Submit record documents with transmittal letter on CONTRACTOR letterhead complying with letter of transmittal requirements in Section 01 33 00, Submittal Procedures.
 - 4. Record documents submittal shall include certification, with original signature of official authorized to execute legal agreements on behalf of CONTRACTOR, reading as follows:

“*[Insert Contractor's corporate name]* has maintained and submitted record documentation in accordance with the General Conditions and Supplementary Conditions, Section 01 78 39, Project Record Documents, and other elements of Contract Documents, for the Water and Sewer Department, Town of Wilmington, MA, Middlesex Avenue / Jefferson Road Pump Station, Sanitary Sewer Extension and Force Main. We certify that each record document

submitted is complete, accurate, and legible relative to the Work performed under our Contract, and that the record documents comply with the requirements of the Contract Documents.

[Provide signature, print name, print signing party's corporate title, and date]"

1.2 RECORDING CHANGES

A. General:

1. At the start of the Project, label each record document to be submitted as, "PROJECT RECORD" using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.
2. Keep record documents current. Make entries on record documents within two working days of receipt of information required to record the change.
3. Do not permanently conceal the Work until required information has been recorded.
4. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from ENGINEER-accepted record documents.
5. Marking of Entries:
 - a. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.
 - b. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files.
 - c. Date all entries on record documents.
 - d. Call attention to changes by drawing a "cloud" around the change(s) indicated.
 - e. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

B. Drawings:

1. Record changes on copy of the Drawings. Submittal of CONTRACTOR-originated or -produced drawings as a substitute for recording changes on the Drawings is unacceptable.
2. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.
3. Record actual construction including:
 - a. Depths of various elements of foundation relative to Project datum.
 - b. Horizontal and vertical location of Underground Facilities referenced to permanent surface improvements. For each Underground Facility, including pipe fittings, provide dimensions to at least two permanent, visible surface improvements.
 - c. Location of exposed utilities and appurtenances concealed in construction,

- referenced to visible and accessible features of structure.
- d. Changes in structural and architectural elements of the Work, including changes in reinforcing.
 - e. Field changes of dimensions, arrangements, and details.
 - f. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders.
 - g. Changes in details on the Drawings. Submit additional details prepared by CONTRACTOR when required to document changes.
4. Recording Changes for Schematic Layouts:
- a. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by CONTRACTOR subject to acceptance by ENGINEER.
 - b. Record on record documents all revisions to schematics on Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Contract. Record actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.
 - c. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items
 - 1) Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.
 - 2) Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.
 - 3) Descriptions shall be sufficiently detailed to be related to Specifications.
 - d. ENGINEER may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in ENGINEER’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.
5. Supplemental Drawings:
- a. In some cases, drawings produced during construction by ENGINEER or CONTRACTOR supplement the Drawings and shall be included with record documents submitted by CONTRACTOR. Supplemental record drawings shall include drawings provided with Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings due to space limitations.
 - b. Supplemental drawings provided with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.
 - c. When supplemental drawings developed by CONTRACTOR using computer-

aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings in AutoCAD 2011 format as part of record drawing submittal. Submit electronic files on compact disc labeled, "Supplemental Record Drawings", together with CONTRACTOR name, Project name, and Contract name and number.

C. Specifications and Addenda:

1. Mark each Section to record:
 - a. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually provided.
 - b. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01 79 23

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall furnish services of Supplier's operation and maintenance training specialists to instruct OWNER's personnel in recommended operation and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
2. Supplier shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.
3. OWNER reserves the right to record training sessions on video for OWNER's later use in instructing OWNER's personnel.

B. Scheduling of Training Sessions:

1. General:
 - a. CONTRACTOR shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to OWNER, in accordance with the Contract Documents.
 - b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to OWNER.
2. Prerequisites to Training:
 - a. Training of OWNER'S personnel shall commence after acceptable preliminary operation and maintenance data has been submitted and work required in Section 01 75 11, Checkout and Startup Procedures, is complete.
 - b. At option of OWNER or ENGINEER, training may be allowed to take place before, during, or after equipment start-up.
3. Training Schedule Submittal:
 - a. Training Schedule Required: CONTRACTOR shall prepare and submit proposed training schedule for review and acceptance by ENGINEER and OWNER. Proposed training schedule shall show all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of hours of training, number of training sessions, and scheduling.
 - c. Timing of Training Schedule Submittal: Submit initial training schedule at least seven days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with

ENGINEER's comments, no later than thirty days prior to starting the first training session.

- d. OWNER reserved the right to modify personnel availability for training in accordance with process or emergency needs at the Site.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer's instructors shall be factory-trained by manufacturer of material or equipment.
2. Manufacturer's instructors shall be proficient and experienced in conducting training of type required.
3. Qualifications of instructors are subject to acceptance by ENGINEER. If ENGINEER does not accept qualifications of proposed instructor, furnish services of replacement instructor with acceptable qualifications.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with time frames specified in this Section.

B. Informational Submittals: Submit the following:

1. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with Table 01 79 23-A and the Contract Documents. Lesson plan shall comply with requirements of this Section. Include with lesson plan copy of handouts that will be used during training sessions. Provide lesson plan submittals in accordance with time frames specified in this Section.
2. Qualifications: Credentials of manufacturer's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

C. Closeout Submittals: Submit the following:

1. Trainee sign-in sheet for each training session. Submit to OWNER's training coordinator.

1.4 LESSON PLAN

- A. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.

- B. Submit acceptable lesson plan seven days prior to starting associated training.
- C. Lesson plan shall include estimated duration of each training segment.
- D. Lesson plan shall include the following:
 - 1. Equipment Overview (required for all types of operations and maintenance training):
 - a. Describe equipment's operating (process) function and performance objectives.
 - b. Describe equipment's fundamental operating principles and dynamics.
 - c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
 - d. Identify all support equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.
 - e. Identify and describe safety precautions and potential hazards related to operation.
 - f. Identify and describe in detail safety and control interlocks.
 - 2. Operations Personnel Training:
 - a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
 - b. Operation:
 - 1) Describe operating principles and practices.
 - 2) Describe routine operating, start-up, and shutdown procedures.
 - 3) Describe abnormal or emergency start-up, operating, and shutdown procedures that may apply.
 - 4) Describe alarm conditions and responses to alarms.
 - 5) Describe routine monitoring and recordkeeping procedures.
 - 6) Describe recommended housekeeping procedures.
 - c. Troubleshooting:
 - 1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.
 - 3. Mechanical Maintenance Training:
 - a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
 - b. Equipment Preventive Maintenance:
 - 1) Describe preventative maintenance inspection procedures required to:
 - a) Inspect equipment in operation.
 - b) Identify potential trouble symptoms and anticipate breakdowns.
 - c) Forecast maintenance requirements (predictive maintenance).
 - 2) Define recommended preventative maintenance intervals for each component.
 - 3) Describe lubricant and replacement part recommendations and limitations.
 - 4) Describe appropriate cleaning practices and recommend intervals.
 - 5) Identify and describe use of special tools required for maintenance of equipment.

- 6) Describe component removal, installation, and disassembly and assembly procedures.
 - 7) Perform “hands-on” demonstrations of preventive maintenance procedures.
 - 8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
 - 9) Define recommended torquing, mounting, calibrating, and aligning procedures and settings, as appropriate.
 - 10) Describe recommended procedures to check and test equipment following corrective maintenance.
- c. Equipment Troubleshooting:
- 1) Define recommended systematic troubleshooting procedures.
 - 2) Provide component-specific troubleshooting checklists.
 - 3) Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
 - 4) Describe common corrective maintenance procedures with “hands on” demonstrations.
4. Instrumentation/Controls Maintenance Training:
- a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.

1.5 TRAINING AIDS

- A. Manufacturer’s instructor shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
1. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.
- B. Handouts:
1. Manufacturer’s instructor shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
 2. Photocopied handouts shall be good quality and completely legible.
 3. Handouts should be coordinated with the instruction, with frequent references made to the handouts.
 4. Provide number of copies of handouts determined by OWNER for each training session.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 TRAINING DELIVERY

A. General:

1. Instructors shall be fully prepared for the training sessions. Training delivery shall be communicative, clear, and proceed according to lesson plan accepted by ENGINEER, with lesson content appropriate for trainees. If OWNER or ENGINEER deems that training delivery does not to comply with the Contract Documents, training shall be postponed, rescheduled, and re-performed in acceptable manner at no additional cost to OWNER.
2. Trainee Sign-in Sheets: In format acceptable to OWNER, furnish sign-in sheet for trainees for each session. Sign-in sheets shall include the Project name, equipment or system for which training was provided, and type of training (e.g., operations, mechanical maintenance, instrumentation/controls maintenance, or other), and name of each trainee. Upon completion of training, submit copy of each sign-in sheet to OWNER's training coordinator.

B. "Hands-on" Demonstrations:

1. Manufacturer's instructor shall present "hands-on" demonstrations of operations and maintenance of equipment for each training session, in accordance with lesson plan accepted by ENGINEER.
2. CONTRACTOR and manufacturer shall furnish tools necessary for demonstrations.

3.2 TRAINING SCHEDULE

- A. Manufacturer shall furnish, at minimum, hours of training and number of sessions indicated in Table 01 79 23-A. Travel time and expenses are responsibility of manufacturer and are excluded from required training time indicated in the Contract Documents.

TABLE 01 79 23-A, TRAINING SUMMARY TABLE

Equipment	Specification Section	Total Training Time (hours)
Submersible End Suction Pumps and Controls	43 21 39.13	8
Instrumentation and Controls for Process Systems	40 60 05	8
Total		16

+ + END OF SECTION + +

SECTION 03 00 05

CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
2. The Work includes:
 - a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
 - b. Fabricating and placing reinforcing, including ties and supports.
 - c. Design, erection, and removal of formwork.
 - d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
 - e. Providing openings in concrete as required to accommodate Work under this and other Sections.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:

1. Class “A” concrete shall be steel-reinforced and includes all concrete unless otherwise shown or indicated.
2. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
 - a. Concrete fill.
 - b. Duct banks.
 - c. Unreinforced encasements.
 - d. Curbs and gutters.
 - e. Sidewalks.
 - f. Thrust blocks.

B. Related Sections:

1. Section 05 05 33, Anchor Systems.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. ACI 224R, Control of Cracking in Concrete Structures.
 2. ACI 301, Specifications for Structural Concrete for Buildings.
 3. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
 4. ACI 305R, Specification for Hot Weather Concreting.
 5. ACI 306R, Cold Weather Concreting.
 6. ACI 309R, Guide for Consolidation of Concrete.
 7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
 8. ACI 347, Guide to Formwork for Concrete.
 9. ACI SP-66, ACI Detailing Manual.
 10. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
 11. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 12. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 13. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
 14. ASTM C33/C33M, Specification for Concrete Aggregates.
 15. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 16. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 16. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
 17. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 18. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
 19. ASTM C150/C150M, Specification for Portland Cement.
 20. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
 21. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 22. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
 23. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 24. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
 25. ASTM C579, Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 26. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
 27. ASTM D1752, Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 28. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials

29. ASTM E154, Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
30. CRD-C 572, U. S. Army Corps of Engineers Specification for Polyvinylchloride Waterstops.
31. CRSI 1MSP, Manual of Standard Practice.

1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:

1. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
2. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
3. Perform the following testing on each trial batch:
 - a. Aggregate gradation for fine and coarse aggregates.
 - b. Slump.
 - c. Air content.
 - d. Compressive strength based on three cylinders each tested at seven days and at 28 days.
4. Submit for each trial batch the following information:
 - a. Project identification name and number (if applicable).
 - b. Date of test report.
 - c. Complete identification of aggregate source of supply.
 - d. Tests of aggregates for compliance with the Contract Documents.
 - e. Scale weight of each aggregate.
 - f. Absorbed water in each aggregate.
 - g. Brand, type, and composition of cementitious materials.
 - h. Brand, type, and amount of each admixture.
 - i. Amounts of water used in trial mixes.
 - j. Proportions of each material per cubic yard.
 - k. Gross weight and yield per cubic yard of trial mixtures.
 - l. Measured slump.
 - m. Measured air content.
 - n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
 - b. Laboratory Trial Batch Reports: Submit laboratory test reports for

- concrete cylinders, materials, and mix design tests.
- c. Concrete placement drawings showing the location and type of all joints.
- d. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI SP-66. For walls and masonry construction, provide elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.
- 2. Product Data:
 - a. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
- 3. Samples:
 - a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER, including names, sources, and descriptions.
- B. Informational Submittals: Submit the following:
 - 1. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94/C94M along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.
 - 2. Site Quality Control Submittals:
 - a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transportation, Delivery, and Handling:
 - 1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
 - 2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
 - 3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
 - 4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
- B. Storage:
 - 1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.

2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.
3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.
4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type II.
- B. Aggregates: ASTM C33/C33M.
 1. Fine Aggregate: Clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
 2. Coarse Aggregate:
 - a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter.
 - b. Coarse aggregate shall comply with the following:
 - 1) Crushed stone, processed from natural rock or stone.
 - 2) Washed gravel, either natural or crushed. Slag, pit gravel, and bank-run gravel are not allowed.
 - c. Coarse Aggregate Size: ASTM C33/C33M, Nos. 57 or 67, unless otherwise approved by ENGINEER.
- C. Water: Clean, potable.
- D. Admixtures:
 1. Air-Entraining Admixture: ASTM C260.
 2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 3. Water Reducing and Set-Adjusting Admixtures: ASTM C494/C494M, Types D and E.
 4. High Range Water-Reducing Admixture: ASTM C494/C494M, Type F/G.
 5. Use only admixtures that have been tested and approved in the mix designs.
 6. Do not use calcium chloride or admixtures containing chloride ions.

2.2 CONCRETE MIX

- A. General:
 1. Normal weight: 145 pounds per cubic foot.

2. Use air-entraining admixture in all concrete. Provide not less than four percent, nor more than eight percent, entrained air for concrete exposed to freezing and thawing, and provide from three to five percent entrained air for other concrete.
- B. Proportioning and Design of Class “A” Concrete Mix:
1. Minimum compressive strength at 28 days: 4,500 psi.
 2. Maximum water-cement ratio by weight: 0.42.
 3. Minimum cement content: 564 pounds per cubic yard.
- C. Proportioning and Design of Class “B” Concrete Mix:
1. Minimum compressive strength at 28 days: 3,000 psi.
 2. Maximum water-cement ratio by weight: 0.50.
 3. Minimum cement content: 517 pounds per cubic yard.
- D. Slump Limits:
1. Proportion and design mixes to result in concrete slump at point of placement of not less than one inch and not more than four inches.
 2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed eight inches at point of placement.
- E. Adjustment of Concrete Mixes:
1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
 2. Submit for ENGINEER’s approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
 3. Implement adjusted mix designs only after ENGINEER’s approval.
 4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.3 FORM MATERIALS

- A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.
- B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.
- C. Unexposed Concrete Surfaces: Material to suit project conditions.
- D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.

E. Form Ties:

1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon removal. Materials used for tying forms are subject to approval of ENGINEER.
2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.
4. Wire ties are unacceptable.

2.4 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.
- B. Welded Wire Fabric: ASTM A185/A185M.
- C. Steel Wire: ASTM A82/A82M.
- D. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
 2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
 3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
 4. Provide precast concrete supports over waterproof membranes.
- E. Adhesive Dowels:
1. Dowels:
 - a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
 2. Adhesive:
 - a. For requirements for adhesive, refer to Section 05 05 33, Anchor Systems.

2.5 RELATED MATERIALS

- A. Waterstops:
1. PVC Waterstops:

- a. Manufacturers: Provide products of one of the following:
 - 1) W.R. Meadows, Inc.
 - 2) Greenstreak Plastic Products Company.
 - 3) Or equal.
 - b. Waterstops shall comply with CRD-C 572. Do not use reclaimed or scrap material.
 - c. Minimum Thickness: 3/8-inch.
 - d. Provide waterstops with minimum of seven ribs equally spaced at each end on each side with the first rib located at the edge. Each rib shall be minimum 1/8-inch in height.
 - e. Construction Joints: Waterstops shall be six-inch wide flat-strip type.
 - f. Expansion Joints: Waterstops shall be nine-inch wide centerbulb type.
2. Hydrophilic Waterstops:
- a. Products and Manufacturers: Provide one of the following:
 - 1) Duroseal Gasket, by BBZ USA, Inc.
 - 2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
 - 3) Hydrotite, by Greenstreak Plastic Products Company.
 - 4) Or equal.
 - b. Hydrophilic waterstop materials shall be bentonite-free and shall expand by minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
 - c. Waterstop material shall be composed of resins and polymers that absorb water and cause a completely reversible and repeatable increase in volume.
 - d. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
 - e. Select material in accordance with manufacturer's recommendations for type of liquid to be contained.
 - f. Minimum cross-sectional dimensions: 3/16-inch by 3/4-inch.
 - g. Location of hydrophilic waterstops shall be as shown or indicated on the Drawings, or where approved by ENGINEER.
 - h. Hydrophilic Sealant: Shall adhere firmly to concrete, metal, and PVC in dry or damp condition and be indefinitely elastic when cured.
 - 1) Products and Manufacturers: Provide one of the following:
 - a) Duroseal Paste, by BBZ USA, Inc.
 - b) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
 - c) Hydrotite, by Greenstreak Plastic Products Company.
 - d) Or equal.

B. Membrane-Forming Curing Compound: ASTM C309, Type I.

C. Epoxy Bonding Agent:

- 1. Two-component epoxy resin bonding agent.
- 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
 - b. Eucopoxy LPL, by the Euclid Chemical Company.
 - c. Or equal.

- D. Epoxy-Cement Bonding Agent:
 - 1. Three-component blended epoxy resin-cement bonding agent.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sika Armatec 110 EpoCem, by Sika Corporation.
 - b. Duralprep A.C., by Euclid Chemical Company.
 - c. Or equal.
- E. Preformed Expansion Joint Filler:
 - 1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).
- F. Joint Sealant and Accessories:
 - 1. For joint sealants and accessories used on isolation joints, control joints, and expansion joints, refer to Section 07 92 00, Joint Sealants.

2.6 GROUT

- A. Non-shrink Grout:
 - 1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
 - 2. Minimum 28-day Compressive Strength: 7,000 psi.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. NS Grout by Euclid Chemical Company.
 - b. Set Grout by Master Builders, Inc.
 - c. NBEC Grout by Five Star Products, Inc.
 - d. Or equal.
- B. Epoxy Grout:
 - 1. Pre-packaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moisture-insensitive, three-component epoxy grouting system.
 - 2. Minimum Seven-day Compressive Strength: 14,000 psi, when tested in accordance with ASTM C579.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Euco High Strength Grout, by Euclid Chemical Company.
 - b. Sikadur 42, Grout Pak, by Sika Corporation.
 - c. Five Star Epoxy Grout, by Five Star Products, Inc.
 - d. Or equal.
- C. Grout Fill:
 - 1. Grout mix shall consist of cement, fine and coarse aggregates, water, and admixtures complying with requirements specified in this Section for similar materials in concrete.
 - 2. Proportion and mix grout fill as follows:
 - a. Minimum Cement Content: 564 pounds per cubic yard.
 - b. Maximum Water-Cement Ratio: 0.45.
 - c. Maximum Coarse Aggregate size: 1/2-inch, unless otherwise indicated.

- d. Minimum 28-day Compressive Strength: 4,000 psi.

PART 3 – EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

- A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.
- B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.
- C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.
- D. Removing Formwork:
 - 1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
 - 2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
 - 3. Removal time for formwork is subject to ENGINEER's acceptance.
 - 4. Repair form tie-holes following in accordance with ACI 301.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

- A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.
- B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.

- C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
 - 1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
 - 2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.
- D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, in accordance with the requirements of ACI 224R.
- F. Install welded wire fabric in lengths as long as practical, lapping adjoining sections a minimum of one full mesh.
- G. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.
- H. Joints:
 - 1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
 - 2. In walls, locate joints at a maximum spacing of 40 feet and approximately 12 feet from corners.
 - 3. In foundation slabs and slabs-on-grade, locate joints at intervals of approximately 40 feet.
 - 4. In mats and structural slabs and beams, locate joints in compliance with ACI 224R.
 - 5. Locations of joints shall be in accordance with the Contract Documents and as approved by ENGINEER in the Shop Drawings.
 - 6. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.
- I. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-

place concrete. Use setting diagrams, templates, and instructions provided under other Sections and, when applicable, other contracts for locating and setting. Refer to Paragraph 1.1.B of this Section. Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.

J. Adhesive Dowels:

1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer's installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
2. Drill holes to adhesive system manufacturer's recommended diameter and depth to develop required tensile strength. Holes shall not be more than 1/4-inch greater than nominal bar diameter, and hole depth shall not be less than twelve times nominal bar diameter. Hammer-drill holes. Cored holes are not allowed.
3. Embedment depths shall be based on concrete compressive strength of 2,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
4. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by ENGINEER.
5. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive is placed, but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.
7. Twist dowels during insertion into partially-filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

- A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.
- B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.
- C. Concrete Placing:

1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
 2. Do not begin placing concrete until work of other trades affecting concrete is completed.
 3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
 4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
 5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
 6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients.
- D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.
- E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
1. In hot weather comply with ACI 305R.
 2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

- A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.
- B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
- C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.
- D. Repair, removal and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

- A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall

not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:

1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.
2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten-foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
4. Use trowel finish for the following:
 - a. Interior exposed slabs, unless otherwise shown or indicated.
 - b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.

B. Formed Finish:

1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.
2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

3.8 GROUT PLACING

- #### A.
- Place grout as shown and indicated, and in accordance with grout manufacturer's instructions and recommendations. If grout manufacturer's instructions conflict with the Contract Documents, notify ENGINEER and not proceed until obtaining ENGINEER's clarification.

- B. Dry-packing is not allowed, unless otherwise indicated.
- C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in ensuring proper use of grout materials at the Site.
- D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

+ + END OF SECTION + +

SECTION 05 05 33

ANCHOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
 - 2. This Section includes all anchor systems required for the Work, but not specified under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ACI 318, Building Code Requirements for Structural Concrete.
 - 2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
 - 3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
 - 4. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 5. ASTM A276, Specification for Stainless Steel Bars and Shapes.
 - 6. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
 - 7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
 - 8. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 9. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 10. ASTM C307, Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
 - 11. ASTM C579, Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 12. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - 13. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.
 - 14. ASTM D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

15. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
16. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
17. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
18. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
20. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).
21. FS A-A-1923A, Concrete Expansion Anchors.
22. FS A-A-1925A, Shield, Expansion (Nail Anchors).
23. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).
24. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
25. ICC-ES AC58, Acceptance Criteria for Adhesive Anchors in Masonry Elements.
26. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
27. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
28. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.
29. ANSI/MSS SP-58, Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
30. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
2. Post-installed Anchor Installer: Shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.

2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.
 - b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection:
 1. Keep materials dry during delivery and storage.
 2. Store adhesive materials within manufacturer's recommended storage temperature range.
 3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. General:
 1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.
 2. Stainless Steel Nuts:
 - a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.
 - b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.
 3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:
 - a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.
 - b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load based on values and requirements in manufacturer's load tables. Alternately, capacity may be based on tension and shear strength capacities determined by independent testing laboratory retained by manufacturer or CONTRACTOR, using minimum safety factor of four.
 - 1) Determine capacity considering reductions due to embedment length, strength of base fastening materials, spacing, and edge distance.
2. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
 - a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
 - b. Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
 - c. Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.
 - d. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents.

C. Application:

1. Anchor Bolts:
 - a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
 - b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
2. Concrete Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Suitable for use in submerged, intermittently submerged, or buried locations.
 - e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
 - f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
3. Concrete Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in concrete.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
 - d. Do not use in submerged, intermittently submerged, or buried locations.
 - e. Suitable for use in overhead applications.
4. Drop-in Expansion Anchors:
 - a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use at submerged, intermittently submerged, or buried locations.
 - e. Do not use in exterior locations or locations subject to freezing.
 - f. Suitable for use in overhead applications.
5. Concrete Undercut Anchors:
 - a. Use where undercut anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Do not use in submerged, intermittently submerged, or buried locations.
 - d. Do not use in exterior locations or locations subject to freezing.
 - e. Suitable for use in overhead applications.
6. Concrete Inserts:
 - a. Use only where shown or indicated in the Contract Documents.

- b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.
- 7. Drive-In Expansion Anchors:
 - a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use in overhead applications.
- 8. For Use in Precast Concrete Planks:
 - a. To support piping or conduit six-inch diameter and smaller, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.
 - b. For piping greater than six-inch diameter, or to support safety-related systems, use through-bolts. Each through-bolt shall consist of threaded rod, nuts, washers, and bearing plate.

2.2 MATERIALS

A. Anchor Bolts:

- 1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade 36, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.
- 2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.
 - a. Stainless steel straight threaded rod shall comply with ductility requirements of ACI 350 or ACI 318 Appendix D, Section D.3.3.
- 3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.
- 4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.

B. Concrete Adhesive Anchors:

- 1. General:
 - a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
- 2. Products and Manufacturers: Provide one of the following:

- a. HIT-RE 500-SD Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
 - b. SET-XP Epoxy-Tie Adhesive, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Adhesive:
- a. Adhesive system shall use two-component adhesive mix.
 - b. Epoxy adhesives shall comply with physical requirements of ASTM C881/C881M, Type IV, Grade 2 and 3, Class A, B, and C, except gel times.
 - c. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308.
 - d. Adhesives shall have minimum bond strength and minimum design bond strength (bond strength multiplied by strength reduction factor) in accordance with Table 05 05 33-A:

TABLE 05 05 33-A:
ADHESIVE BOND STRENGTH^{1,2}

Anchor	Uncracked Concrete		Cracked Concrete	
Rod Diameter / Dowel Size	Bond Strength (psi)	Design Bond Strength (psi)	Bond Strength (psi)	Design Bond Strength (psi)
3/8-inch / #3	2040	1300	1090	700
1/2-inch / #4	1920	1200	920	560
5/8-inch / #5	1830	1150	710	390
3/4-inch / #6	1760	1050	710	460
7/8-inch / #7	1670	900	610	340
1-inch / #8	1650	1050	850	460
- / #9	1900	1000	800	400
1.25-inch / #10	1580	1000	730	400

Table Notes:

1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 110 degrees F and maximum long term concrete temperature of 75 degrees F.

4. Anchor:
- a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

C. Concrete Wedge Expansion Anchors:

1. General:

- a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.
 2. Products and Manufacturers: Provide one of the following:
 - a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
 - b. Or equal.
 3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4.
 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.
 4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
 6. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.
- D. Drop-in Expansion Anchors:
1. General:
 - a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
 2. Products and Manufacturers: Provide one of the following:
 - a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
 - b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.
- E. Concrete Undercut Anchors:
1. General:
 - a. Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.
 2. Products and Manufacturers: Provide one of the following:
 - a. HDA Undercut Anchor, by Hilti Fastening Systems, Inc.
 - b. DUC Ductile Undercut Anchor, by USP Structural Connectors.
 - c. Or equal

3. Provide concrete undercut expansion anchors in accordance with ACI 318 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests.
4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.
5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM B633.
6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.
7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

F. Concrete Inserts:

1. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation.
 - b. Cooper B-Line, Inc.
 - c. Anvil International, Inc.
 - d. Or equal.
2. Spot Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.
3. Continuous Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.
4. Provide inserts with plain finish.

G. Drive-In Expansion Anchors:

1. General:
 - a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
2. Products and Manufacturers: Provide one of the following:
 - a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
 - b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.

3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.
- H. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.
- I. Anti-Seizing Compound:
 1. Products and Manufacturers: Provide one of the following:
 - a. Pure Nickel Never-Seez, by Bostik.
 - b. Nickel-Graf, by Anti-Seize Technology.
 - c. Or equal.
 2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Anchor Bolts:
 1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
 2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
 3. Protect threads and shank from damage during installation and subsequent construction operations.
 4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05 05 33-B:

**TABLE 05 05 33-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS ¹**

Bolt Diameter (inch)	F1554 Grade 36				F1554			
	F593 Type 316, Condition A				Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ^{3,4} (lb)	Tension ³ (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ³ (lb)	Tension ³ (lb)
1/2	6	9	947	1,815	8.5	12.75	1,245	2,393
5/8	7.5	11.25	1,508	2,895	10.5	15.75	1,980	3,810
3/4	9	13.5	2,231	4,290	13	19.5	2,933	5,640
7/8	10.5	15.75	3,080	5,918	15	22.5	4,050	7,793
1	12	18	4,040	7,770	17	25.5	5,318	10,088
1 1/8	13.5	20.25	5,090	9,789	19	28.5	8,930	12,435
1.1/4	15	22.5	6,463	12,429	21	31.5	8,505	15,030

Table Notes:

1. Table is based on ACI 318 and ACI 350, Appendix D, $f'_c = 4000$ psi. Table 05 05 33-B is not applicable to anchor bolts embedded in grouted masonry.
2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 and ACI 350, Appendix D.
3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318 and ACI 350, Appendix D.

B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:

1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:

1. Comply with manufacturer's written installation instructions and the following.
2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.

5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.
9. Limitations:
 - a. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.
 - b. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.
 - c. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

D. Expansion Anchors:

1. Comply with expansion anchor manufacturer's written installation instructions and the following:
2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.

5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.
- E. Concrete Undercut Anchors:
1. Comply with undercut anchor manufacturer's written installation instructions and the following.
 2. Protect threads from damage during anchor installation.
 3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.
 4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
 5. Insert the anchor by hand until anchor reaches bottom of hole.
 6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.
 7. Verify that the setting mark is visible on the threaded rod above the sleeve.
 8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.
- F. Concrete Inserts:
1. Comply with concrete insert manufacturer's installation instructions.
 2. Inserts shall be flush with slab bottom surface.
 3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
 4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.
- G. Anti-Seizing Compound:
1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
 2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING

- A. After embedding concrete is placed, remove protection and clean bolts and inserts.

+ + END OF SECTION + +

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish miscellaneous metal fabrications including surface preparation and shop priming.
 - 2. The Work also includes:
 - a. Providing openings in miscellaneous metal fabrications to accommodate the Work under this and other Sections, and attaching to miscellaneous metal fabrications all items such as sleeves, bands, studs, fasteners, and all items required for which provision is not specifically included under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the Work to be installed with, or attached to miscellaneous metal fabrications Work.
- C. Related Sections:
 - 1. Section 05 05 33, Anchor Systems.
 - 2. Section 09 91 00, Painting,

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ANSI A14.3, Ladders – Fixed –Safety Requirements.
 - 2. ANSI Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
 - 3. ASTM A36/A36M, Specification for Carbon Structural Steel.
 - 4. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 5. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 6. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 7. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
 - 8. ASTM A320/A320M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.

9. ASTM A384/A384M-02 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
10. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
11. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
12. ASTM A793, Specification for Rolled Floor Plate, Stainless Steel.
13. ASTM A992/A992M, Specification for Structural Steel Shapes.
14. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
15. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
16. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
17. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
18. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
19. ASTM B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate.
20. AWS D1.1/D1.1M, Structural Welding Code – Steel.
21. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
22. AWS D1.6, Structural Welding Code – Stainless Steel.
23. NAAMM, Metal Finishes Manual.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Welding:

- a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, or D1.6, as applicable.
- b. When requested by ENGINEER, provide certification that each welder employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

B. Regulatory Requirements: Conform to the following:

1. 29 CFR 1910, Occupational Health and Safety Standards.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Fabrication and erection details for assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for locating and installing miscellaneous metal items and anchorage devices.

2. Product Data:
 - a. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.
- B. Informational Submittals: Submit the following:
 1. Test and Evaluation Reports:
 - a. Mill test report that indicate chemical and physical properties of each type of material, when requested by ENGINEER.
 2. Qualifications Statements:
 - a. Copies of welder's certifications, when requested by ENGINEER.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in other construction in ample time to prevent delaying the Work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Steel:
 1. W-Shapes and WT-Shapes: ASTM A992/A992M.
 2. S-Shapes and Channels: ASTM A572/A572M, Grade 50.
 3. Hollow Structural Sections: ASTM A500, Grade B.
 4. Angles, Plates, Bars: ASTM A36/A36M.
 5. Steel Pipe: ASTM A53/A53M, Grade B.
- B. Aluminum:
 1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B 221, Alloy 6061-T6.
 2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
 3. Aluminum Bars and Rod: ASTM B211, Alloy 6061-T6.
 4. Aluminum Plates: ASTM B209, Alloy 6061-T6.
- C. Stainless Steel:
 1. Plates and Sheets: ASTM A240/A240M, Type 304L or Type 316 stainless steel.
 2. Submerged or Intermittently Submerged: Type 316 stainless steel.
 3. Non-submerged: Type 304L stainless steel.
- D. Stainless Steel Fasteners and Fittings: ASTM A 320/A 320M, Type 304L or Type 316 Stainless Steel.

- E. Zinc-coated Hardware: ASTM A153/A153M.

2.2 MISCELLANEOUS METAL ITEMS

A. Shop Assembly:

1. Pre-assemble items in the shop to the greatest extent possible to minimize field-splicing and field-assembly of units at the Site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Aluminum Ladders:

1. Fabricate ladders for locations shown or indicated with dimensions, spacing, details, and anchorages as shown and specified. Comply with OSHA 29 CFR 1910 and ANSI A14.3, except as otherwise shown or specified.
 - a. Unless otherwise shown, provide 1.5-inch diameter continuous side rails, spaced at least 1.5 feet apart.
 - b. Provide extruded square rungs, spaced maximum of 12 inches on centers, with non-slip surface on top of each rung. Adhesive strips for non-slip surfaces are not acceptable.
2. Fit rungs in centerline of side rails, plug weld, and grind smooth on outer rail faces.
3. Support each ladder at top and bottom and at intermediate points spaced not more than five feet on centers.
4. Use welded or bolted brackets, designed for adequate support and anchorage, and to hold ladder clear of wall surface with minimum of seven inches between wall and centerline of rungs.
5. Unless otherwise shown or approved by ENGINEER, extend rails 3.5 feet above top rung, and return rails to wall or structure, unless other secure handholds are provided. If adjacent structure does not extend above top rung, goose-neck extended rails back to structure to provide secure ladder access.
6. Use extruded aluminum conforming to alloy and temper 6061-T6.

C. Safety Post:

1. Provide safety post for each fixed access ladder located below an access hatch. Safety post shall be manufactured of high-strength structural material with telescoping tubular section that locks automatically when fully extended.
2. Products and Manufacturers: Provide products of one of the following:
 - a. LadderUP Safety Post by Bilco Company
 - b. Or equal.
3. Use upward and downward movement of post shall be controlled by stainless steel spring balancing mechanism.
4. Safety post shall be aluminum with mill finish.

D. Manhole Steps:

1. Provide manhole steps as shown on the Drawings. Conform to requirements of 29 CFR 1910 and ANSI A14.3.
2. Products and Manufacturers: Provide one of the following:

- a. R-1982-W, manufactured by Neenah Foundry Company.
 - b. Or equal.
- 3. Vertical separation of steps shall be uniform at maximum of 12 inches on centers. Steps shall project evenly from manhole or chamber walls.
- 4. Material: Extruded aluminum.
- E. Miscellaneous Framing and Supports:
 - 1. Provide miscellaneous metal framing and supports that are not part of structural steel framework and are required to complete the Work.
 - 2. Fabricate miscellaneous units to sizes, shapes, and profiles shown on the Drawings or, if not shown, of required dimensions to receive adjacent grating, plates, tanks, doors, and other work to be retained by the framing.
 - 3. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all-welded construction using mitered corners, welded brackets, and splice plates and minimum number of joints for field connection.
 - 4. Cut, drill, and tap units to receive hardware and similar items to be anchored to the Work.
 - 5. Furnish units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units are to be installed after concrete is placed.
 - a. Except as otherwise shown, space anchors, 2.0 feet on centers, and provide units the equivalent of 1.25-inch by 1/4-inch by eight-inch strips.
 - b. Galvanize exterior miscellaneous frames and supports.
 - c. Where shown or indicated, galvanize miscellaneous frames and supports that are not to be installed outdoors.
 - 6. Miscellaneous steel framing and supports shall be hot-dip galvanized and finish-painted to suit the environment, unless otherwise shown or indicated.
- F. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.
- G. Anchors and Expansion Anchors: Refer to Section 05 05 33, Anchor Systems.

2.3 FINISHING

- A. Surface Preparation and Shop Priming: Perform surface preparation and apply primer coat to miscellaneous metal fabrications in the shop. Conform to surface preparation and shop priming requirements in Section 09 91 00, Painting.
- B. Galvanizing:
 - 1. Galvanizing of fabricated steel items shall comply with ASTM A123/A123M.
- C. Aluminum Finish: Provide natural mill finish for aluminum Work unless otherwise shown or specified.

2.4 SOURCE QUALITY CONTROL

A. Tests and Inspections:

1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures complying with the Contract Documents.

PART 3 – EXECUTION

3.1 EXAMINATION

- ### A.
- Examine conditions under which the Work is to be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- ### A.
- Install miscellaneous metal fabrications accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry, or other construction.
- ### B.
- Anchor securely as shown and as required for the intended use, using concealed anchors where possible.
- ### C.
- Fit exposed connections accurately together to form tight, hairline joints. Field-weld steel connections that are not to be exposed joints and cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1/D1.1M, D1.2/D1.2M and D1.6, as applicable to the material being welded. Grind steel joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- ### D.
- Protection of Aluminum from Dissimilar Materials:
1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, with a coat of bituminous paint in accordance with Section 09 91 00, Painting.

+ + END OF SECTION + +

SECTION 05 54 63

FLOOR ACCESS HATCH COVERS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install floor access hatch covers.
 - 2. The Work also includes:
 - a. Providing openings in and attachments to floor access hatch covers to accommodate the Work under this and other Sections, and providing for floor access hatch covers items such as anchorage devices, and all items required for which provision is not specifically included under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items to be installed with or before floor access hatch covers Work.
- C. Related Sections:
 - 1. Section 33 05 1, Manholes and Structures.

1.2 REFERENCES

- A. Standards referenced in this Section:
 - 1. AASHTO Standard Specifications for Highway Bridges.
 - 2. MIL-P-21035B, Military Specification, Paint, High Zinc Dust Content Galvanizing Repair.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Manufacturer shall have not less than five years experience producing products substantially similar to those specified and, upon ENGINEER's request, shall submit documentation of not less than five satisfactory installations in place for not less than five years each.
- B. Component Supply and Compatibility:
 - 1. Obtain all products included in this Section regardless of the component manufacturer from a single floor access hatch covers manufacturer. Furnishing covers from more than one manufacturer is unacceptable.

2. Floor access hatch covers manufacturer shall prepare, or shall review and approve, all Shop Drawings and other submittals for all components furnished under this Section.
3. Components shall be suitable for specified service conditions and shall be integrated into the overall assembly by the floor access hatch covers manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Detailed plans and other drawings showing location of products and direction of door swing; floor access hatch cover schedules indicating cover location, material, type, loading capacity, and other information; and fabrication details for the access hatch covers Work, including materials, thickness of metals, finishes, latching or locking provisions, type of anchorages, and accessory items.
 2. Product Data:
 - a. Copies of manufacturer's literature and specifications for each type of floor access hatch incorporated in the Work.
- B. Informational Submittals: Submit the following:
 1. Supplier Instructions:
 - a. Installation data, including setting drawings and templates.
 2. Qualifications Statements:
 - a. Manufacturer, when requested by ENGINEER.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping:
 1. Protect mill finish and other finish during shipping and installation by an attached, adhesive-backed vinyl material that is removable during and after installation of the access hatch cover.
- B. Storage and Protection:
 1. Protect steel members and packaged materials from corrosion and deterioration.

1.5 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. The obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.

B. Special Warranty:

1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace structural components of the products specified in this Section found to have defect in material and workmanship during a period of five years after the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 GENERAL

A. General:

1. Provide manufacturer's standard fabricated access hatch cover units, modified when necessary to comply with the Contract Documents. Where standard units are not available for the sizes and types required, provide custom-fabricated units of the same quality as manufacturer's similar standard-sized units.
2. Fabricate each access hatch cover unit in the shop, complete with anchors, gaskets, hardware, and accessory items, as required.

B. Provide floor access hatch covers in accordance with the contract documents.

2.2 CHANNEL-FRAME TYPE ACCESS HATCH COVERS

A. Aluminum Floor Access Hatch Covers (H-20 Loading) – Channel Frame Type:

1. Design Live Load: H-20 truck loading in accordance with AASHTO Standard Specifications for Highway Bridges, intended for use in off-street locations that may occasionally be subject to H-20 wheel loads.
2. Products and Manufacturers: Provide one of the following:
 - a. Single-Leaf Door Aluminum Access Hatch Cover:
 - 1) Model THS, by U.S.F Fabrication.
 - 2) Type J-AL H-20, by The Bilco Company.
 - 3) Or equal.
 - b. Double-Leaf Door Aluminum Access Hatch Cover:
 - 1) Model THD, by U.S.F Fabrication.
 - 2) Type JD-AL H-20, by The Bilco Company.
 - 3) Or equal.
3. Cover: Not less than 1/4-inch thick, aluminum diamond-pattern plate cover with stiffener plates, as required. Provide flush drop-handle for lifting the cover.
4. Frame: Extruded aluminum channel frame with manufacturer's standard anchor tabs or continuous anchor flange around the perimeter for anchorage to concrete.
5. Drain Coupling: 1.5-inch diameter NPT threaded drain coupling welded under the channel frame for connection of a drain pipe.
6. Gasket: EPDM gasket mechanically attached to the channel frame.

7. Hinges: Type 316 stainless steel, heavy-duty butt hinges with Type 316 stainless steel pin fastened to door with Type 316 stainless steel tamper resistant bolts.
 8. Latch: Type 316 stainless steel, watertight, slam-type latch with inside lever handle and outside removable exterior turn/lift handle fastened to leaf (door) with tamper-resistant Type 316 stainless steel bolts. Latch release shall be protected by a flush, gasketed, removable screw plug.
 9. Lift Assistance: Open-style stainless steel compression springs with Type 316 stainless steel guide tubes. Automatic Type 316 stainless steel hold-open arm with grip handle release.
 10. Finish: Mill finish.
- B. Provide Schedule 40 PVC drain piping from the floor access hatch cover channel frame routed as indicated in the Contract Documents and specified herein.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which floor access hatch cover Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install floor access hatch covers in accordance with approved Shop Drawings and other approved submittals, the Contract Documents, and manufacturer's instructions.
- B. Set floor access hatch covers level and true to line or grade, without warp or rack.
- C. Drain Piping for Channel Frames:
1. Provide drain piping from the floor access hatch cover channel frame and route to the nearest floor drain or sump pit in a manner that does not obstruct access for facility operations and maintenance.
 2. After installation, fill drain piping with water. Drain piping shall be free of visible leaks.
- D. Protection of Aluminum from Dissimilar Materials: Coat surfaces of aluminum in contact with dissimilar materials such as concrete, masonry, steel, and other metals with bituminous paint in accordance with Section 09 91 00, Painting.

3.3 ADJUSTING AND CLEANING

- A. Adjust leafs of floor access hatch covers as necessary to provide proper operations.
- B. Remove stains, concrete splatter, oils, grease, and other foreign materials necessary and provide clean, finished surfaces.

+ + END OF SECTION + +

SECTION 05 56 00

METAL CASTINGS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install metal castings.
 - 2. Castings include metal items that are not part of miscellaneous metal fabrications or metal systems in other Specifications Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before metal castings Work.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ANSI A14.3, Safety Requirements for Fixed Ladders.
 - 2. ASTM A48/A48M, Specification for Gray Iron Castings.
 - 3. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 4. ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Shall have at least five years experience manufacturing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.
- B. Component Supply and Compatibility:
 - 1. Obtain all frame, lid or cover, grate, and manhole step products included in this Section regardless of component manufacturer, from a single castings manufacturer.
 - 2. Obtain all hydrostatic pressure relief valve products included in this Section regardless of component manufacturer, from a single castings manufacturer.
 - 3. Castings manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 4. Components shall be constructed for specified service conditions and shall be integrated into overall assembly by castings manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Fabrication and installation of all casting assemblies. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.
 - 2. Product Data:
 - a. Copies of manufacturer's catalog information for the products proposed for use, specifications, load tables, dimension diagrams, anchor details, and installation instructions.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Furnish certification, signed by authorized officer of CONTRACTOR and notarized, stating that all components are furnished by the same manufacturer.
 - b. Manufacturer's certification that the casting or lot of castings was made, sampled, tested and inspected in accordance with ASTM A48.
 - 2. Qualifications Statements: Submit qualifications for the following:
 - a. Manufacturer, when required by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver products to the Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
- B. Storage and Protection:
 - 1. Protect materials from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Round Manhole Frame with Solid Lid:
 - 1. Material: ASTM A48/A48M, Class 35 B.
 - 2. Diameter: 24"
 - 3. Loading: H20
 - 4. Products and Manufacturers: Provide one of the following:
 - a. R-1530, manufactured by Neenah Foundry Company.
 - b. E-1920, manufactured by East Jordan Iron Works, Inc.
 - c. Or equal.

- B. Valve Box Frame and Lid:
 - 1. Material: ASTM A48/A48M, Class 35 B.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. R-7506-F, manufactured by Neenah Foundry Company.
 - b. 3671, manufactured by East Jordan Iron Works, Inc
 - c. Or equal.
- C. Manhole Steps:
 - 1. Provide manhole steps as shown on the Drawings. Comply with requirements of ASTM C478 and ANSI A14.3.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. R-1982-F, manufactured by Neenah Foundry Company.
 - b. 8512, manufactured by East Jordan Iron Works.
 - c. Or equal.
 - 3. Material: Cast gray iron.

2.2 FABRICATION

- A. Fabrication, General:
 - 1. Castings shall be of uniform quality, free of sand holes, gas holes, shrinkage cracks, and other surface defects.
 - 2. Castings shall be ground smooth and well-cleaned by shot blasting in the shop.
 - 3. Design and fabricate round frames and covers to prevent rocking and rattling under traffic loads that will be imposed in actual use.
 - 4. Fabricate castings true to pattern so that component parts fit together.
 - 5. Each casting shall be identifiable and, depending on its size, shall indicate the following: name of producing foundry, ASTM material designation, individual part number, and cast or heat date. Castings shall include all lettering shown or indicated on the Drawings.
 - 6. The surface of the covers shall have a diamond pattern with the cast words "WATER," "DRAIN" or "SEWER," whichever is appropriate.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Comply with casting manufacturer's printed instructions and the Contract Documents. Where castings are installed on precast concrete, fabricated fiberglass, or other fabricated products, install casting in accordance with requirements of manufacturer of product on which casting will be installed.

- B. Set castings accurately to required location, alignment, and elevation, plumb, level, true and free of rack, measured from established lines and levels. Where applicable, brace temporarily or anchor temporarily in formwork.
- C. Manhole Steps:
 - 1. Install gray cast iron manhole steps as shown on the Drawings. Comply with requirements of ASTM C478 and ANSI A14.3.
 - 2. Vertical separation of steps shall be uniform at maximum of 12 inches on centers. Steps shall project evenly from walls.

+ + END OF SECTION + +

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and apply paint systems.
 - a. CONTRACTOR is responsible for surface preparation and painting of all new and existing interior and exterior items and surfaces throughout the Project areas included under this and other Sections.
2. Extent of painting includes the Work specified below. Painting shown in schedules may not provide CONTRACTOR with complete indication of all painting Work. Refer to Article 2.2 of this Section where all surfaces of generic types specified are specified for preparation and painting according to their status, intended function, and location, using the painting system for that surface, function, and location as specified, unless specifically identified on the Drawings as a surface not to receive specified painting system.
 - a. All new and specifically identified existing surfaces and items except where natural finish of material is specified as a corrosion-resistant material not requiring paint; or is specifically shown as indicated by written note, or specified as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.

B. Coordination:

1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
2. Coordinate painting of areas that will become inaccessible once equipment and similar fixed items have been installed.
3. Furnish information to ENGINEER on characteristics of finish materials proposed for use and ensure compatibility with prime coats used. Provide barrier coats over incompatible primers or remove and repaint as required. Notify ENGINEER in writing of anticipated problems using specified painting systems with surfaces primed by others. Reprime equipment primed in factory and other factory-primed items that are damaged or scratched.

C. Related Sections:

1. Section 40 05 05, Exposed Piping Installation.
2. Section 40 05 19, Ductile Iron Process Pipe.
3. Section 40 05 31, Thermoplastic Process Pipe.

4. Section 40 05 53, Process Valves, Four-inch Diameter and Larger
- D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections or in other contracts:
1. Shop Priming: Shop priming of structural metal, miscellaneous metal fabrications, other metal items and fabricated components such as shop-fabricated or factory-painted process equipment, plumbing equipment, heating and ventilating equipment, electrical equipment, and accessories shall conform to applicable requirements of this Section but are included under other Sections or in other contracts.
 2. Pre-finished Items:
 - a. Items furnished with such finishes as baked-on enamel, porcelain, and polyvinylidene fluoride shall only be touched up at Site by CONTRACTOR using manufacturer's recommended compatible field-applied touchup paint.
 - b. Items furnished with finishes such as chrome plating or anodizing.
 3. Concealed Surfaces: Non-metallic wall or ceiling surfaces in areas not exposed to view, and generally inaccessible areas, such as furred spaces, pipe chases, duct shafts, and elevator shafts.
 4. Concrete floors, unless specifically shown as a surface to be painted.
 5. Face brick, glazed structural tile, and prefaced, ground-faced or split-faced concrete unit masonry.
 6. Exterior face of architectural precast concrete.
 7. Collector bearings, shafts and chains, wood flights, wood stop logs, and wood or fiberglass baffles.
 8. Corrosion-Resistant Metal Surfaces: Where the natural oxide of item forms a barrier to corrosion, whether factory- or Site-formed, including such materials as copper, bronze, muntz metal, terne metal, and stainless steel.
 9. Operating Parts and Labels:
 - a. Do not paint moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sensing devices, interior of motors, and fan shafts.
 - b. Do not paint over labels required by governing authorities having jurisdiction at Site, or equipment identification, performance rating, nameplates, and nomenclature plates.
 - c. Cover moving parts and labels during the painting with protective masking. Remove all protective masking upon completion of Work. Remove all paint, coatings, and splatter that comes in contact with such labels.
 10. Structural and miscellaneous metals covered with concrete need not receive primers, intermediate, or finish coats of paint.
- E. Description of Colors and Finishes:
1. Color Selection:
 - a. ENGINEER reserves the right to select non-standard colors for paint systems specified within ability of paint manufacturer to produce such

non-standard colors. Provide such colors at no additional expense to OWNER.

2. Color Coding of Pipelines, Valves, Equipment, and Ducts:
 - a. Color-coding of pipelines, valves, equipment and ducts shall comply with applicable standards of ANSI A13.1, ANSI Z535.1, CFR 1910.144, Recommended Standards for Water Works, and Recommended Standards for Wastewater Facilities. For piping and equipment not covered by the above standards, conform to OWNER's color standards.
 - b. For equipment located on roofs and equipment that is exposed-to-view, color will be selected by ENGINEER.

1.2 REFERENCES

- A. Referenced Standards: Standards referenced in this Section are:
 1. ANSI A13.1, Scheme for Identification of Piping Systems.
 2. ANSI Z535.1, Safety Color Code.
 3. ASTM D16, Terminology for Paint, Related Coatings, Materials and Applications.
 4. ASTM D2200, Pictorial Surface Preparation Standards for Painting Steel Surfaces.
 5. ASTM D4262, Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 6. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 7. ASTM D4541, Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion-Testers.
 8. ASTM E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
 9. Great Lakes Upper Mississippi River Board of Public Health and Environmental Managers (GLUMRB) Recommended Standards for Water Works.
 10. GLUMRB, Recommended Standards for Wastewater Facilities.
 11. Ozone Transport Commission, (OTC), OTC Model Rule for Architectural and Industrial Maintenance Coatings.
 12. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
 13. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.
 14. SSPC VIS 2, Method of Evaluating Degree of Rusting/Painted Steel Surfaces.
 15. SSPC Volume 2, Systems and Specifications.

1.3 DEFINITIONS

- A. Coating terms defined in ASTM D16 apply to this Section.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications:
 - 1. Engage a single applicator regularly performing installation of painting systems, with documented skill and successful experience in installing types of products required and agrees to employ only tradesmen trained, skilled, and with successful experience in installing types of products specified.
- B. Testing Agency Qualifications: Provide independent testing agency with experience and capability to satisfactorily conduct testing specified in accordance with ASTM E329. Testing agency shall be selected by OWNER and paid for by CONTRACTOR.
- C. Source Quality Control:
 - 1. Obtain products from manufacturers that will provide services of a qualified manufacturer's representative at Site at commencement of painting Work to advise on products, mock-ups, installation, and finishing techniques, at completion of the Work to advise ENGINEER on acceptability of completed Work, and during course of Work as requested by ENGINEER.
 - 2. Submit "or equal" products, when proposed, with direct comparison to products specified, including information on durability, adhesion, color and gloss retention, percent solids, VOC's grams per liter, and recoatability after curing.
 - 3. "Or equal" manufacturers shall furnish same color selection as manufacturers specified, including intense chroma and custom pigmented colors in painting systems.
 - 4. Color Pigments: Provide pure, non-fading, applicable types to suit surfaces and services indicated. Comply with the following:
 - a. Lead and Chromate: Lead and chromate content shall not exceed amount allowed by authorities having jurisdiction.
 - b. Through CONTRACTOR, paint manufacturer shall notify ENGINEER of colors that are not suitable for long-term color retention in areas subject to hydrogen sulfide fume exposure.
 - c. Manufacturer shall identify colors that meet requirements of authorities having jurisdiction at Site for use in locations subject to contact with potable water or water that will be treated to become potable.
 - d. Comply with paint manufacturers' recommendations on preventing coating contact with levels of carbon dioxide and carbon monoxide that may cause yellowing during application and initial stages of curing of paint coatings.
- D. Regulatory Requirements:
 - 1. Comply with VOC content limits of Ozone Transport Commission (OTC), Model Rule for Architectural and Industrial Maintenance Coatings.

- E. Pre-Painting Conference:
1. Conduct a pre-painting conference at the Site to review specified requirements. Meeting attendees shall include painting applicator and its foreman, paint manufacturer's technical representative, installers of other work in and around painting that must follow painting Work, ENGINEER, and other representatives directly concerned with performance of painting Work.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Product Data:
 - a. Copies of manufacturer's technical data sheets, including surface preparation, number of coats, dry film thickness, test performance data including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contract Documents, and application instructions for each product proposed for use
 - b. Submit proof of acceptability of proposed application techniques by paint manufacturer selected.
 - c. Copies of CONTRACTOR's proposed protection procedures in each area of the Work explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption, and for maintaining acceptable application, curing, and environmental conditions during and after painting systems application.
 - d. List each material and cross-reference to the specific painting system and application, including a list of site-specific surfaces to which painting system will be applied. Identify by manufacturer's catalog number and general classification. State number of gallons of each product being purchased for delivery to Site and square foot area calculated to be covered by each painting system specified based on theoretical loss of 20 percent. Where actual area to be covered by paint system exceeds area submitted to ENGINEER for that system, proof of additional material purchase shall be provided to ENGINEER. Calculated coverage shall be as specified for each component of each painting system specified. This requirement does not take precedence over CONTRACTOR's responsibility to provide dry film thickness required for each component of each painting system.
 - e. Identify maximum exposure times allowable for each paint system component before next coat of paint can be applied. Submit proposed methods for preparing surfaces for subsequent coats if maximum exposure times are exceeded.
 - f. Information on curing times and environmental conditions that affect curing time of each paint system component and proposed methods for

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1. Maintenance Manual: Upon completion of the painting Work, furnish ENGINEER five copies of detailed maintenance manual including the following information:
 - a. Complete and updated product catalog of paint manufacturer's currently available products including complete technical information on each product. Identify product names and numbers of each product used in the painting Work.
 - b. Name, address, e-mail address and telephone number of manufacturer, local distributor, applicator and technical representative.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches and staining.
2. Statement of Application: Upon completion of the painting Work, submit a notarized statement to ENGINEER signed by CONTRACTOR and painting applicator stating that Work complies with requirements of the Contract Documents and that application methods, equipment, and environmental conditions were proper and adequate for conditions of installation and use.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Product Delivery Requirements: Deliver products to Site in original, new, and unopened packages and containers, accurately and legibly and accurately labeled with the following:
 1. Container contents, including name and generic description of product.
 2. Manufacturer's stock number and date of manufacture.
 3. Manufacturer's name.
 4. Contents by volume, for major pigment and vehicle constituents.
 5. Grams per liter of volatile organic compounds.
 6. Thinning instructions, where recommended.
 7. Application instructions.
 8. Color name and number.
- B. Product Storage Requirements:
 1. Store acceptable materials at Site.
 2. Store in an environmentally controlled location as recommended in paint manufacturer's written product information. Keep area clean and accessible. Prevent freezing of products.
 3. Store products that are not in actual use in tightly covered containers.
 4. Comply with health and fire regulations of authorities having jurisdiction at Site.
- C. Product Handling Requirements:
 1. Handle products in a manner that minimizes the potential for contamination, or incorrect product catalyzation.
 2. Do not open containers or mix components until necessary preparatory work has been completed and approved by ENGINEER and painting Work will start immediately.

3. Maintain containers used in storing, mixing, and applying paint in a clean condition, free of foreign materials and residue.

1.7 SITE CONDITIONS

A. Site Facilities:

1. Supplemental heat sources, as required to maintain both ambient and surface temperatures within range recommended by paint manufacturer for paint system applications, are not available at the Site.
2. Provision of supplemental heat energy sources, power, equipment, and operating, maintenance, and temperature-monitoring personnel is CONTRACTOR's responsibility.
3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being painted. Properly locate and vent heat sources to exterior so that paint systems and personnel are unaffected by exhaust products.

B. Existing Conditions:

1. Existing surfaces to receive painting Work shall have their surfaces prepared to meet requirements of painting systems specified. Prior to initiating painting Work, perform adhesion tests on existing surfaces to be painted. Perform testing per ASTM D4541 or other method acceptable to ENGINEER. Number and location of tests shall be sufficient to determine the condition of existing coatings and suitability of existing coatings to remain to provide an acceptable substrate for new coatings. Submit testing plan prior to testing and provide ENGINEER the adhesion test results.
2. Provide abrasive blasting, scraping, or other abrading or surface film removal, or preparatory techniques accepted by ENGINEER.
3. Before commencing painting in an area, surfaces to be painted and floors shall be cleaned of dust using commercial vacuum cleaning equipment equipped with high-efficiency particulate air (HEPA) filters and dust containment systems.
4. After painting operations have started in a given area, cleaning only with commercial vacuum cleaning equipment with high-efficiency particulate air (HEPA) filters and dust containment systems.

C. Environmental Requirements:

1. Comply with manufacturer's published requirements.

D. Protection:

1. Cover or otherwise protect finished Work of other trades and those surfaces not being painted concurrently and not to be painted.
2. Provide required personnel safety equipment per requirements of authorities having jurisdiction at Site.
3. Submit protection procedures to be employed. Do not begin surface preparation and painting Work until ENGINEER accepts protection techniques proposed by CONTRACTOR.

4. When working with flammable materials, provide fire extinguishers and post temporary signs warning against smoking and open flame.

PART 2 - PRODUCTS

2.1 PAINTING SYSTEM MANUFACTURERS

- A. Products and Manufacturers: Where referenced under painting systems, provide painting systems manufactured by the following:
 1. Tnemec Company, Incorporated (TCI).
 2. The Carboline Company, part of StonCor Group, an RMP Company (TCC).
 3. Sherwin-Williams Company (SWC).
 4. Or equal.

2.2 PAINTING SYSTEMS

- A. New and Existing Ferrous Metals, Structural Steel (With or Without Sprayed Fireproofing), Miscellaneous Ferrous Metals, Exterior Surfaces of Valves, Exterior Surfaces of Ferrous Piping, and Exterior Surfaces of All Ferrous Metal (Both Exposed and to be Later Covered With Insulation); Non-submerged, Interior:
 1. Surface Preparation: Refer to Paragraphs 1.5.A.2., 3.2.A., 3.2.C.1., 3.2.C.2.
 2. Shop Primer:
 - a. Generic Components:
 - 1) Minimum 67 percent volume solids, build, two-component, cycloaliphatic amine-catalyzed epoxy or polyamido-amine epoxy coating; 250 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Macropoxy HS Epoxy (SWC): One coat, 4.0 to 6.0 dry mils.
 3. Field Primer and Touch-Up:
 - a. Generic Components:
 - 1) Minimum 100 percent volume solids, high-build, two-component, polyamide-catalyzed epoxy; 8 grams per gallon VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 165 Epoxoline 100 (TCI); Carboguard 954 HB (TCC); Cor-Cote HP (SWC): One coat, 8.0 to 12.0 dry mils.
 4. Finish: High-Gloss:
 - a. Generic Components:
 - 1) Minimum 80 percent volume solids, high-build, chemical-resistant, high-gloss, modified, polyamine- or polyamidoamine-catalyzed epoxy finish; 25 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 280 Tneme-Glaze (TCI); Carboguard 890 LT (TCC); Cor-Cote HP (SWC):
 - a) Horizontal Surfaces: One coat, 6.0 to 12.0 dry mils.

- b) Vertical Surfaces: One coat, 4.0 to 8.0 dry mils.
- B. New and Existing Ferrous Metals, Non-Ferrous Metals and Exterior Surfaces of Piping; Submerged or Intermittently Submerged, including up to 4.0 above liquid surface; Interior and Exterior:
- 1. Surface Preparation: Refer to Paragraphs 1.5.A.2., 3.2.A., 3.2.C.1., 3.2.C.2., and 3.2.E.
 - 2. Factory Primer:
 - a. Generic Components:
 - 1) Minimum 67 percent solids, two-component, cycloaliphatic amine-catalyzed epoxy or polyamido-amine epoxy; 334 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Macropoxy HS Epoxy (SWC): One coat, 4.0 dry mils.
 - 3. Shop Prime/Touch-Up/Finish, Satin:
 - a. Generic Components:
 - 1) Minimum 100 percent volume solids, high-build, two-component, polyamide-catalyzed epoxy or polyamido-amine epoxy; 10 grams per gallon VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series N69 Hi-Build Epoxoline (TCI); Carboguard 890 LT (TCC); Dura-Plate UHS (SWC): Three coats, 8.0 to 15.0 dry mils, per coat.
- C. New and Existing Aluminum in Contact with Dissimilar Materials:
- 1. Surface Preparation: Refer to Paragraphs 1.5.A.2., 3.2.A. and 3.2.D.
 - 2. Primer/Finish:
 - a. Generic Components:
 - 1) Minimum 100 percent volume solids, high-build, two-component, polyamido-amine or polyamine epoxy; 49 grams per gallon VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 165 Epoxoline 100 (TCI); Carboguard 954 HB (TCC); Dura-Plate UHS (SWC): Two coats, 8.0 to 15.0 dry mils, per coat.
- D. New and Existing PVC and CPVC Piping and Fiberglass Insulation Covering; Non-submerged, Interior and Exterior:
- 1. Surface Preparation: Refer to Paragraphs 1.5.A.2., 3.2.A. and 3.2.F.
 - 2. Primer:
 - a. Generic Components:
 - 1) Minimum 37 percent volume solids single-component, self-cross linking acrylic primer-sealer; 226 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 114 Uni-Bond DF (TCI); Carbocrylic 3358 (TCC); DTM Acrylic Primer/Finish (SWC): One coat, 2.0 to 4.0 dry mils.
 - 3. Finish: Satin:
 - a. Generic Components:

- 1) Minimum 37 percent volume solids, single component, self-cross linking acrylic; 226 grams per liter VOC, maximum.
- b. Products and Manufacturers: Provide one of the following:
 - 1) Series 115 Uni-Bond (TCI); Carbocrylic 3358 (TCC); DTM Acrylic Primer/Finish (SWC): One coat, 2.0 to 4.0 dry mils.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which painting Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.
- B. Do not paint over existing paint where there is no assurance that existing paint will provide an acceptable surface for long-term adherence and durability of painting systems specified, or where paint manufacturer requires removal of all existing paint to recommend use of specified painting system.

3.2 SURFACE PREPARATION

- A. General:
 1. Comply with paint manufacturer's published recommendations for products, surface condition, and surface preparation.

3.3 PROTECTION OF PROPERTY AND STRUCTURES

- A. Protect property and structures adjacent to the Work from waste residues resulting from cleaning, surface preparation, and painting Work.
- B. Use shrouding, vacuum blasting, or other acceptable methods for cleaning and surface preparation of exterior surfaces.
- C. During blast cleaning and surface preparation of interior and exterior surfaces, control exhausting of dust and grit using shrouding, negative-pressure containment/dust collection systems, or other means to protect adjacent property and structures and prevent dust and grit from escaping. Similarly, control removal and temporarily store residues to protect adjacent property and structures.
- D. For painting of exterior surfaces, use rollers, shrouding, or other acceptable methods as required to protect adjacent property and structures from wind-blown paint residues.
- E. Submit proposed procedures for cleaning, surface preparation, and paint application that describe in detail methods to be used to protect adjacent property

and structures from residues. Do not proceed with cleaning, surface preparation, or painting until proposed procedures are accepted by ENGINEER.

3.4 MATERIALS PREPARATION

- A. General: Mix and prepare painting products in strict accordance with paint manufacturer's product data sheets.

3.5 APPLICATION

- A. General:
 - 1. Apply paint systems by brush, roller, or airless spray per paint manufacturer's recommendations and in compliance with Paint Application Specifications No. 1 in SSPC Volume 2, where applicable, and in strict accordance with paint manufacturer's product data sheets.
 - 2. Surfaces of items not normally exposed-to-view do not require same color as other components of system of which they are a part, but require same painting system specified for exposed surfaces of system.
 - 3. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint before final installation of registers or grilles.
 - 4. Paint backs of access panels and removable or hinged covers to match exposed surfaces.
 - 5. Omit field-applied primer on metal surfaces that have been primed in the shop. Touch-up paint to shop-primed coats and pre-finished items only when approved by ENGINEER using compatible primers and paint manufacturer's recommended compatible field-applied finishes.
 - 6. Welds shall be stripe-coated with intermediate or finish coat of paint after application of prime coat.
- B. Minimum/Maximum Paint Film Thickness: Comply with manufacturer's published recommendations for coating type and surface.
- C. Scheduling Surface Preparation and Painting: Comply with manufacturer's published recommendations for coating type and surface.
- D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to result in a finish coat with no burn-through or other defects caused by insufficient sealing.
- E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.
- F. Brush Application:
 - 1. Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or

other surface imperfections are unacceptable. Neatly draw all glass and color break lines.

2. Brush-apply all primer or first coats, unless otherwise allowed to use mechanical applicators.

G. Mechanical Applicators:

1. Use mechanical methods for applying paint when allowed by applicable ordinances, paint manufacturer, and approved by ENGINEER.
2. Limit roller applications, if approved by ENGINEER, to interior wall finishes for second and third coats. Apply each roller coat to provide equivalent hiding as brush-applied coats.
3. Where spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment for purpose of building up film thickness of two coats in one pass.

H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by ENGINEER.

3.6 FIELD QUALITY CONTROL

- A. Notify ENGINEER after completing each coat of paint. After inspection and checking of film thickness, holidays, and imperfections by OWNER, and after acceptance by ENGINEER, proceed with succeeding coat.
1. ENGINEER will witness all testing and shall be notified of scheduled testing at least twenty-four hours in advance.
 2. Apply additional coats, if required, to produce specified film thickness and to correct holidays and to completely fill all surface air holes.
- B. For magnetic substrates, measure thickness of dry film nonmagnetic coatings following recommendations of SSPC PA-2. These procedures supplement manufacturers' approved instructions for manual operation of measurement gauges and do not replace such instructions.

3.7 PROTECTION

- A. Provide "Wet Paint" signs as required to protect newly painted finishes. After completing painting Work, remove temporary protective wrappings provided for protection of the Work and work of other contractors.

3.8 ADJUSTMENT AND CLEAN-UP

- A. Correct damage to work of other trades by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.
- B. During progress of the Work, remove from Site all discarded paint products, rubbish, cans, and rags at end of each workday.

- C. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- D. At completion of Work of other trades, touch-up and restore all damaged or defaced painted surfaces as determined by ENGINEER.

3.9 SCHEDULES

- A. The schedules listed below, following the “End of Section” designation, are a part of this Specification section.
 - 1. Table 09 91 00-A, Painting Schedule.

+ + END OF SECTION + +

**TABLE 09 91 00-A
PAINTING SCHEDULE**

Facility or Surface *	Room No.	Painting System **	Remarks
Interior metals (including piping, valves and supports) of valve vault	-	A	Provide color charts for selection
Interior metals of wetwell	-	B	Provide color charts for selection
Exterior vent pipes (wetwell and valve vault)	-	D	Provide color charts for selection.

* Refer to Drawings for facility locations and for facilities not listed above.

** Refer to Article 2.2 of this Section.

SECTION 22 13 33

SUMP PUMP

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install submersible sump pump units complete and operational with accessories.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with or before submersible sump pump units Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ABMA.
2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
3. ANSI B73.1, Horizontal End Suction Centrifugal Pumps for Chemicals.
4. ANSI/HI 1.3, Standard for Centrifugal Pumps for Design and Application.
5. ANSI/HI 1.4, Standard for Centrifugal Pumps for Installation, Operation, and Maintenance.
6. ANSI/HI 1.6, Centrifugal Pump Tests.
7. ANSI/HI 9.6.2, Standard for Centrifugal and Vertical Pumps for Allowable Nozzle Loads.
8. ANSI/HI 9.8, Pump Intake Design.
9. ANSI/HI 11.6, Submersible Pump Tests.
10. ASTM.
11. IEEE 112, Test Procedure for Polyphase Induction Motors and Generators.
12. NEMA MG-1, Motors and Generators.
13. NFPA.
14. UL 778, Motor-Operated Water Pumps.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have at least five years experience producing substantially similar equipment to that required and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years.

- B. Component Supply and Compatibility:
1. Obtain all equipment for each type of submersible sump pump unit specified in this Section, regardless of the component manufacturer, from a single submersible sump pump Supplier.
 2. Submersible sump pump units Supplier shall review and approve or prepare all Shop Drawings and other submittals for all components provided under this Section.
 3. All components furnished shall be specifically constructed for the specified service and suitable for the specified service conditions, and shall be integrated into overall assembly by submersible sump pump unit Supplier.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Detailed drawings of all wiring diagrams.
 - b. Detailed installation drawing of each individual component showing: mounting requirements, location at Site, labeled and coded piping and wiring connections
 - c. Schedule of equipment.
 - d. Equipment data sheets.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment, and part lists for all components in sufficient detail for item-by-item comparison with the Contract Documents.
- B. Informational Submittals: Submit the following:
1. Manufacturer's Instructions:
 - a. Setting drawings, templates, and directions for the installing anchor bolts and other anchorages.
 - b. Instructions for handling and installing equipment.
 2. Site Quality Control Submittals:
 - a. Results of field tests for each complete pump system.
- C. Closeout Submittals: Provide the following:
1. Operation and Maintenance Data:
 - a. Submit operation and maintenance manuals including test reports, maintenance data, and schedules, description of operation, and spare parts information.
 - b. Provide operation and maintenance manuals per Section 01 78 23, Operations and Maintenance Data.
- D. Maintenance Material Submittals: Furnish the following:
1. Spare Parts and Special Tools:
 - a. All spare parts and tools recommended by manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Prior to shipping, completely inspect products to assure that components are complete and comply with all requirements. Box or crate products as required to prevent damage during shipment. Protect machined surfaces and matching connections to prevent damage.
2. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products to be embedded in concrete in ample time to prevent delaying the Work.
3. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
4. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:

1. Keep all products off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion and deterioration.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. Design Criteria:

1. Minimum Capacity: 20 gpm at 15-feet total dynamic head.

B. Equipment shall conform to ANSI/HI 1.3, ANSI/HI 9.8, and UL 778.

2.2 MANUFACTURERS OF CAST IRON SUMP PUMPS

A. Manufacturers: Provide products of one of the following:

1. Zoeller Pump Company, Model 57.
2. Myers, Pentair Water, Model MDC33
3. Or equal.

2.3 SUBMERSIBLE SUMP PUMPS

A. Type: Centrifugal, end-suction, single-stage non-clog, heavy duty sump pumps with motors and operating controls.

B. Material:

1. Pump and Motor Housing: Cast iron.
2. Fasteners: 18-8 stainless steel.
3. Shaft: Stainless steel.
4. Discharge: 1-1/2" NPT.

5. Soils passing: ½"
 6. Seals: Mechanical seals ceramic face with heat resistant stainless steel and Buna-N components.
- C. Motor:
1. Motor Chamber: NEMA B, submersible air-filled, hermetically sealed motor with Class F insulation.
 2. Built-in thermal overload protection.
 3. RPM: 1750.
 4. Horsepower: 1/3
- D. Controls:
1. Automatic Control – Integral Float Type: Single phase pump shall have an integral mechanical float switch, which shall require no adjustment, nor require additional equipment for operation.

2.4 SOURCE QUALITY CONTROL

- A. Equipment shall be completely manufactured and pre-assembled. Prior to shipping, perform the following tests and inspections at factory:
1. Test and inspect completed units for UL label.
 2. Factory-test equipment to ensure that each entire sump pump been properly fabricated and assembled, that all controls function as specified, and that equipment meets specified performance requirements.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. General:
1. Install all products per the Contract Documents and as recommended by manufacturer. Do not modify structures to facilitate installation of pumps or ejectors, unless specifically approved by ENGINEER.
 2. Conform to ANSI/HI 1.4.
 3. Perform all fitting required for installation. Set products accurately in location, alignment, and elevation, plumb and true.
 4. Provide utility connections per the Contract Documents. Support piping and valves independent of pump. Verify that utilities and valves are tested and operational before placing equipment into operation.

5. Provide for initial operation lubricants recommended by equipment manufacturer
- B. Comply with Section 01 75 11, Checkout and Startup Procedures.

3.3 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Prior to placing sump pumps into service, successfully test all related piping per the Contract Documents.
 2. Fill all systems and test-operate all equipment and materials.
 3. In the presence of the ENGINEER, check equipment for excessive noise and vibration while systems are operating. Verify by measuring sump liquid level drawdown versus time the capacity of each pump provided. Correct defective Work until successful test results are obtained.

3.4 ADJUSTING AND CLEANING

- A. Adjusting:
 1. While system is operating, balance and adjust all equipment and valves to achieve specified conditions.
- B. Cleaning:
 1. Thoroughly clean all equipment and accessories prior to installation and prior to Substantial Completion.
 2. Remove all dirt, rust, dust, scale, and corrosion from products to receive field painting.
 3. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

SECTION 26 00 05

ELECTRICAL WORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to complete the electrical Work.
- B. Coordination:
 - 1. Review installation procedures and schedules under other Specification Sections and coordinate with other trades the installation of electrical items that will be installed with the pump station and storage building.
 - a. Coordinate with other contractors regarding progress of construction where conduits and built-in items are will be installed. Install conduits and built-in items in manner that does not delay work of other contractors.
 - b. Coordinate with the High School Contractor to provide power and location of conduit and panels for the pump station.
- C. Temporary Facilities:
 - 1. Temporary Light and Power for construction purposes and construction activities shall be provided.
- D. Work Included But Specified Elsewhere:
 - 1. Excavation and backfilling for underground conduits shall conform to the requirements of Section 31 23 16.13, Trenching.
 - 2. Concrete Work for equipment pads and conduit encasement shall conform to the requirements of Section 03 00 05, Concrete.
- E. Intent:
 - 1. The Drawings show the principal elements of the electrical installation. They are not intended as detailed working drawings for the electrical Work but as a complement to the Specifications to clarify the principal features of the electrical systems.
 - 2. It is the intent of this Section that all equipment and devices, furnished and installed under this and other Sections, be properly connected and interconnected with other equipment so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Drawings.

- F. Grounding: Ground all equipment in conformance with the National Electrical Code.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
1. Permits: Obtain all permits required to commence work and, upon completion of the Work, obtain and deliver to Engineer a Certificate of Inspection and Approval from the State Board of Fire Underwriters or other authority having jurisdiction.
 2. Codes: Material and equipment shall be installed in accordance with the current standards and recommendations of the National Electrical Code, the National Electrical Safety Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.
 3. Tests by Independent Regulatory Agencies: Electrical material and equipment shall be new and shall bear the label of the Underwriters' Laboratories, Inc., or other nationally-recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.
 4. Reference Standards: Electrical material and equipment shall conform in all respects to the latest approved standards of the following:
 - a. National Electrical Manufacturers Association (NEMA).
 - b. The American National Standards Institute (ANSI).
 - c. The Institute of Electrical and Electronic Engineers (IEEE).
 - d. Insulated Cable Engineers Association (ICEA).
 - e. National Electrical Code (NEC).
 - f. National Electrical Safety Code (NESC).
 - g. Underwriters' Laboratories (UL).
 - h. National Fire Protection Association (NFPA).
 - i. Instrumentation Society of America (ISA).

1.3 SUBMITTALS

- A. General:
1. Conform to the requirements of Section 01 33 00, Submittal Procedures.
 2. It is the intent of this specification that similar products be by the same manufacturer.
- B. Shop Drawings shall include the following information to the extent applicable to the particular item:
1. List of components including manufacturer's name, designation and catalog number for all products specified under this Section.
 2. Electrical ratings.
 3. Conformance to applicable standards or specifications of ANSI, ICEA, IEEE, NEC, NEMA, UL, or other organizations.

4. Dimensioned plan, section, and elevation drawings showing means for equipment mounting, conduit connections and routing and grounding.
5. Materials and finish specification, including painting.
6. Schematics, internal wiring diagrams and point-to-point interconnection diagrams indicating all connections to components and numbered terminals for external connections. Identification of all wiring by the conduit tag, in which the wire is installed.

C. Submit details of equipment identification as specified under this Section.

1.4 JOB CONDITIONS

A. Existing Conditions:

1. Contractor shall examine the sites and existing facilities in order to compare them with the Drawings and Specifications with respect to the conditions of the premises, location of and connection to existing facilities and any obstructions which may be encountered.
2. Contractor shall visit the sites prior to submitting his bid in order to determine the conditions of the premises, and to establish the full extent of the demolitions and modifications. Coordinate site visit with the Owner.
3. Contractor is cautioned to perform his work with due regard to safety and in a manner that will not interfere with the existing equipment or in any way cause interruption of any of the functions of the facilities.
4. Where the work of Contractor ties in with existing installations, Contractor shall take prior precautions and safeguards in connecting the new work with the existing operating circuits so as to prevent any interruption to the existing operating circuits. The tying in of new work, installed under this Contract, with the existing circuits shall be performed only in the presence of Owner. Advance notice will be required before any equipment is removed from service. Contractor shall notify Owner in writing of his intention to do such work, giving full details.

B. Staging: Contractor shall make all provisions as shown, specified and required to perform all additions, modifications and demolitions at the pump stations. All work shall be staged and executed, so that the existing pump stations may be kept in continuous operation, except for limited scheduled shutdowns. Shutdowns where required shall be limited in duration to the time indicated on the Drawings. Multiple shutdowns shall be permitted but shall be limited to the maximum extent possible. All shutdowns shall be pre-approved in writing by the Owner. It shall be the responsibility of this Contractor to establish the staging requirements of the work.

1.5 AREA CLASSIFICATIONS

- A. All materials and equipment to be provided shall conform to the area classification specified.
- B. Wet Locations: The following areas shall be considered wet locations:
 - 1. All outdoor areas.
 - 2. All indoor areas where designated on the Drawings.
Materials, equipment and incidentals in areas identified as wet locations shall meet NEC and NEMA requirements for wet locations. Enclosures installed in wet locations shall meet NEMA 4 requirements unless specifically specified otherwise.
- C. Corrosive Locations: All areas where designated on the Drawings shall be considered corrosive locations:
Materials, equipment and incidentals in areas identified as corrosive shall meet NEC and NEMA requirements for corrosive locations. Enclosures installed in corrosive locations shall meet NEMA 4X requirements unless specifically specified otherwise.
- D. Dusty Locations: All indoor locations not designated on the Drawings as wet, or corrosive or hazardous shall be considered as a dusty location. Materials, equipment and incidentals in dusty locations shall meet NEC and NEMA 12 requirements unless specifically specified otherwise.
- E. Hazardous Locations: All areas where designated on the Drawings shall be considered hazardous locations.
Materials, equipment and incidentals in areas identified as hazardous locations shall meet the requirements for the Class and Division designated.

1.6 PROJECT CLOSEOUT

- A. Operation and Maintenance Data:
 - 1. Conform to the requirements of Section 01 78 23, Operations and Maintenance Data.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Contractor shall instruct the manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the site.
- B. Storage of Materials: Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.

1.8 IDENTIFICATION OF EQUIPMENT

- A. All electrical items shall be identified. Identification shall be in addition to the manufacturer's nameplates and shall serve to identify the items function and the equipment or system which it serves or controls. It shall be the responsibility of this Contractor to ensure all equipment is properly tagged in accordance with these specifications and the National Electrical Code.
- B. All new equipment shall be identified by means of laminated phenolic nameplates incised to show one-inch high, black letters on a white background. Labels shall be fastened by means of 3/16-inch diameter, round-head, stainless steel, self-tapping screws. In corrosive locations, labels shall be fastened by means of a silicon based adhesive. Equipment whose designations have been changed shall be relabeled accordingly.
- C. Wires and cables shall be color coded, and identified by means of wire markers. Each control, signal and status wire shall be identified by a unique number. Number system shall reflect the actual designations used in the Work and shall be documented on the point-to-point wiring diagrams. Neatly coil all spare wiring at bottom of equipment and individually tag each spare wire and note its origin.

PART 2 - PRODUCTS

2.1 RACEWAY SYSTEMS

- A. General:
 - 1. Provide rigid conduit and fittings for the various systems in accordance with the single line and interconnection diagrams indicated on the Drawings. Conduit routing for the systems may not be shown, but shall be established by the Contractor, it shall be the responsibility of the Contractor to provide for the proper installation of all conduits for each system.
 - 2. The types of raceways required include the following:
 - a. Rigid steel conduit for exposed indoor conduit runs and conduit runs buried in earth when encased in concrete.
 - b. PVC coated rigid steel for exposed exterior conduits, conduit runs buried in earth and conduits installed in areas classified as wet or corrosive.
 - c. Flexible conduit for connections to motors and equipment.
 - d. Schedule 40 PVC conduit where indicated on the Contract Drawings:
 - 3. Coordination:
 - a. Conduit runs where shown are diagrammatic.
 - b. Coordinate conduit installation with piping, ductwork, lighting fixtures and other systems and equipment and locate so as to avoid interference's.

- B. Rigid Steel Conduit, Elbows and Couplings:
1. Material: Rigid, heavy wall, mild steel, hot dip galvanized, smooth interior, tapered threads and carefully reamed ends; 3/4-inch NPS minimum size.
 2. Manufacturer: Provide rigid steel conduit and fittings of one of the following:
 - a. Allied Tube and Conduit.
 - b. Wheatland Tube Company.
 - c. Western Tube and Conduit Corporation.
 - d. Or equal.
- C. PVC Coated Rigid Steel Conduit, Elbows and Couplings:
1. Material: Rigid, heavy wall, mild steel, hot dip galvanized, smooth interior, tapered threads, carefully reamed ends, 3/4-inch NPS minimum size with a factory coating of 40 mil thick polyvinyl chloride.
 2. Color: Color of coating shall be the same on all conduit and fittings.
 3. Manufacturer: Provide PVC coated rigid steel conduit and fittings of one of the following:
 - a. Robroy Industries.
 - b. Perma-Cote Industries.
 - c. OCAL, Inc.
 - d. Or equal.
- D. Non-metallic Conduit and Fittings:
1. PVC Plastic Conduit:
 - a. Material: Schedule 40 PVC plastic, rated for 90 degrees C, conforming to NEMA TC-3 and UL 514B and 651.
 - b. Fittings: Form elbows, bodies, terminations, expansions, and fasteners of same material and manufacturer as base conduit. Provide cement by same manufacturer as base conduit.
 - c. Manufacturers: Provide products of one of the following:
 - 1) Amoco Chemicals Corp.
 - 2) Carlon Electrical Products.
 - 3) Or equal.
- E. Metallic Conduit Fittings and Outlet Bodies:
1. Material and Construction: Cast gray iron alloy, cast malleable iron bodies and covers. Outdoor units to be gasketed and watertight. Gaskets to be of an approved type designed for the purpose. Improvised gaskets not acceptable. All units to be threaded type with five full threads. Material to conform to ANSI C80.4 and be listed by UL. Fittings and bodies in or on PVC coated conduit runs to have a factory-applied coating of 40 mil thick polyvinyl chloride. The use of "LB" fittings shall be avoided and type "LBD" fittings applied wherever the use of fittings is unavoidable.
 2. Manufacturer: Provide metallic conduit fittings and outlet bodies of one of the following:

- a. Crouse-Hinds Company, Syracuse, NY.
 - b. Appleton Electric Company, Chicago, IL.
 - c. Or equal.
- F. Conduit Hubs:
 - 1. Material: Threaded conduit hub, vibration proof, weather proof with captive O-ring seal, zinc metal with insulated throat. Hubs used on PVC coated conduit systems shall have a factory applied PVC coating.
 - 2. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures located in areas designated as wet locations.
 - 3. Manufacturer: Provide material manufactured one of the following:
 - a. Myers Electrical Products Company, Ashland, OH.
 - b. Or equal.
- G. Flexible Conduit (Non-hazardous Areas and Class 1, Division 2, Hazardous Areas):
 - 1. Material: Flexible galvanized steel core with smooth, abrasion-resistant, liquid-tight, polyvinyl chloride cover. Continuous copper ground built in for sizes 3/4-inch through 1-1/4 inch. Material shall be UL listed.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Sealtite UA, as manufactured by Anaconda Metal Hose Division, Anaconda American Brass Company, Greenwich, CT.
 - b. Liqueflex Type L.A., as manufactured by Electric-Flex Company, Roselle, IL.
 - c. Or equal.
- H. Flexible Conduit (Class 1, Group D, Division 1, Hazardous Areas):
 - 1. Material: Flexible brass inner core with bronze outer braid and protective neoprene plastic coating. Steel, brass, or bronze end fittings. Minimum of 12 inches long.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Type ECGJH or ECLK by Crouse Hinds Company.
 - b. Type EXGJH or EXLK by Appleton Electric Company.
 - c. Or equal.
- I. Flexible Conduit Fittings:
 - 1. Material and Construction: Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
 - 2. Manufacturer: Provide flexible conduit fittings of one of the following:
 - a. Crouse-Hinds Company, Syracuse, NY.
 - b. Appleton Electric Company, Chicago, IL.
 - c. Or equal.

- J. Conduit Tags:
1. Material: 19 gauge, 1-1/2 inch diameter round brass with backfilled legend, Style #250-BL as manufactured by Seton Nameplate Corporation or equal.
 2. Fasten conduit tags to conduits with No. 14 AWG solid insulated copper wire. Tag all conduits at the ends and in all intermediate boxes and other enclosures.
- K. Pull, junction and terminal boxes: Provide boxes based upon environmental conditions of the location and as required for the area classifications specified in under this Section.
1. Material and Construction (dusty locations).
 - a. Nema 12 as a minimum.
 - b. Welded and galvanized sheet steel of USS gauge.
 - c. Oil-resistant gasket.
 - d. Lift-off hinges and quick-release latches.
 - e. Boxes with any dimension 24 inches and smaller shall be 14 gauge. Boxes with any dimension larger than 24 inches shall be 12 gauge, except use 10 gauge on boxes with any dimension of 36 inches or more.
 2. Material and construction (wet, corrosive and hazardous locations).
 - a. Nema 4 minimum for wet locations. Nema 4X for corrosive locations. Nema 7 for hazardous locations.
 - b. Cast gray iron alloy or cast malleable iron bodies and covers. Galvanized finish.
 - c. Neoprene gaskets. Gaskets to be of an approved type designed for the purpose. Improvised gaskets not acceptable.
 - d. Stainless steel cover screws.
 - e. External mounting lugs.
 - f. Drilled and tapped conduit holes.
 - g. Boxes where conduits enter a building below grade shall have 1/4-inch drain hole at the bottom of the box.
 - h. Threaded connections for explosion proof boxes.
 3. Manufacturer: Provide boxes of one of the following:
 - a. Crouse-Hinds Company.
 - b. Appleton Electric Company.
 - c. Hoffman Engineering Company.
 - d. Or equal.
 4. Large boxes not generally available in cast construction may be fabricated of copper-free aluminum alloy or stainless steel code gage sheet metal for non-hazardous locations.
 5. In corrosive locations all boxes shall include a factory applied 40 mil PVC coating or boxes may be constructed with non-metallic thermoplastic or fiberglass reinforced polyester material.
 6. Terminal Blocks:
 - a. Material and Construction:
 - 1) NEMA rated nylon modular terminal blocks.

- 2) 600 volt rated.
- 3) Control and alarm circuit terminals shall be screwed type with permanently affixed numeric identifiers beside each connection.
- 4) Power terminals shall be copper and rated for the circuit ampacity.
- b. Manufacturer: Provide terminal blocks of one of the following:
 - 1) Allen-Bradley Company, Bulletin, 1492.
 - 2) General Electric Company, CR151K.
 - 3) Or equal.

L. Sealing Fittings:

- 1. Materials and Construction:
 - a. Cast gray iron alloy or cast malleable iron or copper free aluminum bodies with zinc electroplate and lacquer or enamel finish.
 - b. Ample opening with threaded closure for access to conduit hub for making dam.
 - c. In corrosive locations fittings shall include a factory applied 40 mil PVC coating.
- 2. Sealing fiber for forming the dam within the hub and the sealing compound shall be approved for use with the fittings furnished and shall be products of the fitting manufacturer.
- 3. Manufacturer: Provide sealing fittings manufactured by one of the following:
 - a. Crouse Hinds Company.
 - b. Appleton Electric Company.

2.2 WIRE AND CABLE

A. 600 Volt Cable:

- 1. Insulated Cable In Raceways:
 - a. Material: Single conductor copper cable conforming to ASTM B 3 and B 8 with flame retardant, moisture and heat resistant cross-linked polyethylene or thermoplastic insulation rated 90 C in dry locations and 75 C in wet locations and listed by UL as Type XHHW or RHW-2.
 - b. Application: Use XHHW indoor installations and RHW-2 for outdoor installations
 - c. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for 120 volt control circuits.
 - d. Stranding: All 600 volt cable shall be stranded except that solid cable, size 10 and smaller may be used for lighting circuits.
 - e. Manufacturer: Provide cable of one of the following:
 - 1) Southwire.
 - 2) The Okonite Company.
 - 3) American Insulated Wire
 - 4) General Cable
 - 5) Or equal.

B. Cable Connectors, Solderless Type:

1. For wire sizes up to and including #6 AWG, use compression type. Alarm and control wire shall be terminated using forked type connectors at terminal boards.
2. Product and Manufacturer: Provide one of the following:
 - a. T & B Sta-Kon.
 - b. Burndy Hylug.
 - c. Or equal.
3. For wire sizes #4 AWG and above, use either compression type or bolted type with silver-plated contact faces.
4. For wire sizes #250 kcmil and larger, use connectors with at least 2 cable clamping elements or compression indents and provision for at least 2 bolts for joining to apparatus terminal..
5. Properly size connectors to fit fastening device and wire size.

C. Cable Splices:

1. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings. Splices shall be taped and covered with materials recommended by the cable manufacturers, to provide insulation equal to that on the conductors.
2. For wire sizes No. 10 AWG and smaller, splices may be made up with pre-insulated spring connectors.
3. For wet locations, splices shall be waterproofed. Compression type splices shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductor. Spring connector splices shall be waterproofed with a sealant-filler.
4. Products and Manufacturers: Provide products of one of the following:
 - a. Compression-Type Splices:
 - 1) Burndy, Hylink.
 - 2) T&B, Color-Keyed Compression Connectors.
 - 3) Or equal.
 - b. Spring Connectors:
 - 1) Buchanan, B-Cap.
 - 2) T&B, Wire Connector.
 - 3) Or equal.

D. Cable Markers:

1. Material: Vinyl type, moisture, heat and abrasion resistant with adhesive back. Cable identification shall be clearly marked.
2. Product and Manufacturer: Provide one of the following:
 - a. Buchanan, Wire Markers.
 - b. T&B, E-Z Code.
 - c. Or equal.

2.3 WIRING DEVICES

- A. Outlet Boxes:
 - 1. Material: Cast gray iron alloy, or cast malleable iron, with zinc electroplate finish.
 - 2. Device Cover Plates:
 - a. Stainless steel Type 302 alloy for indoor areas.
 - b. Gasketed spring door type for devices designated as weatherproof.
 - c. Stainless steel screws and hardware.
 - 3. Manufacturer: Provide device boxes of one of the following:
 - a. Crouse-Hinds Company, Syracuse, NY.
 - b. Appleton Electric Company, Chicago, IL.
 - c. Or equal.
- B. Snap Switches:
 - 1. Single pole, AC toggle switch, quiet type, 120/277 volt AC, 20 ampere, black, specification grade.
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Cat. #1221-BLB, as manufactured by Harvey Hubbell Incorporated, Bridgeport, CT.
 - 2) Cat. #1991-BL, as manufactured by Arrow-Hart Incorporated, Syracuse, NY.
 - 3) Or equal.
- C. Receptacles for Non Hazardous Locations:
 - 1. Duplex grounding receptacle, two pole, three wire, 125 volt AC, 20 ampere with weather protective cover, where indicated on the Drawings.
 - a. Product and Manufacturer: Provide one of the following:
 - 1) Cat. #53CM62, as manufactured by Harvey Hubbell Incorporated, Bridgeport CT.
 - 2) Cat. #5362-CR, as manufactured by Arrow-Hart Incorporated, Syracuse, NY.
 - 3) Or equal.
 - 4)
- D. Receptacles for Hazardous Locations:
 - 1. Material: Factory sealed receptacle suitable for installation in Class I, Group D hazardous locations. Copper-free aluminum receptacle and cover with cast gray iron alloy or cast malleable iron mounting box with zinc electroplate finish. Receptacle rated at 20 amperes, 125-250 volt AC, 2 wire, three pole. Provide matching plug for each receptacle.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Series CPS by Crouse-Hinds Company.
 - b. Type CPS by Appleton Electric Company.
 - c. Or equal.

E. Disconnect Switches:

1. Single Throw, Circuit Disconnect Switches:
 - a. Type: Fused or Non-fused as shown on the Contract Drawings, horsepower rated, heavy-duty, single throw, quick-make, quick break mechanism, visible blades in the OFF position and safety handle.
 - b. Rating: Voltage and number of poles as required for motor or equipment circuits being disconnected. Switches shall bear a UL label.
 - c. Furnish one set of spare fuses for each fused disconnect switch to be installed
2. Enclosure:

Enclosures shall be NEMA 12 at a minimum and shall be provided based upon location in accordance with NEMA requirements as required for the area classifications, specified under this Section.
3. Manufacturer: Provide disconnect switches of one of the following:
 - a. Crouse-Hinds Company, Syracuse, NY.
 - b. General Electric Company, Plainville, CT.
 - c. Or equal.

2.4 MAGNETIC STARTERS

A. General:

1. Type: Magnetic coil operated, horsepower rated, NEMA sized with thermal overload protection.
2. Enclosed combination starter with magnetic only motor circuit protector and external operable, pad lockable handle.
3. Functional Type: Full voltage, single speed, nonreversing unless otherwise noted on Drawings.
4. Control power transformer fused and grounded on low voltage (120 V) side for each starter.
5. Overload Relays: Three bimetallic type, manually reset from outside the enclosure by means of an insulated button with normally open auxiliary contact for remote alarm purposes and separate heater elements sized for the full load amperes and service factor of the actual motors furnished.
6. Auxiliary contacts for motor space heaters, remote status signals and interlocks as shown on Drawings.
7. Start and stop control stations, selector switches, pilot lights and other devices as shown on Drawings.
8. Enclosure: Enclosures shall be provided based upon location in accordance with NEMA requirements and as required for the area classifications specified under this Section.

B. Product and Manufacturer: Provide one of the following:

1. Type A 206 by Cutler-Hammer.
2. Type CR287 by General Electric Company.

3. Bulletin 513 by Allen Bradley Company.
4. Or equal.

2.5 GROUNDING SYSTEMS

- A. Bare Ground Cable:
 1. Material: Annealed, bare, stranded copper, No. 8 AWG minimum size.
 2. Manufacturer: Provide ground cable of one of the following:
 - a. Cablec Corporation.
 - b. General Cable Corporation.
 - c. Or equal.
- B. Ground Rods:
 1. Material: Copperclad rigid steel rods, 3/4-inch diameter, 10 feet long.
 2. Manufacturer: Provide ground rods by one of the following:
 - a. Copperweld, Bimetallics Division.
 - b. ITT Blackburn Company.
 - c. Or equal.
- C. Grounding Connectors:
 1. Material: Pressure connectors to be copper alloy castings, designed specifically for the items to be connected, and assembled with Durium or silicone bronze bolts, nuts and washers. Welded connections to be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.
 2. Manufacturer: Provide grounding connectors of one of the following:
 - a. Pressure Connectors:
 - 1) O.Z./Gedney, Division of General Signal Corporation.
 - 2) Burndy Corporation.
 - 3) Or equal.
 - b. Welded Connections:
 - 1) Cadweld by Erico Products, Incorporated.
 - 2) Therm-O-Weld by Burndy Corporation.
 - 3) Or equal.

2.6 SERVICE AND DISTRIBUTION

- A. Lighting and Distribution Panelboards:
 1. Panelboards:
 - a. Rating: As shown on the drawings. Panels shall be UL listed as service entrance equipment.
 - b. Circuit Breakers: Molded case, bolt-in thermal magnetic type quantity and sizes as shown on the Drawings.
 - c. Branch circuit interrupting capacity to exceed the maximum fault current available at the panelboard bus.

- d. Bus Bars: 98 percent conductivity copper. All 4 wire panelboards shall have a solid neutral bar. All panels shall have ground bus.
- e. Main: All panelboards shall have a main circuit breaker unless Drawings specifically call for main lugs only.
- f. Branch circuit breakers connected for sequence phasing.
- g. Construction: Code grade steel, ample gutter space, flush door, flush snap latch and lock.
- h. Trim: Surface or flush as required.
- i. Directory: Typed card, with glass cover in frame on back of door giving the circuit numbers and the area or equipment served.
- j. Identification: Nameplate identifying the panel number and voltage.
- k. Manufacturer: Provide panelboards of one of the following:
 - 1) General Electric Company.
 - 2) Cutler-Hammer.
 - 3) Square D Company.
 - 4) Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Mount equipment so that sufficient access and working space is provided for safe operation and maintenance.
 - 2. Securely fasten enclosures to walls and other structural surfaces on which they are mounted. Provide independent supports where no walls or other structural surface exists.
 - 3. Install in conformance with the National Electrical Code.
- B. Raceway Systems:
 - 1. Supports:
 - a. Rigidly support conduits by clamps, hangers or unistrut channels.
 - b. Support single conduits by means of one hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers with steel horizontal members and threaded hanger rods, Kindorff or equal. Rods shall be not less than 3/8- inch diameter, and shall be cadmium coated.
 - c. For PVC coated rigid steel conduit runs, supports and hardware shall be PVC coated or stainless steel.
 - 2. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures by the following methods:
 - a. To Wood: Wood screws.
 - b. To Hollow Masonry Units: Toggle bolts.
 - c. To Brick Masonry: Price expansion bolts, or equal.
 - d. To Concrete: Phillips; Hilti Corporation; or equal, anchors.

- e. To Steel: Welded threaded studs, beam clamps or bolts with lockwashers or locknuts.
- 3. Exposed Conduit:
 - a. Install parallel or perpendicular to structural members or walls.
 - b. Wherever possible, run in groups. Provide galvanized conduit racks of suitable width, length and height and arranged to suit field conditions. Support every ten feet minimum.
 - c. Install on structural members in protected locations.
 - d. Locate clear of interferences.
 - e. Install vertical runs plumb. Unsecured drop length not to exceed 12 feet.
 - f. Maintain 6 inches from hot fluid lines and 1/4 inch from walls.
- 4. Underground Conduits:
 - a. Install underground conduits a minimum of 24 inches below grade unless otherwise indicated.
 - b. Perform all excavation, bedding, backfilling and surface restoration including pavement replacement where required.
 - c. Make conduit connections watertight.
- 5. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at any bend.
- 6. Joints:
 - a. Apply conductive compound to all joints before assembly.
 - b. Make up joints tight and ground thoroughly.
 - c. Use standard tapered pipe threads for conduit and fittings.
 - d. Cut conduit ends square and ream to prevent damage to wire and cable.
 - e. Use full threaded couplings. Split couplings not permitted.
 - f. Use strap wrenches and vises to install conduit. Replace conduit with wrench marks.
 - g. Apply zinc-rich paint to exposed threads and other areas of galvanized conduit system where the base metal is exposed.
- 7. Terminations:
 - a. Install insulated bushings on conduits entering boxes or cabinets, except threaded hub types.
 - b. Provide locknuts on both inside and outside of enclosure for grounding.
 - c. Bushings not to be used in lieu of locknuts.
- 8.. Moisture Protection:
 - a. Plug or cap conduit ends at time of installation to prevent entrance of moisture or foreign materials.
 - b. Make underground and embedded conduit connections watertight.
 - c. Drainage: Pay particular attention to drainage for conduit runs. Wherever possible, install conduit runs so as to drain to one end and away from buildings. Avoid pockets or depressions in conduit runs.
 - d. For conduits passing through exterior blocks walls or installed in existing construction passing through exterior subsurface walls, exterior concrete walls, floor slabs and roof slabs for use in core bit-drilled holes provide Type CSMI sealing bushing at the inside of the structure and Type CSMC

- sealing bushing at the outside of the structure, within the same core drilled hole. Sealing bushings manufactured by O-Z/Gedney or equal.
- e. For conduits passing through existing interior concrete walls or floors and interior block walls, provide CSMC or CSMI type sealing bushings as manufactured by O-Z/Gedney or equal.
 - f. Seal all conduit openings within control and instrumentation panels and distribution equipment with Type DUX - Duct Sealing Compound, manufactured by O-Z/Gedney or equal to provide a watertight seal.
- Corrosion Protection:
- a. Dissimilar Metals:
 - 1) Take every action to prevent the occurrence of electrolytic action between dissimilar metals.
 - 2) Do not use copper products in connection with aluminum work, and do not use aluminum in locations subject to drainage of copper compounds on the bare aluminum.
 - 3) Back paint aluminum in contact with masonry or concrete with two coats of aluminum-pigmented bituminous paint.
 - b. Underground Conduits:
 - 1) Install conduit runs buried in earth with concrete encasement or use PVC coated rigid steel conduit.
10. Core drill for individual conduits passing through existing concrete slabs. Notify Engineer in advance prior to core drilling. Prior to core drilling, Contractor shall drill sufficient number of small exploratory holes to establish that the area to be core drilled is free of existing embedded conduits. Seal spaces around conduit with epoxy grout.
11. Reused Existing Conduits:
- a. Pull rag swab through conduits to remove water and to clean conduit prior to installing new cable.
 - b. Repeat swabbing until all foreign material is removed.
 - c. Pull mandrel through conduit, if necessary, to remove obstructions.
12. PVC Coated Rigid Galvanized Steel Conduit:
- 1. Install in accordance with manufacturers recommendations.
 - 2. During installation install with manufacturers' installation tools so as not to damage PVC coating.
 - 3. Should PVC coating be damaged during installation and exposing the steel conduit, repair with manufacturers recommended touch-up compounds.
13. Flexible Conduit:
- a. Install at motors and equipment which are subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept 3/4-inch size flexible conduit. Limit flexible conduit length to three feet maximum.
14. Junction Boxes:
- a. Size junction boxes in accordance with the requirements of the National Electrical Code.

- b. Provide terminal blocks in junction boxes where cable terminations or splices are required.
- C. Wire and Cables:
 - 1. 600 Volt Cable:
 - a. Install all cables complete with proper terminations at both ends. Handle existing wiring to be re-installed with care to avoid damage. Protect wire until time of installation. Check and correct for proper phase sequence and proper motor rotation.
 - b. Pulling:
 - 1) Use insulating types of pulling compounds containing no mineral oil.
 - 2) Pulling tension shall be within the limits recommended by the wire and cable manufacturer.
 - 3) Use a dynamometer where mechanical means are used.
 - 4) Cut off section subject to mechanical means.
 - c. Bending Radius: Limit to 6 times cable overall diameter.
 - d. Slack: Provide maximum slack at all terminal points.
 - e. Splices:
 - 1) Where possible, install cable continuous, without splice, from termination to termination.
 - 2) Where required, splice in junction box using terminal boards.
 - 3) Splices in conduits not allowed.
 - f. Identification: Identify all power conductors by circuit number and phase at each terminal or splice location. Identify control and status wiring using numeral tagging system.
 - g. Color code power cables in accordance with Owner's standards.
- D. Wiring Devices:
 - 1. Outlet Boxes:
 - a. Fasten boxes rigidly and neatly to supporting structures.
 - b. For units mounted on masonry or concrete walls, provide suitable 1/2-inch spacers to prevent mounting back of box directly against wall.
 - c. Leave no open conduit holes in boxes. Close unused openings with capped bushings.
 - d. Label each circuit in boxes and identify with durable tag.
 - 2. Snap Switches:
 - a. Install switches in outlet or device boxes.
 - b. Mount wall switches 4 feet-6 inches above finished floor unless otherwise noted.
 - 3. Receptacles:
 - a. Install receptacles in outlet or device boxes.
 - b. Install receptacles with ground pole in the down position.
 - c. Mount receptacles 18 inches above finished floor.

3.2 INSPECTIONS, TESTING AND ADJUSTMENTS

- A. Inspections: Accompany the normal installation tests with inspections to demonstrate to the satisfaction of the County the following:
 - 1. Connections: All circuits are properly connected in accordance with the Drawings and applicable approved Shop Drawings.
 - 2. Operation: All circuits and devices are operable.
 - 3. Identification: All conductors are properly identified at each terminal.

- B. Testing - Submit Test Procedures for the following:
 - 1. Test conduits by pulling through each conduit a cylindrical mandrel not less than two pipe inside diameters long, having an outside diameter equal to 90 percent of the inside diameter of the conduit.
 - 2. 600 Volt Cable:
 - a. Test each new electrical circuit after permanent cables are in place to demonstrate that the circuit and connected equipment perform satisfactorily and that they are free from improper grounds and short circuits.
 - b. Individually test 600 volt cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are put in service with a Megger whose rating is suitable for the tested circuit. Tests shall meet with the applicable specifications of ICEA S-66-524 and NEMA WC7-1971.
 - c. The insulation resistance for any given conductor shall not be less than 1 megohm for 600 volt and less service. Any cable not meeting this value or which fails when tested under full load conditions shall be replaced with a new cable for the full length.
 - 3. Operation Tests:
 - a. Operate all starters, circuit breakers and associated equipment to demonstrate suitability and compliance with Specifications and reference standards, except for short circuit interrupting rating or other inherent design features covered by shop tests.
 - b. Test all motors for direction of rotation and reverse connections if necessary.
 - c. Check control circuits to determine that operation and sequence are correct and adjust devices to give proper operation.

+ + END OF SECTION + +

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to perform clearing and grubbing as shown and specified in the Contract Documents.
2. The Work includes removing from the Site and disposing of trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish, and other objectionable material.
3. Pay all costs associated with transporting and disposing of debris resulting from clearing.
4. Limits of Clearing and Grubbing Work: Clear and grub all areas within the Work areas unless otherwise shown or indicated in the Contract Documents.

1.2 QUALITY ASSURANCE

A. Professional Arborist Qualifications:

1. Engage an accredited professional arborist, acceptable to ENGINEER, skilled, trained and with successful and documented experience in the protection and restorative care of trees, certified by the International Society of Arboriculture or American Society of Consulting Arborists; who agrees to employ only tradesmen with specific skill and successful experience in this type of Work.
2. Submit names and qualifications to ENGINEER along with the following information on a minimum of three successful projects.
 - a. Names and telephone numbers of owner, architects or engineers responsible for projects.
 - b. Approximate contract cost of the tree protection and trimming.
 - c. Amount and kinds of tree protection and trimming performed.

B. Tree Pruning Standards: Comply with ANSI A300 and ISA standards, unless more stringent requirements are specified, or required by Site conditions.

C. Regulatory Requirements:

1. Laws and Regulations applying to the Work under this Section include, but are not necessarily limited to, the following:
 - a. Town of Wilmington, Public Works Department.

1.3 SUBMITTALS

A. Action Submittals: Submit the following

1. Shop Drawings:
 - a. Plan for removing trees and other large vegetation not explicitly shown or

indicated for removal in the Contract Documents.

- b. Plan showing proposed limits of clearing and grubbing, if different from clearing and grubbing limits shown or indicated in the Contract Documents.

B. Informational Submittals: Submit the following

1. Qualification Statements:
 - a. Arborist, in accordance with Article 1.2 of this Section.

1.4 WARRANTY

- A. CONTRACTOR shall warrant that Work performed under this Section will not permanently damage trees, shrubs, turf, and plants designated to remain, or other adjacent work, facilities, or property. If damage resulting from CONTRACTOR's operations becomes evident during the correction period, CONTRACTOR shall replace damaged items and property at no additional cost to OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. Protection:

1. Throughout the Project, protect existing site improvements, including streets, drives, and Underground Facilities to remain (if any), and adjacent property and structures. Repair damage caused by CONTRACTOR to original condition or replace in kind, to satisfaction of ENGINEER, at no additional cost to OWNER.
2. Protect trees, shrubs, vegetation, and grassed areas to remain by providing temporary fencing, barricades, wrapping, or other methods shown, specified, or accepted by ENGINEER. Correct at CONTRACTOR's expense damage caused by CONTRACTOR outside the limits of clearing Work.
3. Do not remove trees without approval of ENGINEER, unless shown or indicated for removal.
4. Do not locate construction equipment, stored materials, or stockpiles within drip line of trees and vegetation to remain.

B. Site Preparation:

1. Obtain, pay costs associated with, and comply with applicable permits required for clearing and grubbing Work.
2. Delineation of Clearing and Grubbing Limits:
 - a. Locate and clearly flag trees and vegetation to remain, and other materials to remain in the clearing and grubbing limits. Locate and clearly flag salvable vegetation to be relocated.
 - b. Provide flagging to delineate limits of areas to be cleared or grubbed. Review

- at Site with ENGINEER before commencing removal of trees, vegetation, and other materials to be removed.
- c. Replace flagging that is lost, removed, or destroyed, until clearing and grubbing Work is complete and ENGINEER allows removal of flagging.
- 3. Erosion and Sediment Controls:
 - a. Provide applicable erosion and sediment controls before commencing clearing and grubbing Work.
 - b. Comply with erosion and sediment control requirements of Section 01 57 05, Temporary Controls.
 - c. Continue providing erosion and sediment controls as clearing and grubbing Work progresses to previously uncleared, ungrubbed areas of the Site.

3.2 CLEARING AND GRUBBING

- A. Remove and dispose of all trees, shrubs, stumps, roots, brush, logs, rubbish, and debris within limits of clearing and grubbing shown or indicated in the Contract Documents, unless otherwise shown or indicated.
- B. Trees and Shrubs Improperly Destroyed or Damaged:
 - 1. For each tree or shrub to remain that is destroyed or damaged beyond repair by CONTRACTOR, provide two replacements of the same species at locations to be designated by ENGINEER.
- C. Trees and shrubs to remain that have been damaged or require trimming shall be treated and repaired under the direction of a qualified arborist, or other professional with qualifications acceptable to ENGINEER. Trees and shrubs intended to remain, that are damaged beyond repair or that are removed, shall be replaced by CONTRACTOR at no additional cost to OWNER.
- D. Disposal of Cleared and Grubbed Materials:
 - 1. Dispose at appropriate off-Site location trees, stumps, rubbish, debris, and other cleared and grubbed material. Do not use cleared or grubbed material as fill, backfill, or in embankments.
 - 2. Dispose of cleared and grubbed material in accordance with Laws and Regulations.
 - 3. Do not burn clearing debris at the Site.

3.3 TOPSOIL REMOVAL

- A. Existing topsoil to be removed is defined as friable, clay loam, surface soil present in depth of at least four inches. Topsoil shall be free of subsoil, clay lumps, stones, and other objects over two-inch diameter and other objectionable material.
- B. Stripping:
 - 1. Strip topsoil to depths encountered, in manner that prevents intermingling of topsoil with underlying subsoil or other objectionable material. Remove heavy growths of grass and vegetation from areas before stripping.

2. Do not strip topsoil from within drip line of each tree to remain as part of the completed Project.

- C. Properly dispose of excess topsoil at OWNER's spoil area.

3.4 ENVIRONMENTAL PROTECTION AND RESTORATION

- A. CONTRACTOR shall be required to provide environmental protection and restoration as shown on the Contract Drawings.
- B. All environmental protection and restoration shall also be in accordance with the Massachusetts Department Environmental Protection and all other local, state, and Federal regulations.

+ + END OF SECTION + +

SECTION 31 23 16.13

TRENCHING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to perform all excavating, filling, and grading, and disposing of earth materials as shown, specified, and required for construction of Underground Facilities and related construction required to complete the Work.
2. Preparation of subgrade is included under this Section.
3. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof, except rock requiring drilling, blasting or special equipment for removal which is under Section 31 23 16.26, Rock Removal.

B. Related Sections:

1. Section 01 55 26, Maintenance and Protection of Traffic
2. Section 01 57 05, Temporary Controls.
3. Section 03 00 05, Concrete.
4. Section 31 23 16.26, Rock Removal.
5. Section 32 12 00, Flexible Paving.
6. Section 33 05 05, Buried Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/AISC 360, Specification for Structural Steel for Buildings.
2. ASTM C33/C33M, Specification for Concrete Aggregates.
3. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
4. ASTM C150/C150M, Specification for Portland Cement.
5. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
6. ASTM D422, Test Method for Particle-Size Analysis of Soils.
7. ASTM D698, Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
8. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
9. ASTM D1557, Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
10. ASTM D2216, Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

11. ASTM D4253, Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
12. ASTM D4254, Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
13. ASTM D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
14. ASTM D4832, Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
15. ASTM D6023, Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM).
16. ASTM D6103, Test Method for Flow Consistency of Controlled Low Strength Material (CLSM).
17. ASTM D6938, Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
18. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

1.3 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:
 1. “Subgrade” is the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. Professional Engineer:
 - a. Engage a registered professional engineer legally qualified to practice in the same jurisdiction as the Site and experienced in providing engineering services of the kind indicated.
 - b. Responsibilities include but are not necessarily limited to:
 - 1) Reviewing system performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.
 - 3) Preparing or supervising the preparation of design calculations and related submittals verifying compliance of the system with the requirements of the Contract Documents.
 - 4) Signing and sealing all calculations, drawings, and submittals prepared by professional engineer.
 - 5) Certifying that:
 - a) it has performed the design of the system in accordance with the performance requirements stated in the Contract Documents, and
 - b) the said design conforms to Laws and Regulations, and to the

prevailing standards of practice.

2. CONTRACTOR's Testing Laboratory:
 - a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
 - b. Testing laboratory shall comply with ASTM E329 and requirements of Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor.
 - c. Testing laboratory shall be experienced in the types of testing required.
 - d. Selection of testing laboratory is subject to ENGINEER's acceptance.

B. Quality Assurance Testing:

1. Quality assurance testing is in addition to field quality control testing required under Part 3 of this Section.
2. Materials used in the Work may require testing and retesting, as directed by ENGINEER, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at OWNER's expense, including retesting of rejected materials and installed Work, shall be performed at CONTRACTOR's expense.
3. CONTRACTOR's Testing Laboratory Scope:
 - a. Collect samples and perform testing of proposed fill materials in the laboratory and in the field to demonstrate compliance of the Work with the Contract Documents.
 - b. Testing laboratory shall perform testing required to obtain data for selecting moisture content for placing and compacting fill materials.
 - c. Submit to ENGINEER and CONTRACTOR written report results of each test.
4. Required Quality Assurance Material Testing by CONTRACTOR's Testing Laboratory:
 - a. Gradation in accordance with ASTM D422. Perform one test for every 1,000 cubic yards of each of the following types of material incorporated into the Work: select fill, general fill, subbase material, drainage fill, and pipe bedding material.
 - b. Atterberg limits in accordance with ASTM D4318. Perform one test for every 1,000 cubic yards of the following types of materials incorporated into the Work: general fill, and pipe bedding material.
 - c. Moisture/density relations in accordance with ASTM D698, ASTM D1557, ASTM D4253, or ASTM D4254, as applicable. Perform one test for every 5,000 cubic yards of the following types of materials incorporated into the Work: select fill, general fill, subbase material, drainage fill, and pipe bedding material.
 - d. Moisture content of stockpiled or borrow material in accordance with ASTM D2216. Perform one test for every 1,000 cubic yards of the following types of material incorporated into the Work: select fill, general fill, subbase material, drainage fill, and pipe bedding material.

C. Regulatory Requirements:

1. Perform excavation work in compliance with requirements of authorities having jurisdiction and Laws and Regulations, including:
 - a. OSHA, 29 CFR Part 1926, Section .650 (Subpart P – Excavations).
2. Obtain required permits and approvals for excavation and fill Work, including work permits from right-of-way owners and permits from environmental authorities having jurisdiction over discharge of water from excavations.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Modifications to the Work proposed due to design of sheeting, shoring, bracing, cofferdams, and similar excavation supports.

B. Informational Submittals: Submit the following:

1. Procedure Submittals:
 - a. Excavation Plan: Prior to starting excavation operations, submit written plan to demonstrate compliance with OSHA 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
 - 1) Name of CONTRACTOR's "competent person" in responsible charge of excavation and fill Work.
 - 2) Excavation method(s) and additional items to be included in the Work, as listed in Paragraph 1.5.B.2.a of this Section.
 - 3) Copies of "manufacturer's data" or other tabulated data if protective system(s) are designed on the basis of such data.
 - 4) Copies of required permits and approvals, from authorities having jurisdiction and affected utility owners, for excavation methods proposed.
 - b. Proposed compaction procedure and compaction equipment proposed for use. Where different procedures or equipment will be used for compacting different types of material or at different locations at the Site, indicate where each procedure and equipment item will be used.
2. Excavation Support Plan and Related Information Prepared by CONTRACTOR's Professional Engineer:
 - a. CONTRACTOR and CONTRACTOR's professional engineer shall prepare the following for submittal:
 - 1) Sheeting and bracing, or other protective system(s) required.
 - 2) Dewatering system.
 - b. Drawings shall be prepared by professional engineer qualified in the specialty involved. Do not submit calculations. ENGINEER's review and acceptance of submittal does not imply approval by ENGINEER of the associated Work. CONTRACTOR shall be solely responsible for designing, installing, operating and maintaining the system(s) necessary to satisfactorily perform all sheeting, bracing, protection, underpinning, and dewatering.
3. Quality Assurance Test Results Submittals:

- a. Submit results of quality assurance testing performed by in accordance with Paragraph 1.4.B of this Section, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:
 - 1) Tests on borrow fill material.
 - 2) Optimum moisture – maximum dry density curve for each type of fill material.
- 4. Field Quality Control Submittals:
 - a. Submit results of testing and inspection performed in accordance with the field quality control Article in Part 3 of this Section, including:
 - 1) Field density testing.
- 5. Qualifications Statements:
 - a. Professional engineer.
 - b. Quality Assurance Testing laboratory. Submit name and qualifications of testing laboratory to be employed, and qualifications of testing laboratory's personnel that will perform quality assurance testing required in this Section.
 - c. Field Quality Control Testing Laboratory: Names and qualifications of testing laboratory employed, and qualifications of testing laboratory's personnel that will perform field quality control testing as required under this Section.

1.6 SITE CONDITIONS

- A. Soil borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to OWNER. Coordinate CONTRACTOR-performed test borings and other exploratory operations with OWNER and utility owners as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of OWNER or utility owners. Comply with Laws and Regulations relative to required notifications.
- B. Existing Structures:
 - 1. The Contract Documents show or indicate certain structures and Underground Facilities adjacent to the Work. Such information was obtained from existing records and is not guaranteed to be correct or complete. CONTRACTOR shall explore ahead of the excavation to determine the exact location of all existing structures and Underground Facilities. Existing structures and Underground Facilities shall be supported and protected from damage by CONTRACTOR. Immediately repair and restore existing structures and Underground Facilities damaged by CONTRACTOR without additional cost to OWNER.
 - 2. Movement or operation of construction equipment over Underground Facilities shall be at CONTRACTOR's sole risk and only after CONTRACTOR has prepared and submitted to ENGINEER and utility owners (as applicable), and received acceptance therefrom, a plan describing CONTRACTOR's analysis of the loads to be imparted and CONTRACTOR's proposed measures to protect structures and Underground Facilities during the Project.

3. Coordinate with utility owners for shut-off of services in active piping and conduits. Completely remove buried piping and conduits indicated for removal and not otherwise indicated as being abandoned or to remain in place.
4. In general, service lines and laterals to individual houses and businesses are not shown; however, CONTRACTOR shall assume that a service exists for each utility owner to each house, business, and property.
5. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when such interruption is indicated in the Contract Documents or when allowed in writing by ENGINEER after acceptable temporary utility services are provided by CONTRACTOR for the affected structure or property.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Select Fill:

1. Material shall be well-graded, crushed aggregate, free of organic material, complying with the following:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1.25-inch	100
No. 4	38 to 65
No. 8	25 to 60
No. 30	10 to 40
No. 200	3 to 12

B. General Fill:

1. Material shall be free of: rock and gravel larger than three inches in any dimension, debris, waste, frozen materials, organic material, and other deleterious matter.
2. Fill shall have a liquid limit not greater than 45, and plasticity index not greater than 25.
3. Previously-excavated materials complying with the Contract Documents requirements for general fill may be used for general fill.
4. When on-Site materials are found unsuitable for use as general fill, provide select fill or approved off-Site general fill materials. Prior to using off-Site material as general fill, furnish submittal for and obtain ENGINEER's approval of the material proposed for use.

C. Subbase Material:

1. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, or natural or crushed sand, complying with the gradation requirements below. Crushed slag is unacceptable.

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
2-inch	100
1 1/4-inch	85 to 100
3/4-inch	10 to 40
1/2-inch	0 to 8

D. Road Gravel

1. Road gravel shall be well graded hard, sound, tough, durable particles of uncrushed gravel free from soft, thin, elongated or laminated pieces, organic matter and other deleterious substance. This gravel is for roads not receiving bituminous treatment.
2. The percentage by weight passing a No. 100 square sieve shall not exceed ten percent and all stones larger than 3-inches shall be removed by screening or by hand.

E. Crushed Stone:

1. Crushed stone shall consist of the product obtained by crushing rock, stone, or gravel.
2. Crushed stone shall satisfy the requirements listed in MHD Specification Section M2.01.
3. Crushed stone greater than 1 1/2-inch-3-inch shall satisfy the following requirements:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
3-inch	100
2 1/2-inch	95 to 100
2-inch	35 to 75
1 1/2-inch	0 to 25

4. All crushed stone shall be double washed and free of iron particles, fines and dust in place.

F. Peastone:

1. Peastone shall be smooth, hard, naturally occurring, rounded stone meeting the following gradation requirements:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
5/8-inch	100
No. 8	0

G. Sand:

1. Sand for use as embedment material around plastic pipes (PVC, HDPE) shall consist of natural or manufactured granular material.
2. Sand material shall contain no organic material. Sand shall be nonplastic, when tested in accordance with ASTM D 4318, 100 percent shall pass a 1/2-inch screen and no more than 20 percent shall pass a No. 200 screen.
3. The sand shall be deposited in uniform layers not to exceed 6-inches in uncompacted thickness. The backfill shall be compacted to not less than 95 percent of laboratory maximum density as determined by ASTM D 698.
4. All material for sand must be tested and approved by the ENGINEER.
5. No sand shall be placed without the approval of the ENGINEER.

2.2 SOURCE QUALITY CONTROL

- A. Perform quality assurance testing, and submit results to ENGINEER, in accordance with the "Quality Assurance" Article in Part 1 of this Section.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Provide ENGINEER with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. ENGINEER will advise CONTRACTOR in writing when ENGINEER is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 TEST PITS

A. General:

1. In advance of the construction, excavate, make observations and measurements, and fill test pits to determine conditions or location of the existing Underground Facilities and structures. Perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, filling, and replacing pavement for test pits. CONTRACTOR shall be responsible for the definite location of each existing Underground Facility involved within the area of excavation for the Work. Exercise care during such location work to avoid damaging and disrupting the affected Underground Facility or structure. CONTRACTOR shall be responsible for repairing, at his expense, damage to Underground Facility or structure caused during the Work.

3.3 PREPARATION

- A. Use of Explosives:

1. Use of explosives is not allowed.
- B. Dust Control:
1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to ENGINEER's acceptance and approval of authorities having jurisdiction.

3.4 DEWATERING

- A. Dewatering – General:
1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the Underground Facilities to be built therein area acceptable to ENGINEER and backfilling operations are completed and acceptable to ENGINEER.
 2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
 3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
 4. CONTRACTOR shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
 5. Remove water from excavations as fast as water collects.
 6. All water removed as part of dewatering operations shall be filtered prior to discharge in accordance with Section 01 57 05, Temporary Controls.
- B. Temporary Dewatering System:
1. CONTRACTOR shall design, provide, and operate dewatering system to include sufficient trenches, sumps, pumps, hose, piping, well points, deep wells, and similar facilities, necessary to depress and maintain groundwater level a minimum of one foot below the base of each excavation during all stages of construction operations.
 2. Design and operate dewatering system to avoid settlement and damage to existing structures and Underground Facilities.
 3. Groundwater table shall be lowered in advance of excavation for a sufficient period of time to allow dewatering of fine grain soils.

4. Maintain groundwater level at excavations two feet below lowest subgrade excavation until the structure or Underground Facility, as applicable, has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural groundwater.
 5. Operate dewatering system continuously, 24 hours per day, seven days per week. Provide standby pumping facilities and personnel to maintain the continued effectiveness of the system. Do not discontinue dewatering operations without first obtaining ENGINEER's acceptance for such discontinuation.
 6. If, in ENGINEER's opinion, the water levels are not being lowered or maintained as required, provide additional or alternate temporary dewatering devices as necessary, at no additional cost to OWNER.
 7. Locate elements of temporary dewatering system to allow continuous dewatering operation without interfering with the Work to the extent practicable.
 8. Where portions of dewatering system are located in the area of permanent construction, submit to and obtain ENGINEER's acceptance of details of proposed methods of constructing the Work at such location. Control of ground water shall continue until the permanent construction provides sufficient dead load to withstand hydrostatic uplift of the normal groundwater, until concrete has attained sufficient strength to withstand earth and hydrostatic loads.
 9. Perform pumping of water from excavations in a manner that prevents carrying away of unsolidified concrete materials, and that avoids damaging the subgrade.
 10. Before discontinuing dewatering operations or permanently allowing rise of groundwater level, prepare computations to demonstrate that structures affected by the water level rise are protected by fill or other means to sustain uplift. Use a safety factor of 1.25 when preparing such calculations.
- C. Disposal of Water Removed by Dewatering System:
1. CONTRACTOR's dewatering system shall discharge to suitable location acceptable to OWNER and owners of other properties potentially affected by water discharge, including owners adjacent to and downstream of dewatering system discharge. Operation dewatering system and disposal of water shall be in accordance with Laws and Regulations.
 2. Convey water from excavations in closed conduits. Do not use trench excavations as temporary drainage ditches.
 3. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
 4. Dispose of water in manner that causes no inconvenience to OWNER, others involved in the Project, and adjacent and downstream properties.

3.5 EXCAVATION

- A. Perform all excavation required to complete the Work as shown, specified, and required. Excavations shall include removing and handling of earth, sand, clay,

gravel, hardpan, soft, weathered or decomposed rock, pavements, rubbish, and other materials within the excavation limits. Where the excavation includes rock that requires drilling or specialized equipment for removal, remove rock in accordance with Section 31 23 16.26, Rock Removal.

B. Excavation Protection:

1. Provide excavation protection system(s) in accordance with Laws and Regulations to prevent injury to persons and property, including Underground Facilities.
2. Excavation Less Than Five Feet Deep: Excavations in stable rock or in soil conditions where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
3. Excavations Greater Than Five Feet Deep: Excavations in stable rock may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
4. Provide and maintain excavation protection system(s) in accordance with submittals accepted by ENGINEER and required under Paragraph 1.5.B of this Section.

C. Maintain excavations in dry condition in accordance with “Dewatering” Article in Part 3 of this Section.

D. Elevation of bottom of footings shown is approximate. ENGINEER may direct such minor changes in dimensions and elevations as may be required to secure a satisfactory footing. Elevations of piping, conduit, and similar other Underground Facilities shall be as shown or indicated on the Contract Documents.

E. When excavations are made below required grades without written order of ENGINEER, fill such excavations with compacted select fill material, as directed by ENGINEER, at CONTRACTOR’s expense.

F. Extend excavations sufficiently on each side of structures, footings, and similar construction to allow setting of forms, installation of shoring and bracing, and the safe sloping of banks, as necessary.

G. Subgrades – General:

1. Subgrades shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades that are otherwise solid but become soft or mucky on top due to construction operations shall be reinforced with subbase material. Finished elevation of stabilized subgrades shall not be above subgrade elevations shown.
2. If, in ENGINEER’s opinion, subgrade becomes softened or mucky because of construction delays, failure to dewater properly, or other cause within CONTRACTOR’s control, subgrade shall be excavated to firm material, trimmed, and backfilled with select fill material at CONTRACTOR’s expense.

H. Pipe Trench Preparation:

1. Not more than 50 feet of trench may be opened in advance of installing pipe in trench.
2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:
 - a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. Refer to Drawings for trench requirements. In no case should trench be wider at top of pipe than pipe barrel OD plus two feet, unless otherwise shown or indicated.
 - b. Enlargement of trench width at pipe joints may be made when required and approved by ENGINEER.
 - c. Trench width shall be sufficient for shoring and bracing, or shielding and dewatering.
 - d. Trench width shall be sufficient to allow thorough compaction of fill adjacent to bottom half of pipe.
 - e. Do not use excavating equipment that requires the trench to be excavated to excessive width.
3. Depth of trench shall be as shown or indicated. If required and approved by ENGINEER in writing, depths may be revised.
4. Where ENGINEER considers existing material beneath bedding material unsuitable, remove and replace such unsuitable material with select fill material.

I. Excavated Materials to be Used as Fill:

1. Stockpile excavated materials that are acceptable for use as fill.
2. As excavation proceeds, keep stockpiles of excavated materials suitable for use as fill separate from unsuitable materials and waste materials.
3. Place, grade, and shape stockpiles for proper drainage.
4. Locate and retain soil materials away from edge of excavations.
5. Dispose of excess soil material and waste materials as specified in this Section.
6. Stockpiled excavated soils for use as select fill or general fill shall be tested and classified by laboratory as on-Site select fill or on-Site general fill. Perform required quality assurance testing for material verification on stockpiled materials as soon as possible to demonstrate compliance of excavated materials with the Contract Documents.

3.6 UNAUTHORIZED EXCAVATION

- A. All excavations outside lines and grades shown or indicated and that are not approved by ENGINEER, together with removing and disposing of the associated material, shall be at CONTRACTOR's expense. Fill unauthorized excavations with properly-compacted select fill material at CONTRACTOR's expense.

3.7 EROSION AND SEDIMENT CONTROLS

- A. Provide temporary erosion and sediment controls in accordance with Section 01 57 05, Temporary Controls. When applicable, also comply with requirements of the erosion and sediment control plan approved by authorities having jurisdiction.

3.8 SHEETING, SHORING, AND BRACING

- A. General:
 - 1. Design and provide sheeting, shoring, bracing, cofferdams, and similar excavation supports as shown, specified, and required for the Work.
 - 2. Clearances and types of temporary sheeting, shoring, bracing, and similar excavation supports, insofar as they may affect the finished character of the Work and the design of sheeting to be left in place, will be subject to the ENGINEER's approval; but CONTRACTOR is responsible for adequacy of all sheeting, shoring, bracing, cofferdams, and similar excavation supports.
 - 3. Materials:
 - a. Previously-used materials shall be in good condition, and shall not be damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary sheeting, shoring, and bracing.
 - b. All steel work for sheeting, shoring, bracing, cofferdams and other excavation supports, shall be in accordance with ANSI/AISC 360, except that field welding will be allowed.
 - 4. As excavation progresses, carry down shoring, bracing, cofferdams, and similar excavation supports to required elevation at bottom of excavation.
 - 5. Comply with Laws and Regulations regarding sheeting, shoring, bracing, cofferdams, and similar excavation supports.
 - 6. Maintain sheeting, shoring, bracing, bracing, and other excavation supports in excavations regardless of time period excavations will be open.
 - 7. Unless otherwise shown, specified, or directed, remove materials used for temporary construction when the Work is completed. Perform such removal in manner not injurious to the structures and Underground Facilities, their appearance, and adjacent construction.
- B. Removal of Sheeting and Bracing:
 - 1. Remove sheeting and bracing from excavations, unless otherwise directed by ENGINEER in writing. Perform removal to avoid damaging the Work and adjacent construction. Removal shall be equal on both sides of excavation to ensure no unequal loads on structures and Underground Facilities.
 - 2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until concrete has cured for not less than seven days.

3.9 TRENCH SHIELDS

- A. Excavation of earth material below bottom of trench shield shall not exceed the limits established in Laws and Regulations.
- B. When using a shield for installing piping:
 - 1. Portions of trench shield extending below the mid-diameter of an installed, rigid pipe, such as prestressed concrete pipe and other types of rigid pipe, shall be raised above the pipe's mid-diameter elevation prior to moving the shield along the trench for further construction.
 - 2. Bottom of shield shall not at any time extend below mid-diameter of installed pipe that is flexible or has flexing capability, such as steel, ductile iron, PVC, CPVC, polyethylene, and other pipe that has flexing capability.
- C. When using a shield for installing structures, including structures that are Underground Facilities, bottom of the shield shall not extend below the top of the bedding for the structures.
- D. When removing the shield or moving the shield ahead, exercise extreme care to prevent moving piping, structures, and other Underground Facilities, and prevent disturbance of bedding material for piping, structures, and other Underground Facilities. When piping, structures, or other Underground Facilities are disturbed, remove and reinstall the disturbed items in accordance with the Contract Documents.

3.10 FILL AND COMPACTION – GENERAL PROVISIONS

- A. Provide and compact all fill required for the finished grades as shown and as specified in this Section.
- B. Place fill in excavations as promptly as progress of the Work allows, but not until completing the following:
 - 1. ENGINEER's authorization after observation of construction below finish grade.
 - 2. Inspection, testing, approval, and recording of locations of Underground Facilities.
 - 3. Removal of formwork.
 - 4. Removal of shoring and bracing, and filling of voids with satisfactory materials.
 - 5. Removal of trash and debris.
 - 6. Field testing of Underground Facilities including piping and conduits, in accordance with Section 33 05 05, Buried Piping Installation, when nature of the test requires observation of pipe exterior during testing.
- C. Fill that includes organic materials or other unacceptable material shall be removed and replaced with approved fill material in accordance with the Contract Documents.

D. Placement – General:

1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around structures and Underground Facilities.
2. Place fill materials at moisture content and density as specified in this Article's requirements on compaction density. Furnish and use equipment capable of adding measured amounts of water to the fill materials to bring fill materials to a condition within required moisture content range. Furnish and use equipment capable of discing, aerating, and mixing the fill materials to ensure reasonable uniformity of moisture content throughout the fill materials, and to reduce moisture content of borrow materials by air drying, when necessary. When subgrade or lift of fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of specified limit shall be dried by aeration or stockpiled for drying.
3. Perform compaction with equipment suitable for the type of fill material placed. Select and use equipment capable of providing the minimum density required in the Contract Documents. Use light compaction equipment, with equipment gross weight not exceeding 7,000 pounds within horizontal distance of ten feet from the wall of completed, below-grade structures. Furnish and use equipment capable of compacting in restricted areas next to structures and around piping and other Underground Facilities. Effectiveness of the equipment selected by CONTRACTOR shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed. If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the amount of coverages, decrease the lift thicknesses, or use different compactor equipment.
4. Place fill materials in horizontal, loose lifts, not exceeding specified uncompacted thickness. Place fill in a manner ensuring uniform lift thickness after placing. Mechanically compact each lift, by not less than two complete coverages of the compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface. Compaction of fill materials by inundation with water is unacceptable.
5. Do not place fill materials when standing water is present on surface of the area where fill will be placed. Do not compact fill when standing water is present on the fill to be compacted. Do not place or compact fill in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material previously described shall be removed and replaced prior to compaction.
6. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment, CONTRACTOR shall perform all work required to provide the required densities. Such work shall include, at no additional cost to OWNER, complete removal of unacceptable

fill areas and replacement and re-compaction until acceptable fill is provided.

7. Repair, at CONTRACTOR's expense, observed or measured settlement. Make repairs and replacements as required within 30 days after being so advised by ENGINEER.

E. Fill Against Concrete:

1. Placing fill against concrete below finished grade is not allowed until the concrete has attained its specified strength, as determined by duration of concrete curing and testing of field-cured concrete cylinders. Requirements for strength and curing time are in Section 03 00 05, Concrete.
2. Elevation of fill placed against concrete walls shall not differ by more than two feet on each side of walls.
3. Backfill structural foundation units as soon as practicable, in accordance with this Section, after concrete has gained sufficient strength to avoid damage, to avoid ponding of surface water and accumulation of debris.
4. Where fill is placed against waterproofed surface, exercise care that waterproofing material is not damaged.

F. Fill in Pipe Trenches:

1. Piping Installed in Fills Above Pre-construction Grade:
 - a. Prior to installing piping, place the fill in accordance with the Contract Documents until the fill reaches a minimum elevation two feet higher than the top of piping to be installed. Excavate the trench; install the piping, and backfill. Subsequently provide the remainder of the fill required for the Work.
2. Piping trenches may be backfilled prior to testing of piping, unless nature of the test requires observation of pipe during testing.
3. Pipe Bedding: Pipe bedding material shall be as follows:
 - a. Install PVC, CPVC, HDPE, and FRP piping on a layer of sand. Sand shall extend to 12 inches above top of pipe and to the trench walls on each side of the pipe.
 - b. Unless otherwise shown, install other types of piping on not less than six-inch layer of aggregate pipe bedding material. Aggregate pipe bedding material shall extend 12 inches above top of the pipe.
4. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placement and compaction of pipe trench fill materials shall comply with the following:
 - a. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
 - b. After each pipe's bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of the pipe and back of the bell or end thereof to hold piping in proper

position and maintain alignment during subsequent pipe jointing and embedment operations. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping. Place and compact pipe trench fill material to an elevation 12 inches above top of pipe, unless otherwise shown or specified.

- c. Each layer of pipe trench fill material shall be compacted by at least two complete coverages of all portions of surface of each lift using appropriate compaction equipment.
- d. Method of compaction and compaction equipment used shall be appropriate for material to be compacted and shall not transmit damaging shocks to the piping.

G. Pavement:

- 1. Place temporary asphalt concrete pavement immediately after filling excavations in paved roadways and other paved areas at the thicknesses shown on the Contract Drawings. At the end of each work day CONTRACTOR shall plate the trench or lay temporary pavement. At the end of the work week, CONTRACTOR shall lay temporary pavement to all trenches. No plates are to be left in place over the weekend.
- 2. Maintain surface of paved area over the fill in good and safe condition during progress of the Work, and promptly fill depressions over and adjacent to the fill area caused by settlement of fill.
- 3. Temporary and permanent pavement shall be in accordance with Section 32 12 00, Flexible Paving.

H. Subbase Placement:

- 1. Provide subbase material where shown to the limits shown or indicated.
- 2. Place subbase material in compacted lifts not exceeding depth of six inches each.

I. Drainage Fill Placement:

- 1. Provide drainage fill material where shown to the limits shown or indicated.
- 2. Place drainage fill material in compacted layers of uniform thickness not exceeding depth of six inches each. Compact lifts of drainage fill using suitable compaction equipment.

J. Compaction Density Requirements:

- 1. Minimum density for fill materials shall be 100 percent of maximum density obtained in the laboratory in accordance with ASTM D698. Compaction of fill materials less than five feet below final grade, behind concrete walls, and pipe bedding materials when not located below structures or pavement shall be 95 percent of maximum density.
- 2. Place fill in trenches below piping, foundations, or paved areas in horizontal uncompacted layers not greater than eight inches deep, and thoroughly compact each layer before next layer is placed. In other pipe trenches, horizontal uncompacted layers shall be not greater than six inches deep.

3. Fill shall be wetted and thoroughly mixed to achieve optimum moisture content plus-or-minus three percent, with the following exceptions:
 - a. On-site clayey soils: Optimum to plus three percent.
 4. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated.
 5. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work. Responsibility for field quality control testing is specified in the "Field Quality Control" Article in Part 3 of this Section.
 6. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the specified compaction. Perform additional compaction Work at no additional cost to OWNER until specified compaction is obtained. Such work includes complete removal of unacceptable (as determined by ENGINEER) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.
- K. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with select fill material and thoroughly compact in accordance with "Compaction Density Requirements" of this Article and the associated "Compaction Density Requirements" in this Article. Slope the sides of excavation in accordance with the maximum inclinations specified for each structure location.

3.11 GRADING

- A. General:
1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
 2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
 3. Blend grading over trench to elevations shown or indicated; where elevations are not shown or indicated, blend finished grade with existing grade on each side of trench.
- B. Finish surfaces free of irregular surface changes, and shall comply with the following:
1. Grassed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below the required subgrade elevations.
 2. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than one inch above or below the required subgrade elevation.

3. Pavements: Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 1/2-inch above or below the required subgrade elevation.

D. Compaction:

1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.12 PAVEMENT SUBBASE COURSE

A. General:

1. Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
2. After completing filling and grading, shape and compact pavement subgrade to an even, firm foundation in accordance with this Section.
3. Fill trenches over which pavement will be placed with select fill.
4. Fill trenches adjacent to paved areas with select fill to an elevation equal to the elevation where a line projecting from outer edge of paved surface (including shoulders) at an angle of 45 degrees from horizontal intersects the centerline of trench. Above this elevation, fill trench with suitable general fill material.

B. Grade Control:

1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Placing of Pavement Subbase Course:

1. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placing operations.
2. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over the compacted subbase.

3.13 DISPOSAL OF EXCAVATED MATERIALS

A. General:

1. CONTRACTOR shall haul away material removed from excavations that does not comply with requirements for fill, or is in excess of the quantity required for fill.
2. Disposal of materials shall be in compliance with Laws and Regulations, at no additional cost to OWNER.

+ + END OF SECTION + +

SECTION 31 23 16.26

ROCK REMOVAL

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to perform rock removal required for the Work, including disposing of excavated rock material.
 - 2. Obtain permits required by authorities having jurisdiction for rock removal Work, including transporting, storing, and using blasting materials.
 - 3. Perform rock removal Work in compliance with Laws and Regulations applicable permits, and requirements of authorities having jurisdiction.
- B. Coordination:
 - 1. Review procedures under this and other Sections and coordinate the Work that must be performed with or before rock removal.
- C. Related Sections:
 - 1. Section 31 23 16.13, Trenching.
- D. Measurement: Limits of rock removal shall be as follows:
 - 1. Structures: Limit for all structures shall be bounded by the following:
 - a. Bottom of footing, drainage course material, or compacted backfill.
 - b. Pre-construction rock surface.
 - c. Vertical planes located 12 inches outside footing.
 - 2. Trenches: Limit for trenches shall be bounded by the following:
 - a. Width of trenches shall be the outside diameter or outside edge (as applicable) of the Underground Facility plus two feet, exclusive of pipe bells, branches, hubs, spurs, or cradles. Sides of trench shall be considered vertical.
 - b. Depth of trench shall be six inches below the outside of the Underground Facility in the trench unless indicated otherwise on the Drawings.
 - c. Length shall be equal to installed length of the Underground Facility, measured horizontally.
 - 3. No payment will be made for additional quantity outside the limits described in this Section.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. United States Bureau of Mines (USBM), Report of Investigations (RI) 8507.

1.3 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:
1. “Rock removal” is removal of igneous, metamorphic, or sedimentary rock or stone; boulders over two cubic yards in volume in open areas and boulders over one cubic yard in volume in trenches; and mass concrete; that cannot be removed using rippers or other mechanical methods and therefore requires drilling and blasting or use of large excavator-mounted pneumatic breakers. The following material will not be measured nor allowed for payment as rock removal:
 - a. Soft, weathered or disintegrated rock that can be removed by normal excavating equipment, including bulldozers with rippers and large trackhoes with rock teeth or rock buckets.
 - b. Loose or previously blasted rock.
 - c. Broken stone in rock fills.
 - d. Rock or stone that falls into the excavation from outside limits of excavation shown or indicated in the Contract Documents.
 - e. Boulders that can be removed without drilling, blasting, or pneumatic breakers.
 - f. Pavements, sidewalks, and gutters of concrete, asphalt, or masonry.
 2. “Trenches” means excavations having vertical sides whose depth exceeds its width, made for Underground Facilities and drainage beds.

1.4 SUBMITTALS

- A. Informational Submittals: Submit the following:
1. Test and Evaluation Reports:
 - a. Rock surface survey information, in accordance with Article 3.1 of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Top-of-Rock Survey:
1. Prior to rock removal, CONTRACTOR shall survey and measure the elevation of the top of rock to determine the in-place quantity of rock to be excavated.
 2. Uncover rock to be excavated in sections or areas acceptable to ENGINEER for surveying.
 3. Conform to Section 01 71 23, Field Engineering.

4. Submit to ENGINEER field notes, site plan showing rock elevations measured, cross-sections of rock surface when necessary or required by ENGINEER, and detailed estimation of quantity of rock to be excavated.

3.2 ROCK REMOVAL

- A. Perform rock removal adjacent to Underground Facilities and above-ground utilities and life-safety facilities with utmost care, after properly notifying and coordinating with utility owners, life-safety facility owners, and authorities having jurisdiction.
- B. Removal and Disposal of Rock:
 1. Do not use excavated rock as backfill. Dispose of excavated rock off the Site at CONTRACTOR's expense in compliance with Laws and Regulations.

3.3 UNAUTHORIZED ROCK REMOVAL

- A. Rock removal outside the limits shown or indicated in the Contract Documents or that is not approved by ENGINEER, including removal, disposal, and backfill, will be at CONTRACTOR's expense.
- B. Fill unauthorized excavation below pipe or foundation with compacted select backfill as directed by ENGINEER in writing, at no additional cost to OWNER. Backfill other unauthorized excavation as specified in Section 31 23 16.13, Trenching.

+ + END OF SECTION + +

SECTION 32 12 00

FLEXIBLE PAVING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install flexible, hot-mix, hot-laid, asphalt concrete pavement.
2. The Work includes:
 - a. Preparation such as sawcutting, milling where shown or indicated, cleaning, and other preparation for installing flexible pavements.
 - b. Providing asphalt concrete paving materials.
 - c. Providing tack coat material.
 - d. Providing pavement markings where shown or indicated.
 - e. Providing quality controls and testing.
 - f. Place temporary asphalt concrete pavement immediately after filling excavations in paved roadways and other paved areas at the thicknesses shown on the Contract Drawings. At the end of each work day CONTRACTOR shall plate the trench or lay temporary pavement. At the end of the work week, CONTRACTOR shall lay temporary pavement to all trenches. No plates are to be left in place over the weekend.
 - g. The Contractor is responsible to maintain and repair the temporary trench pavement for the entire contract duration.
 - h. Permanent trench paving and overlay paving will be at the Town's option.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before flexible paving Work.
2. Notify other contractors in advance of installing flexible paving to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before flexible paving Work.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 31 23 16.13, Trenching.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO M320, Specification for Performance-Graded Asphalt Binder.
2. AASHTO MP1a, Specification for Performance-Graded Asphalt Binder.

3. AI MS-2, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
4. ASTM C1371, Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
5. ASTM C1549, Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
6. ASTM D242/D242M, Specification for Mineral Filler For Bituminous Paving Mixtures.
7. ASTM D692/D692M, Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
8. ASTM D946/D946M, Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
9. ASTM D977, Specification for Emulsified Asphalt.
10. ASTM D1073, Specification for Fine Aggregate for Bituminous Paving Mixtures.
11. ASTM D1188, Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.
12. ASTM D2726, Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
13. ASTM D2950, Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
14. ASTM D3549, Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
15. ASTM D6690, Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
16. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
17. ASTM E408, Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
18. ASTM E1918, Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
19. ASTM E1980, Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
20. FS TT-P-115, Paint, Traffic, Highway, White and Yellow.
21. USGBC LEED-NC, Reference Guide, For New Construction and Major Renovation.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Asphalt Concrete Production Facility:
 - a. Production facility for asphalt concrete, tack coat materials, and other bitumastic materials shall be certified by the Massachusetts Department of Transportation Standard Specifications for Highways and Bridges and Town of Wilmington Department of Public Works.
2. CONTRACTOR's Testing Laboratory:

- a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials provided under this Section.
- b. Testing laboratory shall comply with ASTM E329 and requirements of Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor.
- c. Testing laboratory shall be experienced in the types of testing required.
- d. Selection of testing laboratory is subject to ENGINEER's acceptance.

B. Regulatory Requirements:

- 1. Reference Specifications and Details:
 - a. Comply with applicable requirements of MassDOT Standard Specifications and Standard Details for Highways and Bridges.
- 2. Obtain required highway and street rights-of-way work permits.
- 3. Jurisdiction:
 - a. Jurisdiction of paved areas to be constructed are indicated in Section 01 14 33, Work in Highway Rights-of-Way.

C. Quality Assurance Testing:

- 1. Quality assurance testing is in addition to source quality control testing, when required, and field quality control testing required under Article 3.4 of this Section.
- 2. Materials used in the Work may require testing and retesting, as directed by ENGINEER, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at OWNER's expense, including retesting of rejected materials and installed Work, shall be performed at CONTRACTOR's expense.
- 3. CONTRACTOR's Quality Assurance Testing Laboratory Scope:
 - a. Use of testing laboratory shall not relieve CONTRACTOR of responsibility for providing materials and the Work in compliance with the Contract Documents.
 - b. Quality assurance testing laboratory shall perform the following, unless evidence of material compliance with reference specifications indicated in Paragraph 1.3.B of this Section, is submitted to ENGINEER by CONTRACTOR and asphalt concrete production facility:
 - 1) Test in accordance with reference specifications indicated in Article 1.3 of this Section. In lieu of quality assurance testing, submit evidence and certification of material compliance with reference specifications. When evidence of conformance submitted is not acceptable to ENGINEER, perform quality assurance testing.
 - c. To facilitate testing services, CONTRACTOR shall:
 - 1) Secure and deliver to testing laboratory and ENGINEER (when requested by ENGINEER) representative Samples of materials that CONTRACTOR proposes to furnish and that are required to be tested.
 - 2) Furnish such labor as is necessary to obtain and handle Samples at the Site or at asphalt concrete production facility and other material sources.

- 3) Advise testing laboratory and ENGINEER sufficiently in advance of operations to allow for completion of quality assurance tests and for the assignment of personnel.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Submit the proposed asphalt concrete mix design for each asphalt concrete material, and other bituminous materials, required under this Section, providing complete data on materials, including location in the Work, source, material content and percentages, temperatures and all other pertinent data. Indicate proportion of bituminous material from reclaimed asphalt pavement.
- b. Proposed gradation for each aggregate to be used in flexible paving. Submit gradation test results for the same material furnished on a previous project. Indicate the proportion of reclaimed asphalt pavement.
- c. In lieu of the information required under Paragraphs 1.4.A.1.a and 1.4.A.1.b, above, submit certificates of compliance with the reference specifications indicated in Article 1.3 of this Section, for each for the following:
 - 1) Each mix design required.
 - 2) Bituminous materials required.
 - 3) Aggregates to be used in flexible paving, from each material source and each required gradation.
 - 4) Density of uncompacted asphalt concrete material.
 - 5) Density of previously-compacted, previously-tested asphalt concrete material.
 - 6) Density and voids analysis for each asphalt concrete material test specimen.
 - 7) Evidence of asphalt concrete plant inspection and compliance with the reference specifications indicated in Article 1.3 of this Section.
 - 8) Proportion of reclaimed asphalt pavement in bituminous materials and aggregate.

2. Product Data:

- a. Manufacturer's complete product data on all pavement marking materials proposed for use, including product literature, specifications, and recommended application techniques and other installation data.

B. Informational Submittals: Submit the following:

1. Quality Assurance Test Data Submittals and Source Quality Control Submittals:
 - a. Submit for quality assurance tests and source quality control tests required.
2. Delivery Tickets:

- a. Submit copy of delivery ticket for each load of asphalt concrete, tack coat materials, and other materials obtained from asphalt concrete production facility, signed by CONTRACTOR
- 3. Field Quality Control Submittals:
 - a. Submit results of required field quality control testing.
- 4. Qualifications:
 - a. Asphalt concrete production facility, when required by ENGINEER.
 - b. CONTRACTOR's testing laboratory, when required by ENGINEER.

1.5 SITE CONDITIONS

- A. Weather Limitations:
 - 1. Temperature:
 - a. For base course and binder course paving lifts equal to or greater than two inches thickness, atmospheric temperature shall be 40 degrees F and rising.
 - b. For surface course paving or other pavement courses in lifts less than two inches thick, temperature of surface on which pavement is to be placed shall be 50 degrees F or greater.
 - 2. Prohibitions:
 - a. Do not place flexible paving materials when weather is foggy or during precipitation.
 - b. Do not place flexible paving materials when the base on which the material will be placed contains moisture in excess of optimum.
 - c. Place flexible paving materials only when ENGINEER concurs that weather conditions are suitable.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. System Description:
 - 1. Provide subbase course of the thickness shown or indicated, in accordance with Section 31 23 16.13, Trenching.
 - 2. Flexible Pavement Courses:
 - a. Provide the flexible pavement courses of the thicknesses shown or indicated, in accordance with the Contract Drawings.
 - b. Milling (Cold Planing) with Overlay. Trench areas shall be paved in accordance with the temporary pavement detail. Base course trench pavement shall be maintained a minimum of 90 days prior to cold planing. The entire roadway width is to be cold planed to remove 2 inches of the existing pavement at the crown and 3 inches at the curb. The areas shall then be overlaid with permanent pavement full width top course in accordance with the full width pavement replacement detail. Cold planing and curb to curb pavement shall be performed only with the approval of the Engineer.

2.2 ASPHALT CONCRETE MIXES AND MATERIALS

A. Class I Bituminous Concrete:

1. General: All materials for bituminous concrete pavement shall be as listed below and shall conform to the requirements of Division III, of the MassDOT Standard Specifications (1995 Edition), as applicable. Pavement courses shall match existing courses after compaction.
2. Subbase Course: Subbase course shall be M2.01.3 gravel and shall be installed in conformance with MassDOT Standard Specifications. Subbase course shall be installed to a minimum compacted thickness of 12 inches.
3. Base Course: Base course shall conform to the requirements for Class I Bituminous Concrete Base Course, as specified in Division III, Section M3, of the MassDOT Standard Specifications. The base course shall be treated with Bitumen Prime Coat, at a rate of 0.4 gallons per square yard.
4. Top Course: Top course shall conform to the requirements for Class I Bituminous Concrete Top Course, as specified in Division III, Section M3, of the MassDOT Standard Specifications. Top course shall be installed to match the depth of the existing pavement and shall consist of a minimum of a 1-1/2 inch layer.

B. Tack Coat:

1. Tack coat shall be emulsified asphalt.
2. Provide emulsified asphalt complying with Division III, M3.03, of the MassDOT Standard Specifications.

C. Crack Sealant:

1. Provide hot applied bituminous concrete crack sealer complying with Division III, M3.05.4, of the MassDOT Standard Specifications.

2.3 PAVEMENT MARKING MATERIALS

A. Material:

1. Pavement marking paint shall have chlorinated rubber base.
2. Factory-mixed, quick-drying and non-bleeding, complying with FS TT-P-115, Type III.
3. Glass Beads: In accordance with reference specifications indicated in Article 1.3 of this Section. Apply to paint in accordance with requirements of reference specifications indicated in Article 1.3 of this Section.

B. Colors:

1. Roadway Center Markings Between Opposing Traffic Lanes: Yellow.
2. Roadway Side Striping: White, unless otherwise shown or specified. On roads with divided median, right-side striping of each direction shall be white, and left-side striping shall be yellow.
3. Roadway Miscellaneous Lane Markings (turn lane arrows and text): White.
4. Crossing Walks (High School): coordinate with Town for specific color.

5. Crossing Walks (Public Safety Building): coordinate with Town for specific color.
5. Crossing Walks (other): White.
4. School text: White.
5. No-Parking Areas: Yellow.
5. Handicap Parking Spaces: Unless otherwise indicated with signs, provide handicap symbol on pavement with white paint on blue background.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the subbase and base on which flexible paving will be installed. Notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Do not place materials on subgrades, or subbase that is muddy or has water thereon.

3.2 PREPARATION

- A. Preparation: Before starting installation of flexible paving, perform the following:
 1. Grade Control: Establish and maintain throughout flexible paving installation the required lines and grades, including crown and cross-slope for each asphalt concrete course during construction operations.
 2. Prepare subgrade and provide subbase for flexible pavement in accordance with Section 31 23 16.13, Trenching. Before installing flexible pavement, obtain ENGINEER's concurrence that subgrade and subbase are suitable for installing flexible pavement.
 3. Coordinate placement of flexible pavement with the Work including drainage structures, manholes, valve boxes, and similar items.
 4. Provide appropriate maintenance and protection of traffic measures during placement of pavement.
- B. Milling:
 1. Perform milling of existing pavement where shown or indicated.
 2. "Milling" consists of the milling, shaping, and removing portions of existing surfaces by cold milling process and subsequent cleaning.
 3. Milling Equipment:
 - a. Milling machines shall be power-operated, self-propelled machines capable of removing the desired thickness of existing surfaces. Machines shall have sufficient power, traction, and stability to accurately maintain depth of cut and slope. Machines shall produce a finished profile and cross slope to within 1/4 inch of that required and shall produce uniform surface texture free of gouges and ridges greater than 3/8-inch deep.

- b. Machines shall be equipped with a means to control dust and other particulate matter created by the cutting action.
 - c. Provide equipment that removes milled material as quickly as the rate of milling.
 - d. Use vacuum trucks, street sweepers or power brooms to clean milled surfaces.
- 4. Milling Operations:
 - a. Perform milling so that, when final course of pavement is placed, required elevations and grades are provided. Where required, establish a taut reference string line to control line and grade of milling.
 - b. Minimize the time between milling and placement of pavement over milled surface.
 - c. Areas not accessible to the milling machine, such as around or adjacent to drainage structures, manholes, curbs, and transverse joints on structures, may be removed by a small milling machine, handwork or other method acceptable to ENGINEER.
 - d. Remove milled material as soon as it is milled. Remove fines and other material prior to opening milled area to traffic. Control objectionable dust emissions. When traffic has been allowed into milled area or when more than 48 hours have elapsed since milling, clean the milled area again prior to applying tack coat.
 - e. Maintain drainage to drainage inlets and other drainage structures in a manner acceptable to ENGINEER.
 - f. Properly dispose of milled material at a location away from the Site.
- C. Surface Preparation:
 - 1. Repair surface defects in existing pavement to provide uniform surface to receive new pavement.
 - 2. Provide crack sealant to completely fill cracks more than 1/16-inch wide in areas shown or indicated on the Drawings.
 - 3. Clean existing surfaces over which asphalt concrete pavement will be installed, by removing from the surface foreign material, excess asphalt concrete, excess joint sealant, and crack filler, and other undesirable matter.
 - 4. Provide tack coat as indicated in Article 3.3 of this Section.

3.3 INSTALLATION OF FLEXIBLE PAVING

- A. General:
 - 1. Provide final pavement surfaces of uniform texture, at required grades and cross-sections.
 - 2. Construct roadways to the lines, grades, and typical sections shown or indicated.
- B. Installation of Asphalt Concrete:
 - 1. Asphalt concrete mixture shall be transported to the site of paving and placed as soon as possible after mixing.

2. Placement of each asphalt concrete course shall be completed over the full width of the section under construction during each day's paving operations.
3. Spread and finish asphalt concrete courses by means of self-propelled mechanical spreading and finishing equipment. Compacted thickness of layers placed shall not exceed 150 percent of specified thickness unless approved in writing by ENGINEER.
4. Compaction:
 - a. Rollers:
 - 1) Use sufficient rolling equipment to satisfactorily compact and finish the quantity of asphalt concrete placed. There shall be not less than two rollers on the Project at all times. When acceptable to ENGINEER, one of the rollers may be a pneumatic-tire roller.
 - 2) During rolling operations, roller speed shall not exceed three miles per hour. When sufficient number of rollers is not available, reduce the quantity of asphalt concrete placed to accommodate the available rollers' speed.
 - 3) Required rollers shall be at the Site, in acceptable operating condition, prior to placing of asphalt concrete.
 - 4) Use of vibratory rollers in lieu of steel-wheeled rollers is acceptable, however when thickness of asphalt concrete is one-inch or less, rolling shall be in the static mode.
 - b. Rolling of initially-placed asphalt concrete material, or breakdown rolling, shall begin as soon as the asphalt concrete mixture will bear the roller without undue displacement.
 - c. Rolling shall be longitudinal, overlapping on successive trips by not less than one-half roller rear wheel width, and not more than three-quarters of roller rear wheel width. Alternate trips of the roller shall be of slightly different lengths.
 - d. At all times, roller motion shall be slow enough to avoid displacing the asphalt concrete.
 - e. Operate rollers continuously from breakdown of laid asphalt concrete through finish rolling.
 - f. Perform finish rolling using a steel-wheeled roller or a vibratory steel-wheel roller operating in the static mode.
 - g. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.
 - h. At each location not accessible to roller, thoroughly compact asphalt concrete with tampers and finish, where necessary, with a hot smoothing iron to provide uniform, smooth layer over the entire area so compacted.
5. Each compacted asphalt concrete course shall be within plus or minus 1/4-inch of the indicated thickness.
6. Placement of Adjacent Strips of New Asphalt Concrete:
 - a. When more than one width of asphalt concrete material will be placed, a six-inch wide strip of asphalt concrete adjacent to the area on which the future material is to be placed shall not be rolled until such future material is placed.

- b. Do not leave the unrolled strip unrolled for more than two hours after placement, unless the six-inch unrolled strip is first heated with a joint heater.
- c. After the first strip or width of asphalt concrete is compacted, place, finish, and compact the second width or strip as required for the first width, except that rolling shall be extended to include the six-inch strip of the first width not previously compacted.

C. Construction Joints:

- 1. Construction joints shall be made in such a manner as to ensure a neat junction, thorough compaction, and bond throughout.
- 2. Provide a transverse joint extending over the full width of the strip being laid and at right angles to its centerline at end of each workday and at other times when the placement of hot-mix asphalt concrete will be suspended for a period of time that will allow asphalt concrete mixture to chill.
- 3. Thoroughly compact by rolling the forward end of a freshly laid strip of asphalt concrete before the asphalt concrete mixture becomes chilled. When the Work is resumed, the end shall be cut vertically for the full depth of the layer.

D. Joining of Pavements:

- 1. When pavement is to join existing or previously-laid pavement, the existing or previously-laid pavement shall be neatly and carefully edged to allow for overlapping and feathering of the subsequent course of asphalt concrete material.
- 2. Where new pavement is to meet existing pavement, the existing pavement shall be sawcut and notched.
- 3. Where new pavement will meet existing asphalt pavement, remove existing pavement 12 inches onto undisturbed existing pavement course at edges where new pavement will meet existing pavement.
- 4. Tack Coat:
 - a. Provide tack coat material at the following locations:
 - 1) At edges where new pavement will connect to existing or previously-installed pavement.
 - 2) On surface of existing or previously-installed pavement course over which new pavement will be installed, prior to placement of the subsequent pavement course. Tack coat may be deleted when a succeeding layer of asphalt pavement is being applied over a freshly-placed asphalt pavement course that has been subjected to very little or no traffic, with approval of ENGINEER
 - 3) Where new pavement will abut curbing, concrete gutters, drainage structures and frames, manhole cover frames, valve boxes, and similar items.
 - b. Tack Coat Installation: Install tack coat immediately prior to installing pavement. Place pavement while tack coat is wet. Apply tack coat in accordance with reference specification indicated in Article 1.3 of this Section.

- E. Curing:
 - 1. Do not allow traffic onto pavement until directed by ENGINEER. Traffic will not be allowed on new asphalt concrete pavement until surface temperature is less than 140 degrees F.
 - 2. Hold construction traffic on new pavement to a minimum as acceptable to ENGINEER.
- F. Defective Pavement Work:
 - 1. When directed by ENGINEER, remove and replace defective flexible paving Work. Cut out such areas of defective pavement and fill with fresh asphalt concrete materials, compacted to required density.

3.4 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. Responsibility:
 - a. CONTRACTOR's field quality control testing laboratory will:
 - 1) Perform field density tests to verify that required compaction of asphalt materials has been obtained.
 - 2) Test the proposed materials for compliance with the Contract Documents, as directed by ENGINEER.
 - 3) Submit reports of all test results to ENGINEER.
 - b. Authority Field Quality Control Testing Laboratory:
 - 1) Technicians representing the testing laboratory will inspect materials at the Site and perform required testing. When the materials furnished or Work performed do not comply with the Contract Documents, field quality control testing laboratory technician shall direct the attention of ENGINEER and CONTRACTOR to such non-compliance.
 - 2) Testing laboratory personnel shall not act as foreman or perform other duties for CONTRACTOR. The Work will be checked as it progresses, but failure to detect defective Work shall not in any way prevent the later rejection of such defective Work when defect is discovered. Failure to detect defective Work as it occurs does not obligate ENGINEER to final acceptance. Testing laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, nor to approve or accept any portion of the Work.
 - 2. Asphalt Concrete Mix Temperature: Measure temperature at time of placement, record, and submit to ENGINEER.
 - 3. Surface Smoothness:
 - a. Test finished surface of each flexible paving course for smoothness, using a ten-foot straightedge applied parallel to and at right angles to centerline of paved areas.
 - b. Check surfaced areas at intervals as directed by ENGINEER.
 - c. Surfaces will be acceptable relative to smoothness when measurements are equal to or less than the following:
 - 1) Base Course: 3/8-inch vertical in ten feet horizontal.

- 2) Binder Course: 3/8-inch vertical in ten feet horizontal.
- 3) Top Course (Wearing Course): 1/4-inch vertical in ten feet horizontal.
- d. Elevation: Finished surface of pavement shall be within plus or minus 1/2-inch of elevations shown or indicated.
- 4. Density:
 - a. Test Method: ASTM D2950; test one sample every 1,000 square yards of pavement. Test for each asphalt concrete course installed.
 - b. In addition, when directed by ENGINEER, compare density of in-place flexible paving materials against laboratory specimen or certificates on same asphalt pavement mixture, using nuclear density device.
 - c. Criteria for Acceptance: Density of in-place asphalt pavement material shall be not less than 90 percent of the recorded laboratory specimen or certificate density. Density shall be not greater than 98 percent.

3.5 ADJUSTING

- A. Frames and Covers:
 - 1. Set frames of drainage structures, manholes, valve boxes, and similar items to final grade. Adjust frames of existing structures and frames furnished under other Sections. Frames shall be substantially similar elevation to finished surface course of pavement.
 - 2. Replace covers and gratings of existing structures immediately following adjusting associated frames. Install covers and gratings of structures provided under the Project as quickly as possible.
 - 3. Where there is a delay between adjusting of frames and installation of surface course, provide temporary bituminous material around perimeter of each frame to smooth vehicle access over the frame. Maintain and repair temporary bituminous material as required until placement of surface course. Remove temporary bituminous material before installing surface course.
- B. Pavement Adjustment:
 - 1. Repair or replace in manner acceptable to ENGINEER areas of pavement that are observed to pond or collect water.

3.6 CLEANING

- A. Cleaning: After completing the paving operations, clean surfaces of excess or spilled bituminous materials, excess asphalt concrete, and foreign matter.

3.7 PROTECTION

- A. Protect finished pavement until pavement has become properly hardened and cool.
- B. Cover openings of drainage structures, manholes, valve boxes, and similar items in the paved area until permanent coverings are provided.

3.8 PAVEMENT MARKINGS

- A. Pavement Markings: Provide pavement markings in the same locations as pre-construction conditions.
1. Preparation:
 - a. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.
 - b. Do not begin marking bituminous concrete pavement until approved by ENGINEER.
 - c. When reflective glass beads are required, mix with paint prior to paint application.
 2. Application:
 - a. Using mechanical equipment, provide uniform, straight edges in two separate coats. Apply in accordance with paint manufacturer's recommendations.

+ + END OF SECTION + +

SECTION 32 16 13

CONCRETE SIDEWALKS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete sidewalks.
2. Width, thickness, geometry, and extent of sidewalk shall be as shown or indicated on the Drawings.
3. Requirements for concrete sidewalks apply to concrete driveways, unless otherwise shown or specified, or unless concrete pavement requirements are included in the Contract Documents.

B. Related Sections:

1. Section 03 00 05, Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 347, Guide to Formwork for Concrete.
2. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
3. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
4. ASTM C33/C33M, Specification for Concrete Aggregates.
5. ASTM C150/C150M, Specification for Portland Cement.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer:

- a. Installer shall have not less than two years experience installing concrete sidewalks similar to those required for the Work.
- b. When required by ENGINEER, submit record of experience documenting not less than three successful, completed projects.

B. Regulatory Requirements:

1. Reference Specifications and Details:

- a. Comply with applicable requirements of the Commonwealth of Massachusetts Department of Transportation, Standard Specifications for Highways and Bridges.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Submit concrete mix design when mix design is different from that submitted under Division 03 Sections on concrete. Submit in accordance with Division 03 Sections on concrete.
 - b. Proposed reinforcing materials.
 - 2. Product Data:
 - a. Concrete Materials: Submit Supplier's technical information for materials proposed for use, when concrete materials are different from those submitted under Division 03 Sections on concrete.
 - b. Reinforcing Steel: Submit fabricator's technical information, including catalog information and specifications, for materials proposed for use, sufficient for ENGINEER to verify compliance with the Contract Documents.
 - c. Expansion Joint Filler: Submit Supplier's technical information, including manufacturer's product data, brochure, and specifications, for materials proposed for use, when materials are different from those submitted under Division 03 Sections on concrete.
- B. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. When concrete materials are different from those approved under Division 03 Sections on concrete, submit certifications as required in concrete Specifications Sections referred to in this Section.
 - 2. Site Quality Control Submittals:
 - a. Concrete test results for the Work included under this Section.
 - 3. Qualifications Statements:
 - a. Installer, when requested by ENGINEER.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with Division 03 Sections on concrete referenced in this Section.

1.6 SITE CONDITIONS

- A. Weather and Temperature Limitations:
 - 1. When temperature and environmental conditions warrant, comply with requirements for cold weather placing and hot weather placing under Division 03 Sections referenced in this Section, unless otherwise required under this Section.
 - 2. Temperature of aggregate base material under concrete shall be 39 degrees F or higher. Aggregate base material shall not have snow, ice, frost, or standing water on its surface at the time of concrete placing. Use of insulating materials and heating equipment may be required before concrete placing begins.

3. Discontinue concrete placing when the air temperature falls below 39 degrees F. Do not place concrete in the rain.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Aggregate Bedding: Subbase material in accordance with Section 31 23 16.13, Trenching, unless otherwise shown or indicated.
- B. Concrete Materials:
 1. Concrete Mix, Design, and Testing:
 - a. Comply with applicable requirements of Section 03 00 05, Concrete, for concrete mix design, sampling, and testing, and quality control.
- C. Reinforcing Materials:
 1. Provide deformed steel bars and smooth wire fabric complying with Section 03 00 05, Concrete.
 2. Provide wire fabric in flat sheets. Do not furnish wire fabric in rolls.
- D. Expansion Joint Material:
 1. Preformed Expansion Joint Filler: Comply with Section 03 00 05, Concrete, for preformed expansion joint fillers.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine subgrade, subbase, and conditions under which the Work is will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are been corrected.
- B. Subgrade:
 1. Verify that earthwork is completed to correct line and grade.
 2. Verify that subgrade is smooth, properly compacted, and free of frost and excessive moisture in accordance with Division 31 Section on excavation and fill.
 3. Do not commence the Work under this Section until conditions are satisfactory.

3.2 AGGREGATE BASE FOR SIDEWALKS

- A. Aggregate Base under Sidewalk:
 - 1. Install aggregate fill in accordance with Section 31 23 16.13, Trenching. Properly compact aggregate fill to thickness shown or indicated in the Contract Documents.
 - 2. When thickness of aggregate base is not shown or indicated, provide six-inch thick aggregate base under curbs, sidewalks, and gutters.

3.4 CONSTRUCTION OF FORMS

- A. Conventional Forms:
 - 1. Set forms to line and grade. Forms shall be free from warp.
 - 2. Install forms along full length of sidewalk.
 - 3. Forms shall extend to the full depth of the curb, sidewalk, and gutter (as applicable) and be secured so no displacement occurs during concrete placing.
- B. At CONTRACTOR's option, machine-formed concrete curbs, sidewalks, and gutters are acceptable.

3.5 REINFORCING

- A. General:
 - 1. Locate, place, and support reinforcing in accordance with 03 00 05, Concrete, unless otherwise shown on the Drawings.
 - 2. Size of reinforcing shall be as shown or indicated in the Contract Documents.
 - 3. Unless otherwise shown or indicated, locate reinforcing for sidewalks at the mid-depth point in the concrete slab.

3.6 CONCRETE PLACING

- A. General:
 - 1. Comply with Section 03 00 05, Concrete, and this Section relative to mixing and placing concrete.
- B. Placing:
 - 1. Curbs and Gutters: Place concrete using methods that prevent segregation of the mix. Consolidate concrete along face of forms with an internal vibrator.
 - 2. Sidewalks: Place concrete in one-course, monolithic construction, for full width and depth of sidewalk.
 - 3. Machine-Formed:
 - a. At CONTRACTOR's option, automatic sidewalk machine may be used for installing concrete.
 - b. Machine forming shall produce curbs, gutters, and sidewalks of required cross-section, lines, grades, finish, and jointing, as specified for conventionally-formed concrete.

- c. At curb cuts and driveway entrances, cut-out concrete and hand-finish the curbing to provide the required curb cut or driveway entrance, as applicable.
- d. If results do not comply with the Contract Documents, remove and replace at no additional cost to OWNER.

C. Curbs:

- 1. Provide curb-cuts and driveway entrances for vehicle passage and pedestrian passage where shown, and when not shown but where existing sidewalks and curbs are being replaced, provide curb-cut or driveway entrance (as applicable) at location of existing driveways and pedestrian access ramps in sidewalks.
- 2. Neatly form transitions from curb to curb-cut or driveway entrance.
- 3. Unless otherwise shown or indicated, top of curb at curb-cut or driveway entrance shall be not greater than 1/4-inch above elevation of finished pavement surface.

D. Gutters:

- 1. Unless otherwise shown or indicated, top of gutter shall be not greater than 1/4-inch above elevation of finished pavement surface.

3.7 JOINTS

A. General:

- 1. Provide expansion joints, contraction joints, and construction joints in concrete curbs, gutters, and sidewalks.
- 2. Provide expansion, contraction, and construction joints perpendicular to formed faces of sidewalk.
- 3. Construct transverse joints at right angles to the Work centerline and as shown.

B. Contraction Joints: Provide joints as indicated below:

- 1. Curbs and Gutters: Provide at intervals of ten feet on centers. Joint shall be not less than 1/8- inch and not more than 1/4-inch in width, and have a depth of 1.5 inches.
- 2. Sidewalks: Provide at intervals of five feet on centers. Joint shall be not less than 1/8- inch and not more than 1/4-inch in width, and have a depth of not less than one-third the total thickness of concrete sidewalk.
- 3. Joints may be formed or sawcut.

C. Construction Joints: Place construction joints at locations where concrete placing operations are stopped for more than 30 minutes, except where such pours terminate at expansion joints.

D. Expansion Joints:

- 1. General: Provide preformed expansion joint filler at locations indicated. When sidewalk is not poured monolithically, provide expansion joints where each abuts the other.

2. Curbs and Gutters: Provide 1 1/16-inch wide preformed expansion joint filter at the intervals of 30 feet along curb and gutter; at expansion joints in pavement; at movable structures (such as bridges); and between curb or gutter and structures, returns, and at 30-foot intervals along length of curb or gutter.
3. Sidewalks: Provide 1/2-inch wide preformed expansion joint filler at 30-foot intervals along length of sidewalk and at all joints between sidewalk and: curb, gutters, pavement, buildings, drainage structures, utility metal appurtenances such as manhole cover frames and valve boxes, and similar construction.
4. Place top of expansion joint material not less than 1/2-inch or more than one-inch below concrete surface. Apply joint sealer on top of expansion joint material flush with concrete surface, and in accordance with sealant manufacturer's instructions.

3.8 CONCRETE FINISHING

- A. Smooth exposed surface by screeding and floating. Perform hand-screeding when conventionally-formed concrete is provided.
- B. Work edges of gutter and sidewalks, back top edge of curb, and transverse joints; and round to 1/4-inch radius.
- C. Complete surface finishing by drawing a fine-hair broom across surface, perpendicular to line of traffic.

3.9 CURING

- A. General:
 1. Protect and cure finished concrete curbs, gutters, and sidewalks, in accordance with Section 03 00 05, Concrete.
 2. Cure driveways and sidewalks at driveways for not less than three days prior to opening to vehicle traffic. In colder weather, as indicated in Article 1.6 of this Section, curing period shall be not less than six days prior to opening to vehicle traffic unless other provisions to determine strength are provided and approved by ENGINEER.

3.10 REPAIR AND CLEANING

- A. Repair or replace broken or defective curbs, gutters, and sidewalk as directed by ENGINEER.
- B. Sweep the concrete curb, sidewalk, and gutter Work and wash free of stains, discolorations, dirt, and other foreign material.

+ + END OF SECTION + +

SECTION 32 92 00

LAWNS AND MEADOWS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all plantings and bank stabilization.
2. Types of products required include the following.
 - a. Topsoil.
 - b. Lawn grass seed.
 - c. Fertilizer
 - d. Mulches

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, restoring the site.

C. Related Sections:

1. Section 33 11 00, Clearing and Grubbing.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. Association of Official Analytic Chemists, (AOAC).
 - a. Official Methods of Analysis of AOAC International.
2. Association of Official Seed Analysts, (AOSA).
 - a. Journal of Seed Technology; Rules for Testing Seeds.
3. American Society of Agronomy, (ASA).
 - a. Reference No. 1 - Methods of Soils Analysis, Soil Science Society of America, Incorporated.
4. American Society for Testing and Materials, (ASTM).
 - a. ASTM B 221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
 - b. ASTM C 602, Specification for Agricultural Liming Materials.
 - c. ASTM D 75, Practice for Sampling Aggregates.
 - d. ASTM D 422, Test Method for Particle Size Analysis of Soil.
 - e. ASTM D 977, Specification for Emulsified Asphalt.

- f. ASTM D 2487, Practice for Classification of Soils for Engineering Purposes (United Soil Classification System).
- g. ASTM D 5268, Specification for Topsoil Used for Landscape Purposes.
- h. ASTM E 329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
- i. ASTM E 548, Guide for General Criteria Used for Evaluating Laboratory Competence.
- 5. Turfgrass Producers International, (TPI).
 - a. Guideline Specifications to Turfgrass Sodding.

1.3 DEFINITIONS

- A. The term “finish grade” shall be used to describe the finished surface elevation of planting soil.
- B. The term “manufactured topsoil” shall be used to describe soil produced off-Site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil acceptable as a component of loam.
- C. The term “loam” shall be used to describe topsoil that has been mixed with additional organic and inorganic additives, as specified.
- D. The term “percentage pure live seed” shall be defined as the percent (%) purity multiplied by percent (%) germination divided by 100 to equal the percent pure live seed (PLS) and shall be calculated for all seed lots using each seed lots own unique purity and germination test results. A PLS pound shall be defined as the bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.
- E. The term “subgrade” shall be used to describe the surface of subsoil remaining after completing excavation; or the top surface of a fill or backfill immediately beneath topsoil and which has not been tested for acceptable use as topsoil.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Engage a single landscape installer skilled, trained and with successful and documented experience in the installation of biodegradable slope stabilization, wetland seed mixes and with specific skill and successful experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to ENGINEER along with the following information on a minimum of three successful projects:
 - a. Names and telephone numbers of owner, architects or engineers responsible for projects.
 - b. Approximate contract cost of the site restoration.
 - c. Amount of area installed.

2. Installer's Site Supervisor: Require installer to maintain an experienced full-time landscape supervisor on-Site during the time of preparation for, and planting of, the specified restoration. Supervisor shall have achieved landscape or horticultural certification acceptable to governing authorities having jurisdiction at the Site.
 4. Application of herbicides, chemicals and insecticides shall not be allowed.
- B. Source Quality Control:
1. Analysis and Standards: Package all products with manufacturer's certified analysis performed in accordance with methods established by AOAC, wherever applicable, or as specified.
 2. Seed that has been stored at temperatures, or under conditions not recommended by the seed supplier, or has become wet, moldy, or otherwise damaged, shall not be acceptable. The PLS for each seed lot shall be 75 percent, minimum.
 3. Certify that all seed has been stored under conditions recommended by the seed supplier and has not been subjected to conditions damaging to PLS percentages.
 4. Seed may be mixed by an approved method on-Site or at the seed supplier's facilities. If the seed is mixed on-Site, each variety shall be delivered in the original containers and shall bear the supplier's certified analysis. Where seed is mixed by the seed supplier, provide ENGINEER with the seed supplier's certified statement as to the composition of the mixture.

1.5 SUBMITTALS

- A. Qualifications Data: Submit qualifications data for the following:
1. Landscape installer.
 2. Landscape supervisor.
 3. Testing agency.
- B. Samples: Submit 12-inch by 12-inch sheet of erosion control fabric with manufacturer's selections of standard biodegradable filler papers, and yarns.
- C. Shop Drawings: Submit the following:
1. Schedule planting showing anticipated installation dates for each type of Work.
 2. Manufacturer's product data, specifications and installation instructions for all required materials.
 3. Composition and analysis of commercial fertilizers and all purchase receipts showing the total quantity actually purchased for this Project.
 4. Written statement providing the location from which manufactured topsoil is to be obtained and the names and addresses of the suppliers.
 5. PLS for each type of seed and each seed lot. Include bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.

- D. Test Reports: Submit the following:
 - 1. Soil analysis reports for existing soil and imported manufactured topsoil, as specified. Include recommendations for remediating existing soil into acceptable topsoil.
- E. Certificates: Submit the following:
 - 1. Certification of Grass Seed and Wetland Mixture: For each grass-seed monostand and seed mixture, furnish seed supplier's certification stating the botanical and common name, and percentage by weight of each species and variety, and percentage of purity, germination and weed seed. Include the year of production and date of packaging. Certify that seed has been stored in compliance with all recommendations of the seed supplier.
- F. Operation and Maintenance Data: Submit recommended procedures to be established by OWNER for site maintenance. Submit prior to expiration of required maintenance period.
- G. Warranty: Submit written warranty, signed by CONTRACTOR and landscape installer, as specified.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials:
 - 1. Do not deliver seed, coconut fiber blankets, or coir fiber logs until Site conditions are ready for installation.
 - 2. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.
 - 3. Deliver seed in undamaged, original containers, sealed by the supplier and indicating compliance with approved Shop Drawings.
 - 4. Inspect lawn and meadow materials upon arrival at Site. Immediately and permanently remove unacceptable materials from Site.
- B. Storage of Materials:
 - 1. Store and cover materials to prevent deterioration. Remove packaged materials that become wet or show deterioration or water marks, from the Site.
 - 2. Seed that becomes wet, moldy or damaged during the time of storage on-Site or that has been damaged during transit is not acceptable.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Proceed with and complete restoration as rapidly as portions of the Site become available, working within the seasonal limitations for each type of planting required.
 - 2. Proceed with planting only when current and forecasted weather conditions are favorable to successful planting and establishment of germination.

- a. Do not spread seed when wind velocity exceeds five miles per hour.
 - b. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.
3. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.

B. Scheduling:

1. Coordinate planting with specified extended service periods to provide required service from date of Substantial Completion. Plant during one of the following periods, unless otherwise determined by the ENGINEER:
 - a. Spring Planting: March 15 to June 1.
 - b. Fall Planting: September 1 to October 30.
2. Do not begin plantings until water, acceptable for use and adequate in supply, is available on-Site and can be successfully transported to the areas of Work. Coordinate provision of adequate and acceptable water supply with Project Schedule.
3. Do not proceed with installation of loam until all subgrade utility services have been installed, are operating successfully and have been approved by ENGINEER.

C. Pre-installation Conference:

1. Prior to commencement of site restoration and associated Work, CONTRACTOR shall schedule and meet at the Site with the landscape installer, the installers of other Work in and around areas to be restored, and ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the lawn and meadow Work, including the following:
 - a. Review Project requirements and the Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review availability of water and methods of delivery.
 - d. Review status of below-grade work and required access during lawn and meadow planting and establishment.
 - e. Review Project Schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
 - f. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
 - g. Review procedures required for protection of lawns and meadows during the remainder of the construction period.
 - h. Review required inspection, testing, and certifying procedures.
2. Record the discussions of the Pre-installation Conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending.
3. Record all revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.
4. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

1.8 WARRANTY

- A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.
- B. Special Warranties: Warranty site restoration areas through the specified extended service period.

1.9 EXTENDED SERVICE

- A. Site Restoration Areas:
 - 1. Begin extended service immediately after each restored area is acceptably established. Provide extended service for not less than the following periods:
 - 2. Site Restoration Area: One year from date after restored areas are acceptably established.
 - a. When full service period has not elapsed before end of planting season, or if area is not acceptably established, continue service during next planting season.
 - b. Warranty shall include full replacement (labor and materials) of riprap, seeded areas, coir rolls, coconut blanket, and appurtenances.
 - 3. Service lawn by watering, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth surface.
 - 4. Watering: Provide and maintain temporary piping, hoses, and watering equipment to convey water from sources. Keep newly germinated seed uniformly moist to a depth of 4-inches, applied at a minimum rate of 1-inch per week, or greater as required to maintain minimum moisture depth specified. Provide and maintain watering gages and soil moisture probes until end of maintenance period.
 - a. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 5. Mow lawn as soon as top growth is tall enough to cut (Traveled Way only). Repeat mowing to maintain specified height without cutting more than 40 percent of grass-leaf height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowing to maintain the following grass height:
 - a. Mow grass 1-1/2 to 2-inches high.
 - 6. After seed has passed its expected germination period, reseed all areas and parts of areas that fail to show a uniform stand of grass. Reseed repeatedly until all areas are covered with grass.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. All soil accepted as topsoil, whether obtained from on-Site or off-Site sources, shall comply with specified topsoil analysis.
2. Provide fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth; free of any admixture of subsoil, clods of hard earth, plants or roots, sticks, stones larger than 1-inch in diameter, or other extraneous material harmful to plant growth, in compliance with ASTM D 5268. Provide topsoil with the following analysis:
 - a. 3/4-inch mesh: 100 percent passing.
 - b. No. 4-sieve: 90 to 100 percent passing.
 - c. No. 200-sieve: 0 to 10 percent passing.
 - d. Clay content of material passing No. 200-sieve not greater than 60 percent, as determined by hydrometer tests.
 - e. pH-adjusted with ferrous sulphate or ground limestone to provide pH 5.5 to pH 7.0 at time of installation of lawns, grass and meadow areas, unless particular species of grass or wildflower stand requires a different pH to meet its growing needs.
 - f. Electrical conductivity of a 1:2 soil-water suspension shall not exceed 1.0 milliohm per centimeter and with less than 200 parts per million of extractable aluminum.
 - g. Cation Exchange Capacity: 5, minimum.
 - h. Organic content not less than five percent, as determined by ignition loss of oven-dried samples passing No. 10-sieve (Muffle Furnace Temperature: 110 plus or minus five degrees C for eight hours).
 - i. Free of pests and pest larvae.
3. Topsoil Source: Amend existing in-place surface soil to produce topsoil, where possible. Verify suitability of surface soil to produce topsoil, as specified. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Supplement acceptable surface soil with manufactured topsoil from off-Site sources, when quantities available on Site are insufficient to complete the Work.

B. Lawn Grass Seed:

1. Lawn Grass Seed Mixture: Provide fresh, clean, new-crop seed complying with the tolerance for purity and germination established by AOSA. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, specified.
2. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 80 percent pure seed, and not more than 0.25 percent weed seed by weight:
 - a. Sun and Partial Shade: Proportioned by weight as follows:
 - 1) 50 percent Kentucky Bluegrass (*Poa pratensis*).
 - 2) 30 percent Chewings Red Fescue (*Festuca rubra* variety).
 - 3) 10 percent Perennial Ryegrass (*Lolium perenne*).
 - 4) 10 percent Redtop (*Agrostis alba*).

C. Fertilizers:

4. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - a. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

D. Mulches:

4. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
4. Coir fiber logs to be planted with wetland plants (2" plugs), which root through the coir logs into the bank and substrate.

2.2 LOAM MIXES

- A. Follow recommendations of soil-testing laboratory for modifying on-Site soil and manufactured soil, for use as topsoil.
- B. On-Site soil and manufactured soil that has been provided with all inorganic soil amendments and fertilizers recommended by soil-testing laboratory, and acceptable for use as topsoil, shall be mixed with an additional organic soil amendment mix in a ratio of two parts topsoil to one part organic soil amendment mix, by volume.
 1. Prepare soil amendment mix by combining 40 percent compost, 40 percent peat moss, ten percent wood derivatives, five percent well-rotted manure and five percent grit aggregate, by volume.
- C. Loam: Thoroughly blend topsoil with organic soil amendment mix and use as planting media for all lawn and meadow Work.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the areas and conditions under which restoration Work is to be performed, and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Thoroughly blend and mix loam before spreading.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
- C. 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.
- D. Excavate or fill subgrade, as required, to bring subgrade to elevations shown. Maintain all angles of repose. Confirm that subgrade is at proper elevations and that no further earthwork is required to bring the subgrade to proper elevations. Provide subgrade elevations that slope parallel to finished grade and towards subsurface drains shown.
- E. Remove all construction debris, trash, rubble and all extraneous materials from subgrade. In the event that fuels, oils, concrete washout or other material harmful to plant growth or germination have been spilled into the subgrade, excavate the subgrade sufficiently to remove all such harmful materials and fill with approved fill, compacted to the required subgrade compaction level.

3.3 FINE GRADING

- A. Immediately prior to dumping and spreading loam, clean subgrade of all stones greater than 2-inches and all other extraneous matter. Remove all such material from Site. Notify ENGINEER that subgrade has been cleaned, and obtain approval prior to spreading loam.
- B. Do not attempt to spread excessively wet, muddy or frozen loam. Do not spread loam more than five days before seeding or planting.
- C. Spread loam to a depth of 4-inches but not less than required to meet finish grades after light rolling and natural settlement.
 - 1. Spread approximately one-half the thickness of required loam depth. After spreading loam, rototill, disk or harrow loam and subgrade to bring top 2-

inches of subgrade upward into loam layer, so that there is a transitional layer between loam and subgrade.

2. Spread remainder of loam to required finish grades.
 3. Compact each lift sufficiently to reduce settling, but not enough to prevent the movement of water and feeder roots through loam. After compaction spread loam should offer firm, even resistance when a soil sampling tube is inserted.
 4. Phase the placement of the final lift so that wheeled vehicles do not have to travel over areas where final lifts are already in-place.
 5. Spread and compact to a smooth, uniform surface plane, to within plus or minus 1/2-inch of finish elevations. Roll and rake and remove all ridges, and fill depressions, as required. Remove all stones larger than 1-inch in any dimension and all sticks, roots, trash and other extraneous matter.
 6. Perform percolation tests as for subgrades, except limit depth of holes to 2/3 the depth of loam layer.
- D. Grade planting areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous material in excess of 1-inch diameter. Roll, rake and remove ridges and fill depressions, as required to meet finish grades.
- E. Moisten prepared areas before seeding, sodding, sprigging or plugging. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy loam condition.
- F. Prior to seeding or planting, restore loam to specified condition, if eroded or otherwise disturbed.

3.4 CONVENTIONAL SEEDING

- A. General: Maintain grade stakes until removal is mutually agreed upon by all parties concerned.
- B. Rake or harrow all seedbeds immediately prior to seeding to produce a rough, grooved surface, no deeper than 1-inch. Seed only when seedbed is in a friable condition and not muddy or hard.
- C. Sow seed using a spreader or seeding machine.
- D. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.
- E. Unless otherwise specified, sow lawn grass seed mixture at the rate of not less than five-pounds for every 1000 square feet.
- F. Using a uniform fine spray, thoroughly and evenly water seeded areas. Provide adequate water to moisten seedbed to a depth of 2-inches.

1. Repeat this process when peat mulch color lightens. Maintain all seedbeds in a uniformly moist condition, conducive to seed germination and plant establishment, as specified.
- G. Reseed areas that remain without mulch for longer than three days.
 - H. Take precautions to prevent damage or staining of construction or other plantings adjacent to newly planted areas. Immediately clean damaged or stained areas.
 - I. Prevent foot or vehicular traffic, or the movement of equipment, over the newly planted areas. Reseed areas damaged as a result of such activity.
- C. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at a minimum rate of 500-pounds per acre dry weight, but not less than the rate required to obtain specified seed-sowing rate so that the seed comes into direct contact with loam.
 - D. Apply slurry cover coat of fiber mulch at a rate of 1000-pounds per acre.

3.5 RECONDITIONING EXISTING LAWNS AND MEADOWS

- A. Recondition existing lawn and meadow damaged by CONTRACTOR'S operations, including areas used for storage of materials or equipment and areas damaged by movement of vehicles. Recondition existing lawns and meadow areas where minor regrading is required.
- B. Recondition other existing lawn and meadow areas shown.
- C. Provide, seed or sod and soil amendments, as specified for new lawn and meadow, and as required to provide satisfactorily reconditioned lawns and meadows. Provide new loam as required to fill low spots and meet new finish grades.
- D. Till stripped, bare, and compacted areas thoroughly to a depth of 12-inches.
- E. Remove diseased or unsatisfactory lawn and meadow areas; do not bury into soil. Remove topsoil containing extraneous materials resulting from CONTRACTOR'S operations including oil drippings, stone, gravel and other construction materials.
- F. Water newly planted areas and keep moist until new lawns and meadows are established, as specified.

3.6 ACCEPTANCE CRITERIA FOR LAWNS AND MEADOWS

- A. Lawn and meadow Work will be considered acceptable when:

1. Seeded Areas: When a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 square feet and bare spots not exceeding 5-inches by 5-inches.

3.7 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris, created by lawn and meadow Work, from paved areas. Clean wheels of vehicles before leaving Site to avoid tracking soil and loam onto roads, walks, or other paved areas.
- B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout extended service period and remove when service period ends. Treat, repair or replace damaged lawns and meadows.

3.8 INSPECTION AND ACCEPTANCE

- A. Where lawns and meadows do not comply with specified acceptance criteria, reestablish lawns and meadows and continue extended service period until lawns and meadows comply with criteria for acceptance.

3.9 DEMONSTRATION

- A. Engage installer's Site supervisor to train and instruct OWNER'S personnel in the proper maintenance of lawns and meadows and procedures to be performed throughout the year for proper care and maintenance of lawn and meadows.
 1. Include instructions and training on reconditioning established lawns and meadow and sources of lawn and meadow materials.
 2. Schedule training with OWNER, through ENGINEER, with at least seven days' advance notice.
- B. Review Operation and Maintenance information and be sure all instructions are clearly understood by OWNER'S personnel and are supplemented with additional information, clarifications and instructions, as required.
- C. Provide minimum of 2-hours on-Site training time during day shift normal working hours.

+ + END OF SECTION + +

SECTION 33 05 05

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:
 - a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections or other contracts.
 - b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.
 - c. Work on or affecting existing buried piping.
 - d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and other Work required for a complete, buried piping installation.
 - e. Supports, restraints, and thrust blocks.
 - f. Pipe encasements, with the exception of piping embedded in concrete within a structure or foundation specified under Section 40 05 05, Exposed Piping Installation.
 - g. Field quality control, including testing.
 - h. Cleaning and disinfecting.
 - i. Incorporation of valves, meters, and special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.
2. Coordinate with appropriate piping Sections of Division 40, Process Integration.
3. Notify other contractors in advance of installing buried piping to provide them with sufficient time for installing items included in their contracts to be installed with or before buried piping installation Work.

C. Related Sections:

1. Section 03 30 05, Concrete.
2. Section 31 23 16.13, Trenching.
3. Section 33 05 13, Manholes and Structures.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. ASME Boiler and Pressure Vessel Code.
 2. ASME B31.3, Process Piping.
 3. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
 4. ASTM B32, Specification for Solder Metal.
 5. ASTM C12, Practice for Installing Vitrified Clay Pipe Lines.
 6. ASTM C425, Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 7. ASTM C828, Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines.
 8. ASTM C924, Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Test Method.
 9. ASTM D2321, Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
 10. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
 11. ASTM D4174, Practice for Cleaning, Flushing and Purification of Petroleum Fluid Hydraulic Systems.
 12. ASTM F1417, Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air.
 13. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
 14. ANSI/AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems.
 15. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 16. ANSI/AWWA C206, Field Welding of Steel Water Pipe.
 17. ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
 18. ANSI/AWWA C603, Installation of Asbestos-Cement Pressure Pipe.
 19. ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 20. ANSI/AWWA C606, Grooved and Shouldered Joints.
 21. ANSI/AWWA C651, Disinfecting Water Mains.
 22. ANSI/AWWA C800, Underground Service Line Valves and Fittings
 23. AWWA M9, Concrete Pressure Pipe.
 24. AWWA M11, Steel Water Pipe - A Guide for Design and Installation.
 25. AWWA M23, PVC Pipe - Design and Installation.
 26. AWWA M41, Ductile-Iron Pipe and Fittings.
 27. AWWA M45, Fiberglass Pipe Design.
 28. AWWA M55, PE Pipe - Design and Installation.
 29. ASCE 37, Design and Construction of Sanitary and Storm Sewers.
 30. American Concrete Pipe Association, Concrete Pipe Handbook.

31. Chlorine Institute, Inc., Piping Systems for Dry Chlorine, Pamphlet No. 6.
32. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including.
 - a. MassDEP, Massachusetts Department of Environmental Protection.
 - b. Town of Wilmington, Conservation Commission.
 2. Obtain required permits for Work in roads, rights-of-way, railroads, and other areas of the Work.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Laying schedules for concrete pipe and piping with restrained joints.
 - b. Details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances.
 2. Product Data:
 - a. Manufacturer's literature and specifications, as applicable, for products specified in this Section.
 3. Testing Procedures:
 - a. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain ENGINEER's approval prior to commencing testing.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
 2. Field Quality Control Submittals:
 - a. Results of each specified field quality control test.
- C. Closeout Submittals: Submit the following:
 1. Record Documentation:
 - a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
 - b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.

- c. Include profile drawings with buried piping record documents when the Contract Documents include piping profile drawings.
- d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.
- B. Storage:
 - 1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
 - 2. Pipe and fittings other than PVC and CPVC may be stored outdoors without cover. Cover PVC and CPVC pipe and fittings stored outdoors.
- C. Handling:
 - 1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.
 - 2. Avoid unnecessary handling of pipe.
 - 3. Keep pipe interiors free from dirt and foreign matter.
 - 4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Piping materials are specified in the Buried Piping Schedule at end of this Section. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable Sections of Division 40, Process Integration.
- B. General:
 - 1. Pipe Markings:
 - a.. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.

2.2 BURIED PIPING IDENTIFICATION

- A. Polyethylene Underground Warning Tape for Metallic Pipelines:
 - 1. Tracer tape shall be of inert, acid- and alkali-resistant, polyethylene, four mils thick, six inches wide, suitable for direct burial. Tape shall be capable of

- stretching to twice its original length.
2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other service as appropriate, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW", with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as pipeline colors specified for associated pipe service in Section 09 91 00, Painting.
 3. Manufacturer: Provide products of one of the following:
 - a. Brady Corporation
 - b. Seton Identification Products
 - c. Marking Services, Inc.
 - d. Or equal.
- B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
1. Tape shall be of inert, acid- and alkali-resistant, polyethylene, five mils thick, six inches wide, with aluminum backing, and have 15,000 psi tensile strength and 80 percent elongation capability. Tape shall be suitable for direct burial.
 2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other appropriate service, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW" with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as the pipeline colors as specified for the associated pipe service in Section 09 91 00, Painting.
 3. Manufacturer: Provide products of one of the following:
 - a. Brady Corporation
 - b. Seton Identification Products
 - c. Marking Services, Inc.
 - d. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
 2. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from ENGINEER before proceeding.
 3. ENGINEER will observe excavations and bedding prior to laying pipe by CONTRACTOR. Notify ENGINEER in advance of excavating, bedding, pipe laying, and backfilling operations.
 4. Minimum cover over buried piping shall be four feet, unless otherwise shown or approved by ENGINEER.
 5. Earthwork is specified in Section 31 23 16.13, Trenching.

6. Excavation in excess of that required or shown, and that is not authorized by ENGINEER shall be filled at CONTRACTOR's expense with granular material furnished, placed, and compacted in accordance with Section 31 23 16.13, Trenching.
7. Comply with NFPA 24 for "Outside Protection", where applicable to water piping systems used for fire protection.

B. Separation of Sewers and Potable Water Piping:

1. Horizontal Separation:
 - a. Where possible, existing and proposed potable water mains and service lines, and sanitary, combined, and storm sewers shall be separated horizontally by clear distance of at least ten feet.
 - b. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undistributed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above top of sewer.
 - c. Exception:
 - 1) Where it is not possible to provide minimum horizontal separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe complying with public water supply design standards of authority having jurisdiction.
2. Vertical Separation:
 - a. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of sewer when sewer crosses over potable water main.
 - b. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.
 - c. Provide adequate structural support where potable water main crosses under sewer. At minimum, provide compacted select backfill for ten feet on each side of crossing.
 - d. Exceptions:
 - 1) Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe.
 - 2) Encase either potable water main or sewer in watertight carrier pipe extending ten feet on each side of crossing, measured perpendicular to potable water main.

C. Plugs:

1. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.

3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
 4. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to ENGINEER.
- E. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.
1. Trench excavation and backfill, and bedding materials shall conform to Section 31 23 16.13, Trenching, as applicable.
 2. Where ENGINEER deems existing bedding material unsuitable, remove and replace existing bedding with approved granular material furnished, placed, and compacted in accordance with Section 31 23 16.13, Trenching.
 3. Where pipe is installed in rock excavation, provide minimum of three inches of granular bedding material underneath pipe smaller than four-inch nominal diameter, and minimum of six inches of granular bedding material underneath pipes four-inch nominal diameter and larger.
 4. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.
 5. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.
 6. Do not lay pipe until ENGINEER approves bedding condition.
 7. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.
- F. Laying Pipe:
1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:
 - a. Ductile Iron Pipe: ANSI/AWWA C600, ANSI/AWWA C105, AWWA M41.
 - b. Thermoplastic Pipe: ASTM D2321, ASTM D2774, ANSI/AWWA C605, AWWA M23, AWWA M45, AWWA, M55.
 - c. Sanitary and Storm Sewers: ASCE 37.
 2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by ENGINEER. Remove and reinstall pipes that are not installed correctly.
 3. Slope piping uniformly between elevations shown.
 4. Keep groundwater level in trench at least 24 inches below bottom of pipe before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.
 5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by ENGINEER.
 6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by ENGINEER.
 7. Place concrete pipe containing elliptical reinforcement with minor axis of reinforcement in vertical position.

8. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.
9. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by ENGINEER.
10. For PVC and CPVC piping with solvent welded joints, 2.5-inch diameter and smaller, and copper tubing, snake piping in trench to compensate for thermal expansion and contraction.
11. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
12. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before pipe is laid.
13. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
14. Do not place blocking under pipe, unless specifically approved by ENGINEER for special conditions.
15. Touch up protective coatings in manner satisfactory to ENGINEER prior to backfilling.
16. Notify ENGINEER in advance of backfilling operations.
17. On steep slopes, take measures acceptable to ENGINEER to prevent movement of pipe during installation.
18. Thrust Restraint: Where required, provide thrust restraint conforming to Article
19. Place copper tubing to be sure that the pipe does not have kinks or sharp bends and to assure against its being in contact with sharp stones or ledge which would cause damage to the pipe. At least 6 inches of sand shall be placed adjacent to, under and above the pipe, and no stone larger than 2 inches shall be placed over the pipe until the depth of backfill above the pipe is in excess of 1 foot.

H. Jointing Pipe:

1. Ductile Iron Mechanical Joint Pipe:
 - a. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.
 - b. Lubricate plain ends and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.
 - c. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.
 - d. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.

- e. Push gland toward socket and center gland around pipe with gland lip against gasket.
- f. Insert bolts and hand-tighten nuts.
- g. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

Pipe Diameter (inches)	Bolt Diameter (inches)	Range of Torque (ft-lbs)
3	5/8	45 to 60
4 to 24	3/4	75 to 90
30 to 36	1	100 to 120
42 to 48	1.25	120 to 150

- h. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Tnemec, or equal.
 - i. Restrained mechanical joints shall be in accordance with Section 40 05 19, Ductile Iron Process Pipe.
2. Ductile Iron Push-On Joint Pipe:
- a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
 - b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
 - c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
 - d. Immediately prior to joint assembly, apply thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
 - e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
 - f. Maintain an adequate supply of gaskets and joint lubricant at the Site when pipe jointing operations are in progress.
3. Ductile Iron Proprietary Joints:

- a. Install pipe that utilizes proprietary joints for restraint specified in Section 40 05 19, Ductile Iron Process Pipe, or other such joints, in accordance with manufacturer's instructions.
- 4. Thermoplastic Pipe Joints:
 - a. Solvent Cement Welded Joints:
 - 1) Bevel pipe ends and remove all burrs before making joints. Clean pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.
 - 2) Use solvent cement supplied or recommended by pipe manufacturer.
 - 3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
 - 4) Take appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
 - b. Bell and Spigot Joints:
 - 1) Bevel pipe ends, remove all burrs, and provide a reference mark at correct distance from pipe end before making joints.
 - 2) Clean spigot end and bell thoroughly before making the joint. Insert O-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer's recommended lubricant. Do not lubricate bell and O-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.
- 5. Copper Tubing Joints:
 - a. Mechanical Joints:
 - 1) Conform to applicable requirements of Section 40 05 17 – Copper Process Pipe
- 6. HDPE Pipe Joints:
 - a. Butt Fusion Welded Joints:
 - 1) Install joints in accordance with manufacturer's instructions using hydraulic butt fusion machine or manual machine equipped with torque wrench. Equipment shall be able to achieve and maintain heating tool temperature range of 400 to 450 degrees F and an interface pressure of 60 to 90 psi.
 - 2) Clean interior and exterior of pipe and fitting ends with clean, dry, lint-free cloth.
 - 3) Align ends to be joined in the fusion machine without forcing ends into alignment. Adjust alignment as necessary and tighten clamps to prevent slippage.
 - 4) Place facing tool between ends to be joined and face them to provide clean, smooth, parallel mating surface. If stops are present, face ends down to the stops. Remove all shavings after facing without touching ends.
 - 5) Re-check alignment of ends and check for slippage against fusion pressure. There shall be no detectable gaps between ends. Align

outside diameters.

- 6) Heating tool shall maintain pipe manufacture's recommended temperature range. Place the tool between ends to be joined. Move ends against heating tool to achieve full contact. Hold ends against heating tool without force until the following melt bead size is formed:

Pipe Diameter (inches)	Required Melt Bead Size (inches)
2 to 4	1/8 to 3/16
4 to 12	3/16 to 1/4
12 to 24	1/4 to 7/16
24 to 54	7/16 to 9/16

- 7) Upon forming proper melt bead size, quickly separate ends and remove heating tool. Quickly inspect melted ends and bring ends together applying joining force recommended by manufacturer, using 60 to 90 psi interfacial pressure to form double bead rolled over surface of pipe on both ends.
- 8) Hold joining force against ends until joint is cool to the touch. Cooling period shall be 30 to 90 seconds per inch of pipe diameter. Heavier wall thicknesses may require longer cooling times as recommended by pipe manufacturer.
- 9) Upon completing joint, inspect to verify double bead has been formed on both sides, uniformly rounded and consistent in size all around joint. Remove faulty joints and re-joint.

I. Backfilling:

1. Conform to applicable requirements of Section 31 23 16.13, Trenching.
2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.

J. Connections to Valves and Hydrants:

1. Install valves and hydrants as shown and indicated in the Contract Documents.
2. Provide suitable adapters when valves or hydrants and piping have different joint types.
3. Provide thrust restraint at all hydrants and at valves located at pipeline terminations.

K. Transitions from One Type of Pipe to Another:

1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

L. Closures:

1. Provide closure pieces shown or required to complete the Work.

M. Water Service Connections to Water Main:

1. The tapping machine shall be rigidly fastened to the pipe as near the horizontal diameter as possible.

2. The length of travel to the tap shall be established that when the stop is inserted and tightened with a 14 inch wrench, not more than one to three threads will be exposed on the outside.
3. When a wet tapping machine is used, the corporation cock shall be inserted with the machine while it is still in place.
4. Stops shall be tightened only sufficiently to give watertightness and care must be constantly exercised not to overtighten them.

3.2 TRACER TAPE INSTALLATION

- A. Polyethylene Underground Warning Tape for Metallic Pipelines:
 1. Provide polyethylene tracer tape for buried metallic piping, which includes pipe that is steel, ductile iron, cast iron, concrete, copper, and corrugated metal.
 2. Provide tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.
 3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along pipe centerline.
 4. Tape shall be spread flat with message side up before backfilling.
- B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
 1. Provide polyethylene tracer tape with aluminum backing for buried, non-metallic piping, which includes pipe that is PVC, CPVC, polyethylene, HDPE, FRP, ABS, and vitrified clay.
 2. Provide magnetic tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.
 3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along the pipe centerline.
 4. Tape shall be spread flat with message side up before backfilling.

3.3 THRUST RESTRAINT

- A. Provide thrust restraint on pressure piping systems where shown or indicated in the Contract Documents.
- B. Thrust restraint may be accomplished by using restrained pipe joints, concrete thrust blocks, or harnessing buried pipe. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Buried Piping Schedule at the end of this Section.
- C. Place concrete thrust blocks against undisturbed soil. Where undisturbed soil does not exist, or for projects where the Site consists of backfill material, thrust restraint shall be provided by restrained pipe joints.
- D. Restrained Pipe Joints:

1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
 - a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with proprietary restrained joint system as specified in Section 40 05 19, Ductile Iron Process Pipe; lugs and tie rods; or other joint restraint systems approved by ENGINEER.
 - b. Thermoplastic and HDPE Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across joint or other suitable joint restraint system, subject to the approval of ENGINEER.
- E. Concrete Thrust Blocks:
 1. Provide concrete thrust blocks on pressure piping at changes in alignment of 15 degrees or more, at tees, plugs and caps, and where shown or indicated in the Contract Documents. Construct thrust blocks of Class B concrete, conforming to 03 00 05, Concrete.
 2. Install thrust blocks against undisturbed soil. Place concrete so that pipe and fitting joints are accessible for repair.
 3. Concrete thrust block size shall be as shown on the Drawings or as approved by ENGINEER.
- F. Harnessed lengths of buried pipe shall be as shown on the Drawings.

3.4 WORK AFFECTING EXISTING PIPING

- A. Location of Existing Underground Facilities:
 1. Locations of existing Underground Facilities shown on the Drawings should be considered approximate.
 2. Determine the true location of existing Underground Facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of Underground Facilities that could be disturbed during excavation and backfilling operations, or that may be affected by the Work.
- B. Taking Existing Pipelines and Underground Facilities Out of Service:
 1. Conform to Section 01 14 16, Coordination with Owner's Operations.
 2. Do not take pipelines or Underground Facilities out of service unless specifically listed in Section 01 14 16, Coordination with Owner's Operations, or approved by ENGINEER.
 3. Notify ENGINEER in writing prior to taking pipeline or Underground Facilities out of service. Shutdown notification shall be provided in advance of the shutdown in accordance with the General Conditions and Section 01 14 16, Coordination with Owner's Operations.
- C. Work on Existing Pipelines or Underground Facilities:
 1. Cut or tap piping or Underground Facilities as shown or required with machines specifically designed for cutting or tapping pipelines or Underground Facilities, as applicable.

2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
4. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations, Section 01 73 29, Cutting and Patching, and Section 01 73 24, Connections to Existing Facilities.

3.5 FIELD QUALITY CONTROL

A. General:

1. Test all piping, except as exempted in the Buried Piping Schedule in this Section.
2. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
3. Conduct all tests in presence of ENGINEER.
4. Remove or protect pipeline-mounted devices that could be damaged by testing.
5. Provide all apparatus and services required for testing, including:
 - a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER's operations.
 - b. Temporary bulkheads, bracing, blocking, and thrust restraints.
6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into piping being tested. CONTRACTOR shall provide fluid for other types of testing required.
8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by CONTRACTOR and that fails the test shall be repaired upon authorization of OWNER. Unless otherwise included in the Work, repair of existing piping or Underground Facilities will be paid as extra Work.

B. Test Schedule:

1. Refer to the Buried Piping Schedule in this Section for type of test required and required test pressure.
2. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.
3. For piping not listed in Buried Piping Schedule in this Section:
 - a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires separate test.

- b. Use exfiltration testing, low-pressure air testing, or vacuum testing for other piping.
 - c. Disinfect for bacteriological testing piping that conveys potable water.
 - 4. Test Pressure:
 - a. Use test pressures listed in Buried Piping Schedule in this Section.
 - b. If test pressure is not listed in Buried Piping Schedule, or if test is required for piping not listed in the Buried Piping Schedule, test pressure will be determined by ENGINEER based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.
- C. Hydrostatic Testing:
 - 1. Preparation for Testing:
 - a. For thermoplastic pipe and fiberglass pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
 - b. For HDPE pipe, follow procedures described in ASTM F2164. Test duration, including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize, shall not exceed eight hours. If re-testing of a test section or pipeline is required, at least eight hours shall elapse between tests.
 - c. For ductile iron pipe, follow procedures described in ANSI/AWWA Standard C600.
 - d. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.
 - 2. Test Procedure:
 - a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
 - b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
 - c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
 - d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
 - e. HDPE Pipe: After filling pipeline, gradually pressurize pipe to test pressure and maintain required test pressure for three hours for pipe to expand. During expansion, add fluid to maintain required test pressure. Begin timed test period after expansion period and other requirements are met.
 - f. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
 - g. Timed Test Period: After stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. For HDPE pipe, after three hour expansion phase, reduce test pressure by ten psig

h. Pump from test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.

- #### D. Bacteriological Testing:

- ## 3.6 CLEANING AND DISINFECTION

- 33 05 05-16

5. Bacteriologic tests will be performed by OWNER. Certified test laboratory report will be provided to CONTRACTOR, if requested.
6. Chlorine concentration in water entering the piping shall be between 50 and 100 ppm, such that minimum residual concentration of 25 mg/L remains after 24-hour retention period. Disinfect piping and all related components. Repeat as necessary to provide complete disinfection.
7. After required retention period, flush chlorinated water to closed drain line, unless otherwise acceptable to ENGINEER. Properly dispose of chlorinated water in accordance with Laws and Regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

3.7 SCHEDULES

- A. Schedules listed below, following the “End of Section” designation, are part of this Specification section.
 1. Table 33 05 05-A, Buried Piping Schedule.

+ + END OF SECTION + +

TABLE 33 05 05-A, BURIED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test
SAN	8	PVC	N/A	N/A	SDR 21	RPOJ	HYD (50)
SFM	6	PVC	N/A	N/A	SDR 21	RPOJ	HYD (50)
SAN-HDD	8	HDPE	N/A	N/A	DR 11	BFW	HYD (50)
SFM-HDD	6	HDPE	N/A	N/A	DR 11	BFW	HYD (50)
Wetwell Vent	4	CI	N/A	AC	SV	COMP	NR

The following abbreviations are used in the Buried Piping Schedule.

A. Service Abbreviations

Service	Abbrev		Service	Abbrev.
Sanitary Sewer	SAN		Wastewater	WW
Storm Sewer	ST		Overflow	OF
Combined Sewer	CS		Centrate	CEN
Sanitary Force Main	SFM		Filtrate	FILT
Raw Water	RW		Scum	SCUM
Potable Water	PW		Primary Sludge	PS
City Water	CW		Return Activated Sludge	RAS
Non-Potable Water	NPW		Waste Activate Sludge	WAS
Plant Effluent Water	PEW		Thickened Sludge	TS
Spray Water	SPW		Mixed Sludge	MS
Backwash Water	BW		Digested Sludge	DS
Hot Water Supply	HWS		Chlorine Solution	CLS
Hot Water Return	HWR		Sodium Hydroxide	NAOH
Influent	INF		Sodium Hypochlorite	NAOCL
Effluent	EFF		Polymer Solution	POLYS
Drain	DR		Alum	AL
Process Air	PA		Hydraulic Fluid	HF
Instrument Air	IA		Fuel Oil	FO
Digester Gas	DIG		Lube Oil	LO
Chlorine Gas	CLG		Horizontal Directional Drilling	HDD

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Ductile Iron	DI		Polyvinyl Chloride	PVC
Cast Iron	CI		Chlorinated Polyvinyl Chloride	CPVC
Carbon Steel	CS		Polyethylene	PE
Stainless Steel	SS		High Density Polyethylene	HDPE
Copper	C		Fiberglass Reinforced Plastic	FRP
Corrugated Metal Pipe	CMP		Acrylonitrile Butadiene Styrene	ABS
Reinforced Concrete Pipe	RCP		Vitrified Clay	VC
Prestressed Concrete Cylinder Pipe	PCCP			
Non-Prestressed Concrete Cylinder Pipe	CCP			
Steel Cylinder Pipe	SCP			

C. Lining/Coating Abbreviations

Lining	Abbrev		Coating	Abbrev.
Cement Mortar Lined	CL		Asphaltic Coated	AC
Glass Lined	GL		Polyethylene Wrapped	PEW
Ceramic Epoxy	CE		Painted	P
Fusion Bonded Epoxy Lined	FBEL		Fusion Bonded Epoxy Coated	FBEC
Plastic Lined	PL		Insulated	I
			Galvanized	Galv

D. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Bell and Spigot	BS		Butt Weld	BW
Restrained Bell and Spigot	RBS		Lap Weld	LW
Push-on Joint	POJ		Butt Fusion Weld	BFW
Restrained Push-on Joint	RPOJ		Solvent Weld	SW
Mechanical Joint	MJ		Sleeve-type Flexible Coupling	SLFC
Restrained Mech. Joint	RMJ		Split Flexible Coupling	SPFC
Soldered	Sd		Plasticized PVC Coupling	PPVC
Brazed	Bz		Grooved or Shouldered End Coupling	GSEC
Threaded	Thd		Flanged	Flg
Compression Sleeve Coupling	CSC		Compression Flange Adapter	CFA

E. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ()		Process Air Pipe Test (test pressure in psig)	PA ()
Exfiltration	EX		Chlorine Pipe Test	CL
Low-pressure Air Sewer Test	AIR		Disinfection and Bacteriological Testing	DBT
Vacuum Test	VAC		Examination of Welds	EW
Vertical Deflection	VD		No Test Required	NR
Televised Inspection	TV			

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all precast, cast-in-place and masonry manholes and structures (wetwells and vaults).

B. General:

1. Manholes and structures shall conform in shape, size, dimensions, material, and other respects to the details shown or as directed by ENGINEER.
2. Cast-iron frames, grates and covers shall be the standard frame and grate or cover unless otherwise shown and shall be as specified in Section 05 56 00, Metal Castings.
3. Concrete for cast-in-place manholes and structures and for inverts in precast and masonry manholes and structures shall be Class "A" and shall conform to the requirements specified under Section 03 00 05, Concrete.

C. Related Sections:

1. Section 03 00 05, Concrete.
2. Section 05 50 13, Miscellaneous Metal Fabrications.
3. Section 05 56 00, Metal Castings.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, (ASTM).
 - a. ASTM C 32, Specification for Sewer and Manhole Brick (made from Clay or Shale).
 - b. ASTM C 139, Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
 - c. ASTM C 140, Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - d. ASTM C 207, Specification for Hydrated Lime for Masonry Purposes.
 - e. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.
2. American Water Works Association, (AWWA).
 - a. AWWA C302, Reinforced Concrete Pressure Pipe, Non-cylinder Type, for Water and Other Liquids.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Submit drawings showing design and construction details of all precast concrete and cast-in-place manholes and structures, including details of joints between the manhole bases and riser sections and stubs or openings for the connections.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES AND STRUCTURES

- A. Precast manholes and structures shall conform to the details shown. Provide cast-in-place concrete bases where shown.
- B. Except where otherwise specified precast manhole and structure components shall consist of reinforced concrete pipe sections especially designed for manhole construction and manufactured in accordance with ASTM C 478, except as modified herein.
- C. Precast, reinforced concrete manhole and structure bases, riser sections, flat slabs and other components shall be manufactured by wet cast methods only, using forms which will provide smooth surfaces free from irregularities, honeycombing or other imperfections.
- D. Joints between manhole and structure components shall be the tongue and groove type employing a single, continuous rubber O-ring gasket and shall conform to AWWA C302. The circumferential and longitudinal steel reinforcement shall extend into the bell and spigot ends of the joint without breaking the continuity of the steel. Joints between the base sections, riser sections and top slabs of manholes 72-inches in diameter and less shall be rubber and concrete joints. Joints for manhole components greater than 72-inches in diameter shall be provided with steel bell and spigot rings. Joints between riser sections shall be double butyl sealed.
- E. All precast manhole and structure components shall be of approved design and of sufficient strength to withstand the loads imposed upon them. They shall be designed for a minimum earth cover loading of 130 pounds per cubic foot, an H-20 wheel loading, and an allowance of 30 percent in roadways and 15 percent in rights-of-way for impact. Manhole bases shall have two cages of reinforcing steel in their walls, each of the area equal to that required in the riser sections. Wall thickness shall not be less than 5-inches. Concrete top slabs shall not be less than 8-inches thick.
- F. Lifting holes, if used in manhole and structure components, shall be tapered, and no more than two shall be cast in each section. Tapered, solid rubber plugs shall be furnished to seal the lifting holes. The lifting holes shall be made to be sealed by plugs

driven from the outside face of the section only.

- G. The point of intersection (P.I.) of the sewer pipe centerlines shall be marked with 1/4-inch diameter steel pin firmly enclosed in the floor of each manhole base and protruding approximately 1-inch above the finished floor of the base.
- H. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.
- I. The barrel of the manhole shall be constructed of various lengths of riser pipe manufactured in increments of one foot to provide the correct height with the fewest joints. Openings in the barrel of the manholes for sewers or drop connections will not be permitted closer than one foot from the nearest joint. Special manhole base or riser sections shall be furnished as necessary to meet this requirement.
- J. A precast or cast-in-place slab or precast eccentric cone, as shown or approved, shall be provided at the top of the manhole barrel to receive the cast iron frame and cover.
- K. Provide an inlet baffle or drop connection to dissipate energy and prevent vorteces and air entrainment in the pumps.

2.2 JOINTING PRECAST WET WELL AND VAULT SECTIONS

- A. Seal tongue and groove joints of precast sections with either rubber “O”-ring gasket or preformed flexible joint sealant. “O”-ring gasket shall conform to ASTM C443. Preformed flexible joint sealant shall be Kent Seal No.2 as manufactured by Hamilton-Kent; Ram-Nek as manufactured by K.T. Snyder Company or equal.
- B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.3 PIPE CONNECTIONS TO WETWELLS AND VAULTS

- A. Connect pipe to manhole in the following ways:
 - 1. Grout in place - Precast sections shall have a formed, tapered circular opening larger than the pipe outside diameter. Grout shall be non-shrink and waterproof equal to Hallemite, Waterplug or Embeco. Plastic pipe shall have a waterstop gasket secured to pipe with a stainless steel clamp.
 - 2. Flexible sleeve — Integrally cast sleeve in precast sections or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.
 - 3. Compression gasket - Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A- Lok, or equal.

2.4 DAMPPROOFING

- A. Dampproofing shall be Hydrocide 648 by Sonneborn Building Products; Dehydratine 4 by A.C. Horn Inc; RIW Marine Liquid by Toch Brothers, or equal.

2.5 MISCELLANEOUS METALS

- A. Metal frames and covers and similar required items shall be provided as shown and in accordance with Division 05, Metals.

2.6 DROP CONNECTIONS

- A. Drop connections for manholes and structures shall be constructed where shown or directed by the ENGINEER and shall conform to the design and details shown. Pipe and fittings shall be as shown or otherwise approved.

PART 3 - EXECUTION

3.1 LAYING MASONRY

- A. Brick shall be satisfactorily wet when being laid and each brick shall be laid in mortar so as to form full bed, end and side joints in one operation. The joints shall not be wider than 3/8-inch, except when the bricks are laid radially, in which case the narrowest part of the joint shall not exceed 1/4-inch. Masonry work shall be kept moist for a period of three days after completion, and precautions shall be taken to prevent freezing during cold weather.
- B. For concrete block, the vertical keyways shall be completely filled with mortar.
- C. Each grading ring shall be laid in a full bed of mortar and shall be thoroughly bonded.

3.2 PLASTERING

- A. The outside of brick manholes and structures, brick stacks and grading rings shall be neatly plastered with 1/2-inch of cement mortar as the Work progresses.

3.3 PRECAST BASES

- B. Precast bases shall be set on a crushed stone or crushed gravel foundation as shown. Precast bases shall be set at the proper grade and carefully leveled and aligned.

3.4 PRECAST MANHOLE AND STRUCTURE SECTIONS

- A. Set sections vertical with steps and sections in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1:2 cement-sand mortar to provide a uniform bearing between components. Joints between riser sections shall be double butyl sealed. All other joints shall be sealed with cement mortar inside and out and

troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.

- B. Install sections, joints and gaskets in accordance with manufacturers recommendations.
- C. Lifting holes shall be sealed tight with a solid rubber plug driven into the hole from the outside of the barrel and the remaining void filled with 1 to 2 cement-sand mortar.

3.5 MANHOLE CHANNELS

- A. All invert channels through manholes and structures shall be constructed of Class "A" concrete. Channels shall be properly formed to the sizes, cross sections, grades and shapes shown or as ordered. Benches shall be built up to the heights shown or as directed by the ENGINEER and given a uniform wood float finish. Care shall be taken to slope all benches for proper drainage to the invert channel.

3.6 GRADING RINGS

- A. Grading rings or brick stacks shall be used for all precast and masonry manholes and structures, where required. Stacks or grade rings shall be a maximum of 12-inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the stack or grade rings shall be such as required to bring the manhole frame to the proper grade.
- B. Each grade ring shall be laid in a full bed of mortar and shall be thoroughly bonded.
- C. Brick work shall be as specified in Article 2.2 and Article 3.1, above.

3.7 STUBS FOR FUTURE CONNECTIONS

- A. As shown or required for connections, cast iron sleeves, bell end tile, ductile iron or reinforced concrete pipe stubs with approved watertight plugs shall be installed in manholes and structures. Where pipe stubs, sleeves or couplings for future connections are shown or directed by the ENGINEER, CONTRACTOR shall provide all materials and labor in order to complete the Work.

3.8 GRADING AT MANHOLES AND STRUCTURES

- A. All manholes and structures in unpaved areas shall be built, as shown or directed by the ENGINEER, to an elevation higher than the original ground. The ground surface shall be graded to drain away from the manhole. Fill shall be placed around manholes to the level of the upper rim of the manhole frame, and the surface evenly graded on a 1 to 5 slope to the existing surrounding ground, unless otherwise shown or directed by the ENGINEER. The slope shall be covered with 4-inches of topsoil, seeded and maintained until a satisfactory growth of grass is obtained.
- B. Manholes and structures in paved areas shall be constructed to meet the final surface grade.

In paved areas on State Highways, all manholes and structures shall be 1/2- inch below final wearing surfaces. Manholes and structures shall not project above finished roadway pavements to prevent damage from snowplows.

- C. CONTRACTOR shall be solely responsible for the proper height of all manholes and structures necessary to reach the final grade at all locations. CONTRACTOR is cautioned that ENGINEER'S review of Shop Drawings for manhole components will be general in nature and CONTRACTOR shall provide an adequate supply of random length precast manhole riser sections to adjust any manhole to meet field conditions for final grading.

3.09 MANHOLE WATERTIGHTNESS

- A. All manholes and structures shall be free of visible leakage. Each manhole shall be tested for leaks and inspected, and all leaks shall be repaired in a manner subject to ENGINEER'S approval. Manhole testing shall conform to the requirements of Section 33 05 05, Buried Piping Installation.

3.10 FLEXIBLE PIPE JOINT AT MANHOLE BASE

- A. An approved flexible joint shall be provided between each pipe entering and exiting the manhole or structure. This may be accomplished by the installation in the manhole base of the bell end of a pipe or by other means subject to approval of ENGINEER. Joints shall be similar to the approved pipe joints. The joint into the manhole base shall be completely watertight.

3.11 WET WELL AND VALVE VAULT INSTALLATION

- A. Wet wells and vaults shall be constructed to the dimension shown on the Drawings and as specified in these specifications. Protect all work against flooding and flotation.
- B. Base, walls and bottom shall be at least of the thickness shown and reinforced to withstand the loads to be expected. Connections for sewer pipes shall conform to the details shown.
- C. Set precast concrete sections plumb with a 1/4-inch maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber "O" ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or non-shrink grout to the satisfaction of the Engineer.
- D. Set sections vertical with sections in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1:2 cement-sand mortar to provide a uniform bearing between components. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.
- E. Install sections, joints and gaskets in accordance with manufacturers recommendations.

- F. Lifting holes shall be sealed tight with a solid rubber plug driven into the hole from the outside of the barrel and the remaining void filled with 1 to 2 cement-sand mortar.
- G. Allow joints to set for 14 hours before backfilling unless a shorter period is specifically approved by the Engineer. Backfill carefully and evenly around precast sections.
- H. Wet well and valve vault shall be constructed to meet the final surface grade as shown.
- I. Contractor shall be solely responsible for the proper height of wet well and valve vault necessary to reach the final grade at all locations. Contractor is cautioned that Engineer's review of Shop drawings for wet well and valve vault components will be general in nature.
- J. Wet well and valve vault shall be free of visible leakage, and tested for leaks. All leaks shall be repaired in a manner subject to Engineer's approval.
- K. An approved flexible joint shall be provided for any gravity sanitary sewer pipe entering and exiting wet wells. This may be accomplished by the installation in the wet well base of the bell end of a pipe or by other means subject to approval of Engineer. Joints shall be similar to the approved pipe joints. The joint into the manhole base shall be completely watertight under the specified test pressure.
- L. Precast bases shall be set level. Precast bases shall be set at the proper grade and carefully leveled and aligned.
- M. Plug holes in the concrete sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.
- N. Cut holes in precast sections to accommodate pipes prior to setting wet well or valve vault sections in place to prevent jarring which may loosen the mortar joints.

3.12 DAMPPROOFING

- A. Paint outer surfaces of precast concrete wet well and vaults with two coats of bituminous dampproofing at the rate of 30 to 60 sq ft per gallon, in accordance with manufacturer's instructions.

3.13 CLEANING

- A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

3.14 LEAKAGE TESTS

- A. Test each wet well and valve vault for leakage. Engineer shall observe each test. Precast tanks shall be tested after the recast risers have been installed. These tanks shall be filled to the top of the riser. Perform exfiltration test as described below:
- B. Assemble in place; fill and point all lifting holes and exterior joints within six feet of the ground surface with an approved non-shrinking mortar. Test prior to placing the shelf and invert and before filling and pointing the horizontal joints below 6-ft of depth. Lower ground water table below bottom of the wet well or valve vault for the duration of the test. Plug all pipes and other openings into the wet well or valve vault and brace to prevent blow out.
- C. Fill with water to the top of the precast structure. If the excavation has not been backfilled and no water is observed moving down the surface of the wet well or valve vault, the structure is satisfactorily water-tight. If the test, as described above is unsatisfactory as determined by the Engineer, or if the wet well or valve vault excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill wet well or valve vault to the top of the precast structure, if necessary and allow at least eight hours to pass. At the end of the test period, refill the wet well or valve vault to the top of the precast structure, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each wet well or valve vault shall not exceed one gallon per vertical foot for a 24-hour period. If the wet well or valve vault fails this requirement, but the leakage does not exceed three gallons per vertical foot per day, repairs by approved methods may be made as directed by the Engineer. If leakage due to a defective section of joint exceeds three gallons per vertical foot per day, the wet well or valve vault shall be rejected. Uncover the rejected wet well or valve vault as necessary and to disassemble, reconstruct or replace it as directed by the Engineer. Retest the wet well or valve vault and, if satisfactory, fill and paint the interior joints.
- D. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.
- E. An infiltration test may be substituted for an exfiltration test the ground water table is above the highest joint in the wet well or valve vault. If there is no leakage into the wet well or valve vault as determined by the Engineer, the wet well or valve vault will be considered water-tight. If the Engineer is not satisfied, testing shall be performed as described above.

+ + END OF SECTION + +

SECTION 33 05 23.13

UTILITY HORIZONTAL DIRECTIONAL DRILLING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to install and test pipe using horizontal directional drilling (HDD) methods. Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.
 - 2. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to perform the successful installation of the pipeline to the required line and grade shown on the Drawings.
- B. Related Sections:
 - 1. Section 33 05 05, Buried Piping Installation.
 - 2. Section 40 05 33, High Density Polyethylene Pipe.

1.2 DEFINITIONS AND ABBREVIATIONS

- A. Horizontal Directional Drilling (HDD) - HDD is a trenchless excavation method which is accomplished in two phases. The first phase consists of drilling a small diameter pilot hole along a designed directional path. The second phase consists of enlarging the pilot hole to a diameter suitable for installation of the pipe or conduit, and pulling the pipe or conduit into the enlarged hole. HDD is accomplished using a specialized horizontal drilling rig with ancillary tools and equipment.

1.3 SUBMITTALS

- A. All procedure or material descriptions requiring OWNER approval shall be submitted not less than 2 weeks prior to commencing any HDD activities. Review and acceptance by the OWNER shall not be construed as relieving the CONTRACTOR of his responsibilities under this Contract.
- B. Qualifications
 - 1. Submit written documentation summarizing the qualifications of the CONTRACTOR and CONTRACTOR's Directional Drilling Installation Specialist in accordance with the requirements of Paragraph 1.4. If the HDD Work is to be performed by a subcontractor, provide name and qualifications of proposed subcontractor.

2. Submit written documentation summarizing the qualifications of the CONTRACTOR's qualified fusion technician in accordance with the requirements of Paragraph 3.1.D.
- C. Shop Drawings
1. Equipment: Submit detailed description of the HDD equipment and procedures to be employed. Provide manufacturer's literature describing in detail the HDD system to be used. Describe method and capabilities for drilling the pilot hole, surveying the pilot hole, steering and guidance, and enlarging the hole.
 2. Tests: Submit description of the pipe joint testing methods, procedures, and apparatus. Submit copies of all test reports.
 3. Certificates: Submit certificates of compliance with referenced standards.
 4. Buoyancy Control: Buoyancy control and modification procedures proposed for use shall be submitted to the OWNER for approval.
 5. Record Drawings: During the progress of the Work, keep an up to date set of drawings showing field and shop drawing modifications. The drawings shall show all piping in plan and profile, with all reference dimensions and elevations required for complete record drawings of the piping systems.
- D. Pipe Material Calculations: The CONTRACTOR shall provide calculations determining the maximum pulling force that may be anticipated during the pull back operation to overcome theoretical frictional forces. The calculations shall be signed and sealed by a Professional Engineer registered in the State of Massachusetts accompanied by written approval from the manufacturer verifying that the maximum calculated pulling force will not exceed the manufacturer's recommended yield tensile strength and factor of safety for the proposed pipe material.
- E. Bending Radius: The CONTRACTOR shall submit the proposed equation for calculation of the maximum bending radius of the drill pipe. CONTRACTOR shall certify in writing that maximum bending radius shall not be exceeded along the force main alignment shown on the Drawings.
- F. Drilling Plan: The CONTRACTOR shall submit a detailed narrative description of the sequence of events that will be performed to install the specified pipe using HDD. The plan shall include, but not be limited to, a description of the CONTRACTOR's proposed HDD procedures, equipment, and fusion welding equipment. The plan shall include full-size (24 x 36) scaled site drawings showing location of proposed equipment, drill rigs, storage, trailers, parking, site entry and exit points, spill containment and erosion control measures, etc., The plan shall indicate the diameter of the pilot hole, rig pulling capacity, torque, and mud pumping capabilities. Include a description of methods and precautions the CONTRACTOR proposes to use to prevent exceeding the pipe manufacturer's approved safe yield tensile strength during pull back, precautions to prevent inadvertent return of drilling mud along the project site, and contingency plans for

cleanup of inadvertent returns, should they occur. Plan shall also include an Excavation and Sediment Control Plan, giving anticipated sizes and locations of pits and sediment and erosion control methods to be employed.

- G. Monitoring Plan: The CONTRACTOR shall submit a borepath monitoring and installation verification plan for review by the ENGINEER prior to mobilization of drilling equipment. The plan shall summarize procedures, equipment, instrumentation, responsible personnel (with experience information) and reporting provisions.
- H. Drilling Fluids: The composition of all drilling fluids proposed for use shall be submitted to the ENGINEER for approval. Where applicable, catalog cuts and Material Safety Data Sheets (MSDS) shall be provided for drilling fluids and additives. The method of disposal of the drilling fluids and separated solids shall also be submitted for approval.
- I. Solids Control System: The CONTRACTOR shall submit details of the proposed drilling fluid solids control system including the manufacturer's literature, a schematic of the proposed system, the system components, capacity, soil fractions which can be separated and a characterization of the water which will be recirculated or disposed of.
- J. Post Installation Survey: The CONTRACTOR shall submit details of proposed means and methods for conducting the required post installation pipeline alignment survey.

1.4 QUALITY ASSURANCE

- A. Experience:
 - 1. The CONTRACTOR shall have a minimum of 5 years experience using HDD for the installation of pipelines. Additionally, the CONTRACTOR shall have performed at least three prior projects with single continuous pull lengths and pipe diameters equal to or greater than 300-ft and 12-inches respectively.
 - 2. Installation Specialist: The CONTRACTOR shall provide the full-time services of a competent installation specialist during the HDD to assist in technical matters. The specialist shall advise the CONTRACTOR on drilling matters which may include, but not be limited to, drilling procedures, pipe support, mapping of the pipe location, quality assurance of the work, safety or other items as necessary.
 - a. The Installation Specialist shall have a minimum of 3 years experience using HDD for installation of similar pipelines.
 - b. The Installation Specialist may be the CONTRACTOR's or Subcontractor's superintendent.
 - 3. Operators: HDD equipment operator(s) shall have at least 2 years of experience using equipment similar to that required on this project.

- B. Requirements of Regulatory Agencies: Comply with standards of OSHA, the OWNER, MADEP, Underwriter's Laboratories, and all other authorities having jurisdiction.

1.5 JOB CONDITIONS

- A. The CONTRACTOR shall make an inspection of the area(s) within the vicinity of the project and the immediate area of the Work and become thoroughly familiar with the natural and man-made features.
- B. Existing Utilities: The CONTRACTOR shall be responsible for field locating existing underground utilities and repairing any utilities damaged by the HDD construction in the areas of the Work.
 - 1. Contact the utility location/notification service for the construction area.
 - 2. The CONTRACTOR shall be responsible for locating any and all underground facilities, regardless of the OWNER's previous efforts in this regard. Positively locate and stake or mark out all existing lines, cables, or other underground facilities including exposing any facilities which are located within 10 feet of the designed drill alignment.
 - 3. The CONTRACTOR shall be responsible for all losses and repairs occasioned by damage to underground facilities resulting from drilling operations. Should uncharted or incorrectly charted piping or utilities be encountered during the work, consult the piping or utility owner and the OWNER for instructions. The CONTRACTOR shall cooperate with the OWNER and utility companies in keeping respective services and facilities in operation. Damaged utilities shall be repaired to the satisfaction of the utility owner. Modify drilling practices and downhole assemblies to prevent damage to existing facilities.
 - 4. Do not interrupt existing utilities serving facilities occupied and used by the OWNER or others, except when permitted in writing by the OWNER and then only after acceptable temporary utility services have been provided.
 - 5. Coordinate with utility companies for shut-off of services, if required.
- C. Dust Control: The CONTRACTOR shall conduct all operations and maintain the area of the Work activities, including sweeping and sprinkling work areas, so as to minimize creation and dispersion of dust.

1.6 DESIGN CRITERIA

- A. Selection of specific HDD means and methods is the responsibility of the CONTRACTOR. The means and methods selected by the CONTRACTOR shall be capable of achieving certain installation line and grade performance requirements as indicated below. The CONTRACTOR shall accept full responsibility for meeting these minimum requirements with no exceptions. If as-drilled mapping information indicates any of the requirements are not satisfied, the

CONTRACTOR shall take whatever measures are necessary to meet all the requirements, at no additional cost to the OWNER.

- B. Alignment Tolerances:
 - 1. The intended design horizontal and vertical alignment of the force main pipeline is shown on the Drawings. At no location shall the actual installed pipe location be more than 1 foot away from the intended horizontal or vertical alignment.
 - 2. Slope reversals creating localized peaks in the force main profile will not be allowed.
 - 3. In no case shall the actual depth of cover over the installed force main be less than 4 feet.
- C. The minimum pipeline bending radius shall conform to the pipe manufacturer's recommendations.
- D. Ground surface settlement and heave shall be maintained to less than 0.5 inches.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Pipe to be installed by HDD methods shall be HDPE as specified in Section 40 05 33.

2.2 DRILLING SYSTEM EQUIPMENT

- A. General: The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pullback of the pipe(s), a drilling fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project. All required equipment shall be included per the emergency and contingency plan as submitted per these specifications.
- B. Drilling Rig:
 - 1. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a steerable drill head. The machine shall be anchored to withstand the pulling, pushing and rotating forces required to complete the project.
 - 2. The drilling rig hydraulic system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be

free of leaks.

3. The drilling rig shall have a system to monitor and record maximum pull-back hydraulic pressure during pull-back operations.

C. Drill Head:

1. The horizontal directional drilling equipment shall produce a stable fluid lined tunnel with the use of a steerable drill head.
2. The system must be able to control the depth and direction of the pipe.
3. Drill head shall contain all necessary cutters and fluid jets for the operation, and shall be of the appropriate design for the medium being drilled.

D. Drilling Fluid System:

1. Drilling Fluid (Mud)

- a. Drilling fluid shall be composed of clean water and the appropriate additive(s) for the fluid to be used. Water shall be from a clean source and shall meet the mixing requirements of the manufacturer.
- b. The water and additives shall be mixed thoroughly to assure the absence of any clumps or clods. No hazardous additives may be used.
- c. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s).
- d. Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.
- e. No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid as submitted for this project without written consent of the Owner and/or Engineer.

2. Mixing System

- a. A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.
- b. The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.
- c. The mixing system shall continually agitate the drilling fluid during drilling operations.

3. Drilling Fluid Delivery and Recovery System

- a. The drilling fluid pumping system shall have a minimum capacity to supply drilling fluid in accordance with the drilling equipment pull-back rating at a constant required pressure.

- b. The delivery system shall have filters or other appropriate in-line equipment to prevent solids from being pumped into the drill pipe.
- c. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. The use of spill containment measures shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps, vacuum truck(s), and/or storage of sufficient size shall be in place to contain excess drilling fluid.
- d. A closed-loop drilling fluid system and a drilling fluid cleaning system should be used to whatever extent practical, depending upon project size and conditions. Under no circumstances shall drilling fluid that has escaped containment be reused in the drilling system.

E. Pipe Pull Heads:

- 1. Pipe pulls heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
- 2. Pipe pull heads shall be specifically designed for use with fusible polyvinylchloride pipe, and shall be as recommended by the pipe supplier.

2.3 HORIZONTAL DIRECTIONAL DRILLING

- A. Drill Rig Capacity: The capacity of the HDD system used by the CONTRACTOR shall be adequate to install the specified pipeline.
- B. Pump Capacity: The pump used by the CONTRACTOR shall be adequate to supply the required flow rate and pressures at the anticipated drilling fluid viscosity at all times. Drilling speeds shall not exceed pump capacity.
- C. Bore Tracking and Monitoring: At all times during the pilot bore the CONTRACTOR shall provide and maintain a bore tracking system that is capable of accurately locating the position of the drill head in the x, y, and z axes. The Contractor shall record these data at least twice per drill pipe length or every (15) feet whichever is more frequent.
 - 1. Downhole and Surface Grid Tracking System: CONTRACTOR shall monitor and record x, y, and z coordinates relative to an established surface survey bench mark, from downhole survey data using downhole wireline system. Tru-tracker energized surface grid, or equivalent, shall be installed and used to supplement the wireline system. The Tru-tracker grid shall encompass the entire area of the bore including underwater. Alternatively, the CONTRACTOR may propose fixed Tru-tracker grids on land outside the waterway, supplemented by moveable grids on floating templates that can be

temporarily anchored and surveyed while drilling the pilot hole. The moveable template should be sufficiently large to encompass the active drilling area for a 2 hour drilling period, and should be at least as wide as the maximum depth of the bore. The grids shall be surveyed to establish horizontal and vertical position to 0.1 feet accuracy. The data shall be continuously monitored and recorded at least twice per drill pipe length or every (15) feet, whichever is more frequent.

2. Deviations between the recorded and design bore path shall be calculated and reported on the daily log. If the deviations exceed tolerances specified elsewhere, such occurrences shall be reported immediately to the ENGINEER. The CONTRACTOR shall undertake all necessary measures to correct deviations and return to design line and grade.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General:

1. CONTRACTOR shall be responsible for his means and methods of directional drilling construction and shall ensure the safety of the work, the CONTRACTOR's employees, the public, and adjacent property, whether public or private.
2. CONTRACTOR shall anticipate that portions of the drilled excavation will be below the groundwater table.
3. CONTRACTOR shall comply with all local, state, and federal laws, rules, and regulations at all times to prevent pollution of the air, ground, and water.

B. Drilling Operations:

1. Directional drilling/boring shall use techniques of creating or directing a borehole along a predetermined path to a specified target location. This must involve use of mechanical and hydraulic deviation equipment to change the boring course and must use instrumentation to monitor the location and orientation of the boring head assembly along a predetermined course.
2. Drilling must be accomplished with fluid assisted mechanical cutting. The spoils must be transported from the job site and be properly disposed. Under NO circumstances will the drilling spoils be permitted to be disposed into waterways, sanitary, storm, or any other public or private drainage system.
3. Steering shall be accomplished by the installation of an offset section of drill stem that causes the cutterhead to turn eccentrically about its centerline when it is rotating. When steering adjustments are required,

the cutterhead offset section is rotated toward the desired direction of travel and the drill stem is advanced forward without rotation.

C. Tolerances:

1. The CONTRACTOR shall at all times provide and maintain instrumentation that will accurately locate the pilot bore/hole and measure drilling fluid flow and pressure.
2. CONTRACTOR shall provide and grant the ENGINEER access to all data and readout pertaining to the position of the bore head and fluid pressures and flows. No information pertaining to the position or inclination of the pilot bores shall be withheld from the ENGINEER.
3. CONTRACTOR is responsible for horizontal and vertical alignment of the pilot drill and final installed piping. The pilot drill shall conform to the conduit alignment as shown on the approved Shop Drawings.
4. CONTRACTOR shall submit all proposed changes to the vertical alignment shown on the Drawings to the ENGINEER for approval prior to commencing work. Under no circumstances shall water main be installed at an elevation less than the minimum required 4 feet of cover required.
5. Deviations between the recorded and design bore path shall be calculated and reported on the daily log. If the deviations exceed tolerances specified elsewhere, such occurrences shall be reported immediately to the ENGINEER. The CONTRACTOR shall undertake all necessary measures to correct deviations and return to design line and grade.
6. CONTRACTOR shall provide the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 20 feet. This "as-built" plan and profile shall be updated as the pilot bore is advanced. Entry and exit pits shall be surveyed in advance by a licensed professional surveyor for the purpose of establishing a benchmark, grades, and piping locations for the record drawings.
7. The minimum pipeline bending radius shall conform to the manufacturer's recommendations.

D. Pilot Hole Drilling and Reaming

1. Drill a pilot hole from the approved entrance pit location. The pilot hole shall follow the design centerline of the pipe with the path recorded and controlled using an instrument package situated behind the drill bit.
2. The pilot hole shall be drilled along the path shown on the plan and profile drawing to the tolerances listed in these Specifications. However, in all cases, right-of-way restrictions shall take precedence over the listed tolerances. Regardless of the tolerance achieved, no pilot hole will be accepted if it will result in any or all of the conduit being installed in violation of right-of-way restrictions. In addition,

concern for adjacent utilities and/or structures shall take precedence over the listed tolerances. Listing of tolerances does not relieve the CONTRACTOR from responsibility for safe operation or damage to adjacent utilities and structures.

3. The CONTRACTOR is responsible for horizontal and vertical alignment of the pilot hole and final installed pipe. The pilot hole alignment shall conform to the pipeline alignment as shown on the Drawings and specified in Paragraph 1.6.
4. Curves shall be drilled at a radius equal to or greater than that shown on the plan and profile drawing, but not exceeding the maximum bending radius calculated as specified in this Section. The drilled radius shall be calculated over any three joint (two drill pipe) range using an approved formula.
5. The drill head location shall be monitored continuously throughout the drilling process. The CONTRACTOR shall have a full-time person responsible for tracking and recording the bore path. In addition, the instrumentation shall be linked to a data logging device capable of providing the following: project tracking database; project and drill data reports; graphs of as-built drill path (side view and plan view); graphs of roll, pitch (to 0.1% accuracy) and distance. The instrumentation system shall be capable of providing real-time display at drill site, as well as storing and transferring data. The instrumentation shall be used in accordance with the manufacturer's recommendations, including pre-bore testing and calibration for sensitivity. As-built information shall be available to the ENGINEER in the field as the drilling proceeds.
6. The CONTRACTOR shall map the location of each pilot drill string joint to a minimum horizontal and vertical scale of 1 inch equals 40 feet. The map shall be posted in the CONTRACTOR's trailer for inspection by the OWNER.
7. At the completion of the pilot hole drilling, the CONTRACTOR shall provide a tabulation of coordinates, referenced to the drilled entry point, which accurately describe the location of the pilot hole.
8. Should the CONTRACTOR exceed the limits described above, a new pilot drill shall be performed at the expense of the CONTRACTOR and at no cost to the OWNER.
9. The pilot hole shall be used to pre-ream and widen the drilled hole to its final diameter. Simultaneous pre-reaming and pull back will not be allowed without prior approval from the OWNER.
10. The CONTRACTOR shall maximize recirculation of drilling fluid surface returns. The CONTRACTOR shall provide a solids control and fluid cleaning equipment of a configuration and capacity that can process surface returns and produce drilling fluid suitable for reuse. The solids control system shall have shakers, screens, and cyclones as part of the minimum system components.

D. Pipe Pull Back

1. A barrel reamer shall be used to smooth the wall of the hole and direct cuttings to the surface. A swivel shall be installed between the barrel reamer and the pipe to ensure that no torque is transmitted to the casing while being pulled back. A bulkhead shall be fused to the end of the pipe prior to attaching the swivel and barrel reamer.
2. The pipe shall be pulled back in a continuous operation for each section at a constant speed until the pull back is complete. The pipe shall be pulled beyond the exit pit a minimum distance of one percent of the total pipe length and allowed to reach equilibrium before any other work is performed on the pipe (per the shop drawings). Approximately 12 hours, or as recommended by the manufacturer, should be allowed for the pipe material to reach equilibrium.
3. The pipe shall be filled with potable water during pull back unless otherwise approved by the OWNER. The pull section shall be installed in the reamed hole in such a manner that external pressures are minimized. Any damage to the pipe resulting from external pressure during installation shall be the responsibility of the CONTRACTOR. Buoyancy modification shall be used at the discretion of the CONTRACTOR. No procedure shall be used which the OWNER has not approved. The CONTRACTOR is responsible for any damage to the pull section resulting from buoyancy modification.
4. The maximum allowable tensile load imposed on the pull section shall be equal to 90 percent of the product of the specified minimum yield strength of the pipe and the area of the pipe section. If more than one value is involved for a given pull section, the lesser shall govern.
5. The pull section shall be supported as it proceeds during pull back so that it moves freely and the pipe is not damaged.
6. Should the pipe become lodged during the pull back operation, the CONTRACTOR shall be responsible for all additional costs to dislodge the pipe.
7. After the pipeline is placed, cleaning pigs shall be used to remove residual water and debris. After the cleaning operation, the CONTRACTOR shall provide and run a caliper pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The caliper pig run shall be considered acceptable if the survey results indicate that there are no sharp anomalies (e.g., dents, buckles, gouges, and internal obstructions) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. The depth of a dent shall be measured as the gap between the lowest point of the dent and prolongation of the original contour of the pipe in any direction. For gauging purposes, dent locations are those defined above which occur within a span of 5 feet or less. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters. For gauging purposes, ovality locations are those defined above which exceed a span of 5

feet. The results of electronic gauging pig run shall be analyzed by an approved engineering technician.

3.2 POST INSTALLATION SURVEY

- A. The CONTRACTOR shall conduct an alignment survey of the installed pipeline. The means and methods for conducting the alignment survey shall be at the discretion of the CONTRACTOR, with the minimum performance criteria being that the pipeline shall meet the horizontal and vertical tolerances specified in Paragraph 1.6.

3.3 ENVIRONMENTAL CONTROLS

- A. The CONTRACTOR shall meet the environmental control requirements for all Work on this project at all locations utilized by the CONTRACTOR during the progress of the Work.
- B. Disposal Site: All costs for proper disposal of drilling mud and excess excavated materials shall be included in the lump sum bid price for the Work. Disposal of excess drilling fluids is the responsibility of the CONTRACTOR and shall be conducted in compliance with all environmental regulation, right-of-way, and workspace agreements, and permit requirements. No procedure may be used which has not been approved by the ENGINEER or OWNER.
- C. The CONTRACTOR shall employ the best efforts to maintain full annular circulation of drilling fluids. Drilling fluid returns at locations other than the entry and exit points (inadvertent returns) are not allowed and shall be minimized. In the event that annular circulation is lost, the CONTRACTOR shall take immediate steps to restore circulation. If inadvertent surface returns or drilling fluids occur, they shall be immediately contained with hand placed barriers (i.e., hay bales, sand bags, silt fences, collection pumps, etc.) and collected using pumps as much as practical. If surface returns are too great to control, drilling operations shall be suspended until surface return volumes can be brought under control.
- D. Waste cuttings and drilling fluid shall be dewatered and dried by the CONTRACTOR to the full extent necessary for disposal at an offsite location. Water from the dewatering process shall be treated by the CONTRACTOR to meet permit requirements and disposed of. The cuttings and water for disposal may be sampled by the OWNER and tested at any time to verify compliance with environmental permits. The construction area shall be inspected at least twice daily for signs of unplanned leaks or seeps and findings recorded with date and time noted.
- E. Equipment (graders, front-end loaders, etc.) and materials (such as ground sheets, hay bales, silt fencing, and absorbent pads) for cleanup and contingencies shall be provided by the CONTRACTOR and be readily available and maintained within

the work areas.

- F. Any fuels or lubricants spilled shall be cleaned up immediately to the satisfaction of the OWNER.
- G. All operations involving drilling mud shall be controlled and monitored by the CONTRACTOR to ensure containment.
 - 1. The CONTRACTOR shall establish bermed or sandbagged pits lined with sealed plastic of sufficient size to accommodate the volume of drilling mud anticipated plus a 2-foot freeboard. The bermed areas shall be maintained and designed by the CONTRACTOR to ensure containment and prevent loss of drilling mud.
 - 2. Transportation of the disposal materials off site by public roads shall meet all Massachusetts Department of Transportation requirements.
- H. The site must be restored to its existing condition. CONTRACTOR shall replace any trees damaged during the HDD procedure in-kind; with trees of the same type size and caliper.

+ + END OF SECTION + +

SECTION 40 05 05

EXPOSED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:
 - a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections.
 - b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.
 - c. Work on or affecting existing exposed piping.
 - d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.
 - e. Supports, restraints, and other anchors.
 - f. Field quality control, including testing.
 - g. Cleaning and disinfecting.
 - h. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.
2. Coordinate with appropriate piping Sections of Division 40, Mechanical.

C. Related Sections:

1. Section 09 91 00, Painting.
2. Section 40 05 07, Pipe Hangers and Supports.
3. Section 40 05 06, Couplings, Adapters, and Specials for Process Piping.
4. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings

2. ASME Boiler and Pressure Vessel Code.
3. ASME B31.3, Process Piping.
4. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
5. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
6. ASTM B32, Specification for Solder Metal.
7. ASTM D4161, Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
8. ASTM D4174, Standard Practice for Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems
9. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
10. AWS D1.1/D1.1M, Structural Welding Code-Steel.
11. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
12. ANSI/AWWA C206, Field Welding of Steel Water Pipe.
13. ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
14. ANSI/AWWA C606, Grooved and Shouldered Joints.
15. ANSI/AWWA C651, Disinfecting Water Mains.
16. AWWA M9, Concrete Pressure Pipe.
17. AWWA M11, Steel Pipe - A Guide for Design and Installation.
18. AWWA M23, PVC Piping - Design and Installation.
19. AWWA M41, Ductile-Iron Pipe and Fittings.
20. AWWA M45, Fiberglass Pipe Design.
21. AWWA M55, PE Pipe - Design and Installation.
22. SAE J1227, Method for Assessing the Cleanliness Level of New Hydraulic Fluid.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Refer to the General and Supplementary Conditions regarding requirements for this Project.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Detailed drawings in plan and, as applicable, section.
 - b. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping,
2. Testing Plans, Procedures, and Testing Limitations
 - a. Submit description of proposed testing methods, procedures, and apparatus, and obtain ENGINEER's approval prior to testing.

- B. Informational Submittals: Submit the following:
1. Certificates:
 - a. Submit a certificate signed by manufacturer of each product certifying product conforms to applicable referenced standards.
 2. Source Quality Control Submittals:
 - a. Submit copies of testing report for each test.
 3. Site Quality Control Reports:
 - a. Submit copies of testing report for each test.
- C. Closeout Submittals: Submit the following:
1. Record Documentation:
 - a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by ENGINEER.
 - b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures. For straight runs of pipe provide offset dimensions as required to document pipe location.
 - c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
 - d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
1. Deliver products to Site to ensure uninterrupted progress of the Work.
 2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.
- B. Storage:
1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.
 2. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.
- C. Handling:
1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.
 2. Avoid unnecessary handling of pipe.
 3. Keep pipe interiors free of dirt and foreign matter.

4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Piping materials are specified in the Exposed Piping Schedule at the end of this Section. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 40, Process Integration.
- B. Markings and Identification:
 1. Pipe Markings:
 - a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
 - b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.
 2. Pipe Identification Markers and Arrows: Refer to Section 10 14 00, Signage.
- C. Appurtenances: Provide products that comply with:
 1. Section 40 05 07, Pipe Hangers and Supports.
 2. Section 40 05 06, Couplings, Adapters, and Specials for Process Piping.
 3. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.
 2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from ENGINEER before proceeding.
 3. Provide pipe manufacturer's installation specialist at Site as specified on this Section.
- B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:

1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.
3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.
4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to ENGINEER.

C. Piping Installation:

1. Conform to manufacturer's instructions and requirements of standards and manuals listed in this Section, as applicable:
 - a. Ductile Iron Pipe: ANSI/AWWA C600, AWWA M41.
 - b. Thermoplastic Pipe: AWWA M23
2. Install straight runs true to line and elevation.
3. Install vertical pipe truly plumb in all directions.
4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the ENGINEER.
5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by ENGINEER provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.
7. Protect and keep clean interiors, fittings, and valves of pipe that will convey potable water, chemicals, and other pipe designated by ENGINEER.
8. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
9. Additional General Requirements for FRP and Thermoplastic Piping:
 - a. Utilize wide band supports as recommended by pipe manufacturer and approved by ENGINEER to minimize localized stresses.
 - b. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.
 - c. Provide anchored supports at elbows, valves, bends in piping, and at connections to equipment and tanks.
 - d. Spacing of supports shall be in accordance with the manufacturer's published recommendations at maximum design operating temperature of pipe.

- e. Provide U-clamps with wide band circumferential contact.
- f. Provide guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by pipe manufacturer.
- g. Provide anchored supports to restrain joints that allow expansion. Minimize use of bellows style joints. Where required and approved by the ENGINEER provide bellows style joints with low axial force to take up pipe expansion. Flexible connectors may be used to absorb thermal movement when approved in writing by ENGINEER.
- i. Provide devices that will reduce hydraulic pulsation in piping, together with shut-off and drain valve on all discharge lines of positive displacement pumps to reduce hydraulic hammer, and provide flexible connectors to absorb vibration. Submit details for ENGINEER to review.

D. Jointing Pipe:

- 1. General:
 - a. Make joints in accordance with pipe manufacturer's recommendations and Contract Documents.
 - b. Cut piping accurately and squarely and install without forcing or springing.
 - c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
 - d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
- 2. Ductile Iron and Steel Flanged Joints:
 - a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised-face flanges. Use full-face gaskets for flat-face flanges, unless otherwise approved by ENGINEER or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
 - b. Tighten bolts in a sequence that provides equal distribution of bolt loads.
 - c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.
 - d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.
 - e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
 - f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with same coating specified in Section 09 91 00, Painting, for material of pipe and fittings being joined.
- 3. Thermoplastic Pipe Joints:
 - a. Solvent Cement Welded Joints:
 - 1) Bevel pipe ends and remove all burrs before making joint. Clean pipe and fittings thoroughly. Do not make solvent cement joints if

temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.

- 2) Use solvent cement supplied or recommended by pipe manufacturer.
- 3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
- 4) Implement appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit fluid when flushing or filling pipelines to prevent compression of gases within pipes.

4. Copper Tubing Joints:

a. Threaded Joints:

- 1) When open flames for soldering are impractical, or at unions and connections to equipment and appurtenances, assemble copper tubing with flared ends as permitted by authority having jurisdiction.
- 2) Ends of tubing shall be flared at an angle of 45 degrees with flaring tool recommended by pipe manufacturer. Flaring tool shall have same outside diameter as tube to be flared.
- 3) Tubing to be flared shall be soft temper or annealed prior to flaring.
- 4) Cut end of tube square and ream to remove burrs.
- 5) Resize back to round tube that is out-of-round.
- 6) Clean and polish contact surfaces of joints using an abrasive cloth.
- 7) Place flare nut over end of tube with threads closest to end being flared.
- 8) Insert appropriate length of tube between flaring bar of flaring tool and position yolk with flaring cone over tube end and clamp yoke in place.
- 9) Turn handle of yolk clockwise without over-tightening. Cracked or deformed tubes will be rejected.
- 10) Do not apply jointing compounds to mating surfaces of flare fitting and flared tube end before attaching flare nut to threaded connection.

E. Installing Valves and Accessories:

1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.
2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.
3. Position swing check valves and butterfly valves so that they do not conflict with upstream and downstream elements of the piping system.

F. Unions:

1. Install dielectric unions as specified in Section 40 05 06, Couplings, Adapters, and Specials for Process Piping, where dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
2. Provide a union downstream of each valve with screwed connections.

3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.
- G. Transitions from One Type of Pipe to Another:
1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.
- H. Closures:
1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.2 THRUST RESTRAINT

- A. Provide thrust restraint on all pressure piping systems and where otherwise shown or specified.
- B. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Exposed Piping Schedule at end of this Section.
- C. Restrained Pipe Joints:
1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
 - a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with a proprietary restrained joint system as specified in Section 40 05 19. Ductile iron pipe, lugs, and tie rods, or other joint restraint systems approved by ENGINEER. Restrain ductile iron pipe connected by flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.

3.3 PAINTING

- A. Field painting shall conform to Section 09 91 00, Painting.

3.4 FIELD QUALITY CONTROL

- A. Testing, General:
1. Test all piping, except as exempted in the Exposed Piping Schedule.
 2. Notification:
 - a. Notify ENGINEER at least 48 hours prior to testing.
 - b. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
 3. Conduct all tests in presence of ENGINEER.
 4. Remove or protect pipeline-mounted devices that could be damaged by testing.
 5. Provide all apparatus and services required for testing, including:

- a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER's operations.
 - b. Temporary bulkheads, bracing, blocking, and thrust restraints.
 6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
 7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into the pipe being tested. CONTRACTOR shall provide fluid for other types of testing required.
 8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
 9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by CONTRACTOR and that fails the test shall be repaired upon authorization of ENGINEER or OWNER. Repair of existing piping will be paid as extra work unless otherwise specified.
- B. Test Schedule:
1. Refer to the Exposed Piping Schedule for type of test required and required test pressure.
 2. Unless otherwise specified, the required test pressures are at lowest elevation of pipeline segment being tested.
 3. For piping not listed in Exposed Piping Schedule:
 - a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires a separate test.
 - b. Disinfect for bacteriological testing piping that conveys potable water.
 4. Test Pressure:
 - a. Use test pressures listed in Exposed Piping Schedule.
 - b. If test pressure is not listed in Exposed Piping Schedule, or if a test is required for piping not listed in the Exposed Piping Schedule, test pressure will be determined by the ENGINEER based on the maximum anticipated sustained operating pressure and the methods described in the applicable ANSI/AWWA manual or standard that applies to the piping system.
- C. Hydrostatic Testing:
1. Preparation for Testing:
 - a. For ductile iron piping follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined.
 - b. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.
 2. Test Procedure:

- a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.
 - b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
 - c. Examine joints and valves, and make repairs to eliminate visible leakage.
 - d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
 - e. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.
 - f. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. For HDPE pipe, after three hour expansion phase, reduce test pressure by ten psig and do not add liquid. The test pressure shall then remain steady for one hour, indicating no leakage.
 - g. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.
3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:
- a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
 - b. Rates based on formula or table in AWWA Manual M41:
 - 1) Metal and fiberglass pipe joined with rubber gaskets as sealing members, including the following joint types:
 - a) Bell and spigot and push-on joints.
 - b) Mechanical joints.
 - c) Bolted sleeve type couplings.
 - d) Grooved and shouldered couplings.
 - c. Rates based on make-up allowance in AWWA Manual M9:
 - 1) Prestressed concrete cylinder pipe and other types of concrete pipe joined with O-ring rubber gasket sealing members.
 - d. Rates based on formula or table in ANSI/AWWA C605:
 - 1) Plastic pipe joined with O-ring gasket sealing members.

3.5 CLEANING AND DISINFECTION

- A. Cleaning, General: Clean pipe systems as follows:
 1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by ENGINEER, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.
 2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.

3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with a five percent hypochlorite solution.

3.6 EXPOSED PIPING SCHEDULE

- A. The schedules listed below, following the “End of Section” designation, are a part of this Specification section.
 1. Table 40 05 05-A, Exposed Piping Schedule.

+ + END OF SECTION + +

TABLE
40 05 05-A, EXPOSED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test
SAN	8	PVC	CL	P	TC 53	Flg	HYD (50)
SFM	6	PVC	CL	P	TC 53	Flg	HYD (50)
Vent	4	PVC	-	P	SCH 40	SW	NR

The following abbreviations are used in the Exposed Piping Schedule.

A.Service Abbreviations

Service	Abbrev.	Service	Abbrev.
Sanitary Sewer	SAN	Overflow	OF
Sanitary Force Main	SFM	Centrate	CEN
Raw Water	RW	Filtrate	FILT
Potable Water	PW	Scum	SCUM
City Water	CW	Primary Sludge	PS
Non-Potable Water	NPW	Return Activated Sludge	RAS
Plant Effluent Water	PEW	Waste Activate Sludge	WAS
Spray Water	SPW	Thickened Sludge	TS
Backwash Water	BW	Mixed Sludge	MS
Hot Water Supply	HWS	Digested Sludge	DS
Hot Water Return	HWR	Chlorine Solution	CLS
Influent	INF	Sodium Hydroxide (Caustic)	NAOH
Effluent	EFF	Sodium Hypochlorite	NAOCL
Drain	DR	Polymer Solution	POLYS
Process Air	PA	Alum	AL
Instrument Air	IA	Hydraulic Fluid	HF
Digester Gas	DIG	Fuel Oil	FO
Chlorine Gas	CLG	Lube Oil	LO
Wastewater	WW		

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Ductile Iron	DI		Polyvinyl Chloride	PVC
Cast Iron	CI		Chlorinated Polyvinyl Chloride	CPVC
Carbon Steel	CS		Polyethylene	PE
Stainless Steel	SS		High Density Polyethylene	HDPE
Copper	C		Fiberglass Reinforced Plastic	FRP
Prestressed Concrete Cylinder Pipe	PCCP			
Non-Prestressed Concrete Cylinder Pipe	CCP			
Steel Cylinder Pipe	SCP			

C. Lining/Coating Abbreviations

Lining	Abbrev		Coating	Abbrev.
Cement Mortar Lined	CL		Painted	P
Glass Lined	GL		Insulated	I
Ceramic Epoxy	CE		Galvanized	Galv
Fusion Bonded Epoxy Lined	FBEL			
Plastic Lined	PL			

D. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Bell and Spigot	BS		Flanged	Flg
Restrained Bell and Spigot	RBS		Butt Weld	BW
Push-on Joint	POJ		Lap Weld	LW
Restrained Push-on Joint	RPOJ		Butt Fusion Weld	BFW
Mechanical Joint	MJ		Solvent Weld	SW
Restrained Mech. Joint	RMJ		Sleeve-type Flexible Coupling	SLFC
Soldered	Sd		Split Flexible Coupling	SPFC
Brazed	Bz		Plasticized PVC Coupling	PPVC
Threaded	Thd		Grooved or Shouldered End Coupling	GSEC
			Flanged Adapter	FA

E. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ()		Disinfection and Bacteriological Testing	DBT
Process Air Pipe Test (test pressure in psig)	PA ()		Examination of Welds	EW
Chlorine Pipe Test	CL		Exfiltration Test	EX
			No Test Required	NR

SECTION 40 05 06

COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all couplings, adapters, and specials for process piping.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before couplings, adapters, and specials for process piping Work.
- C. Related Sections:
 - 1. Section 09 91 00, Painting.
 - 2. Section 33 05 05, Buried Piping Installation
 - 3. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
 - 2. ANSI B16.39, Malleable Iron Threaded Pipe Unions.
 - 3. ASME B31, Standards of Pressure Piping.
 - 4. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated, Welded and Seamless.
 - 5. ASTM A105/A105M, Specification for Carbon Steel Forgings and Piping Applications.
 - 6. ASTM B169/B169M Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar.
 - 7. ASTM B650, Specification for Electro-Deposited Engineering Chromium Coatings of Ferrous Substrates.
 - 8. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - 9. AWWA C606, Grooved and Shouldered Joints.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer shall have at least five years experience producing substantial similar products to those specified and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain each type of coupling, adapter, and special for process piping product included in this Section, regardless of component manufacturer, from a single couplings, adapters, and specials manufacturer.
2. Supplier shall prepare, or review, and approve all submittals for components furnished under this Section.
3. Components shall be suitable for specified service conditions and be integrated into overall assembly by the Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Submit piping layout Shop Drawings in accordance with Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
2. Product Data:
 - a. Submit product data on each type of coupling, expansion joint, and other piping specialties and accessories, including gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. When requested by ENGINEER submit certificate attesting to compliance with standards referenced in this Section, signed by manufacturer.
2. Manufacturer's Instructions:
 - a. Provide instructions for handling, storing, installing, and adjusting of products.
3. Source Quality Control:
 - a. When requested by ENGINEER, submit results of source quality control tests.
4. Qualifications Statements:
 - a. Submit qualifications of manufacturer when requested by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 COUPLINGS

A. Sleeve-type, Flexible Couplings:

1. Pressure and Service: Same as connected piping.
2. Products and Manufacturers: Provide products of one of the following:
 - a. Style 253, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
 - b. Style 441, by Smith Blair, Inc.
 - c. Or equal.
3. Material: Ductile Iron.
4. Gaskets: Suitable for specified service, as recommended by manufacturer.
5. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and with nitrided stainless nuts.
6. Harnessing:
 - a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - b. Tie adjacent flanges with bolts of corrosion-resistant alloy steel. Provide flange-mounted stretcher bolt plates to be designed by manufacturer, unless otherwise approved. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers.
 - c. On plain-end piping, for harnessing couplings, provide anchor restraint system such as Dresser Piping Specialties STAR Anchor Style 443, or equal.
 - d. Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by ENGINEER for pipe size, wall thickness, and test pressure required. Provide minimum 5/8-inch diameter bolts.
7. Remove pipe stop(s) if used, unless otherwise shown or specified.

B. Flanged Coupling Adapters:

1. Description: One end of adapter shall be flanged and opposite end shall have sleeve-type flexible coupling.
2. Products and Manufacturers: Provide one of the following:
 - a. Style 227, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
 - b. Style 912, by Smith Blair, Inc.
 - c. Or equal.
3. Pressure and Service: Same as connected piping.
4. Material: Ductile iron.
5. Gasket: As recommended by the manufacturer.

6. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and nitrided stainless nuts.
7. Harnessing:
 - a. Harness adapters to restrain pressure piping. For pressure pipelines, test pressures are included in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - b. For flanged adapters 12-inch diameter and smaller, provide 1/2-inch diameter (minimum) Type 316 stainless steel anchor studs installed in pressure-tight anchor boss. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by flanged adapter manufacturer. Provide the following minimum anchor studs unless otherwise approved by ENGINEER.
 - 1) Six-inch Diameter and Smaller: Two
 - 2) Eight-inch Diameter and Smaller: Four
 - 3) Ten-inch Diameter and Smaller: Six
 - 4) Twelve-inch Diameter and Smaller: Eight

2.2 EXPANSION JOINTS

A. Rubber-type Expansion Joints:

1. General:
 - a. Use rubber-type expansion joints at all expansion joint locations, except where other types of expansion joints are shown or specified.
2. Manufacturers: Provide products of one of the following:
 - a. Mercer Rubber Company.
 - b. U.S. Rubber Supply Company, USA
 - c. Or equal.
3. Liquid Service:
 - a. Construct expansion joints of neoprene or Buna-N suitable for temperatures up to 180 degrees F.
 - b. Expansion joints shall be filled arch type. Provide backup or retaining rings as recommended by expansion joint manufacturer.
 - c. Expansion joints shall be yoked in manner to provide transmission of tension loading to which expansion joint may be subjected during system operation. Compressive or lateral movement of expansion joint shall not be impaired by yoking system. Details of expansion joint yoking shall be submitted to ENGINEER for approval.
4. Air Service:
 - a. Provide pipe expansion joints in air piping where shown as a minimum. Provide additional expansion joints if recommended by pipe manufacturer.
 - b. Air Service Expansion Joints – General:

- 1) Except for expansion joints required at inlet and outlet connections of air blowers, construct expansion joints of chlorobutyl rubber, reinforced with embedded steel rings and strong synthetic fabric.
- 2) Expansion joints six-inch diameter and smaller shall be double arch units. Expansion joints larger than six-inch diameter shall be triple arch units.
- 3) Ends shall be flanged, with flanges conforming to ANSI B16.1, Class 125. Provide epoxy-coated split steel retaining rings to prevent damage to flanges when bolts are tightened.
- 4) Expansion joints shall be suitable for temperatures up to 300 degrees F, and pressures to 40 psi.
- c. Air Service Expansion Joints – At Air Blower Inlet and Outlet Connections:
 - 1) Expansion joints shall be U-type units constructed of chlorobutyl rubber, reinforced with a strong synthetic fabric.
 - 2) Expansion joints shall minimize the transmission of vibration from blower to piping at suction and discharge connections.
 - 3) Expansion joint ends shall be flanged, with flanges conforming to ANSI B16.1, Class 125. Provide epoxy-coated split steel retaining rings to prevent damage to flanges when bolts are tightened.
 - 4) Expansion joints shall be suitable for temperatures up to 300 degrees F, and pressures to 40 psi.
5. Harnessing:
 - a. Harness each expansion joint against thrust for test pressure in piping, as specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - b. Harnessing shall be by control units consisting of two or more tie rods connected between flanges, set for maximum allowable elongation of expansion joint.
 - c. Provide epoxy-coated triangular plates to connect tie rods to flanges. Tie rods shall be Series 300 stainless steel. Rubber washers shall be used between triangular plates and tie rods.
 - d. Provide control units in accordance with recommendations of expansion joint manufacturer.

2.3 MISCELLANEOUS SPECIALTIES AND ACCESSORIES

- A. Dielectric Connections:
 1. General: Where copper pipe connects to steel pipe, cast-iron pipe, or ductile iron pipe, provide either dielectric union or an insulating section of rubber or plastic pipe. When used, insulating section shall have minimum length of 12 pipe diameters.
 2. Manufacturers: Provide products of one of the following:
 - a. Epco Sales, Inc.
 - b. Watts Regulator Company.
 - c. Capitol Manufacturing Company.

- d. Or equal.
- 3. Dielectric Unions: Rated for 250 psi, ANSI B16.39.
- 4. Insulating Sections: Rated for same pressure as associated piping test pressure. Material shall be suitable for the application and service.

2.4 PAINTING

- A. Shop Painting:
 - 1. Clean and prime-coat ferrous metal surfaces of products in the manufacturer's shop in accordance with Section 09 91 00, Painting, unless otherwise specified in this Section
 - 2. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound that shall be maintained during storage and until products are placed into operation.
- B. Field painting shall conform to Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect materials for defects in material and workmanship. Verify compatibility of products with pipe, fittings, valves, and appurtenances.

3.2 INSTALLATION

- A. Installation:
 - 1. Install piping specialties in accordance with the Contract Documents and manufacturer's instructions.
 - 2. For buried installations, refer to Section 33 05 05, Buried Piping Installation.
 - 3. For exposed installations, refer to Section 40 05 05, Exposed Piping Installation.
- B. Adjust expansion joints as required to ensure that expansion joints will be fully extended when ambient temperature is at minimum operating temperature, and fully compressed at maximum operating temperature for the system in which expansion joints are installed.

+ + END OF SECTION + +

SECTION 40 05 07

PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to design, furnish, and install all hangers, supports and appurtenances necessary to complete the Work.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the pipe hangers and supports Work.
- C. Related Sections:
 - 1. Section 03 00 05, Concrete.
 - 2. Section 05 50 13, Miscellaneous Metal Fabrications.
 - 3. Section 09 91 00, Painting.
 - 4. Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 575, Specification for Steel Bars Carbon, Merchant Quality, M-Grades.
 - b. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
 - 2. Federal Specification, (FS).
 - a. FS A-A-1192, Hangers, Pipe.
 - 3. Manufacturers Standardization Society of the Valve and Fittings Industry, (MSS).
 - a. MSS SP 58, Pipe Hangers and Supports-Materials, Design and Manufacture.
 - b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.
 - 4. Underwriters' Laboratories, Inc., (UL).
 - a. UL 203, Pipe Hanger Equipment for Fire Protection Service.

1.3 QUALITY ASSURANCE

- A. Each type of pipe hanger or support shall be the product of one manufacturer.
- B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single pipe hangers and supports manufacturer.
2. The pipe hangers and supports equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pipe hangers and supports equipment manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Detailed drawings showing all hangers and supports for each piping system specified. Shop Drawings shall show location, installation, material, loads or forces, and deflection of all hangers and supports.
 2. Product Data:
 - a. Submit manufacturers' catalogs, literature, and engineering data on all hangers and supports. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP 58, MSS SP 69 and Federal Specification A-A-1192.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 2. Store materials in covered storage off the ground and prevent condensation.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Hangers and supports shall meet with the following requirements:

1. Standard and fabricated hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
2. Generally, run piping in groups where practicable and parallel to building wall. Provide minimum clearance of 1-inch between pipe and other work.
3. Install hangers or supports at all locations where pipe changes direction.
4. All hangers and supports shall be capable of adjustment after placement of piping.
5. Different types of hangers or supports shall be kept to a minimum.
6. All suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub.
7. Support vertical piping at each floor and between floors by stays or braces to prevent rattling and vibration.
8. Hanger rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
9. Maximum support spacing unless otherwise shown or approved for standard weight steel pipe shall be as follows:

<u>Pipe Size (in.)</u>	<u>Spacing (ft)</u>
Up to 1-1/2	6
2 through 3	10
3-1/2 and greater	12

10. Maximum support spacing, unless otherwise shown for plastic pipe at ambient temperature, shall be one-half of the values specified for steel pipe.
11. Plastic pipe at temperature greater than 130°F shall be continuously supported in a metal cradle or tray.
12. Where proper hanger or support spacing does not correspond with joist or rib spacing, structural steel channels may be attached to joists or ribs and pipes suspended there from.
13. Prevent contact between dissimilar metals when supporting copper tubing, by use of copper plated, rubber or vinyl coated, or stainless steel hangers or supports.
14. Isolate thin walled stainless steel piping from carbon steel by use of plastic coated hangers or supports or by taping at points of contact with PVC or vinyl.
15. Supports and hangers shall be of a material that is compatible with the fluid being conveyed in such pipe being supported.
16. Anchors for pipe support systems shall be compatible or protected by a coating system which is compatible with the fluid being conveyed in such pipe being supported.

- B. Expansion compensation shall be designed for individual exposed piping systems with the following Design Criteria:
1. $\Delta L = L \times \Delta T \times \alpha$
 - a. Where ΔL = pipe length change (inches).
 - b. L = pipe length between anchors (inches).
 - c. $\Delta T = 100$ (F).
 - d. α = coefficient of thermal expansion (inches/inches/F).
 2. Expansion compensation shall be designed as an integral part of the piping hanger, support and anchorage system.
 3. Expansion compensation shall be achieved via expansion joints specified in Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

2.2 HANGERS AND SUPPORTS

- A. Hangers and supports where shown shall be in accordance with detail drawings. Hangers and supports not shown shall be in accordance with MSS SP 58.
- B. Products and Manufacturers: Provide one of the following:
1. Anvil International, Inc.
 2. Elcen.
 3. B-Line.
 4. Unistrut Corporation.
 5. Or equal.

2.3 ACCESSORIES

- A. Hanger rods shall be made from ASTM A 575, with square head nut on top and running thread on bottom end.
- B. Concrete Inserts:
1. Concrete inserts shall be MSS SP 58 malleable Type 18.
 3. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation, Wayne, Michigan.
 - b. Elcan Metal Products, Company, Franklin Park, Illinois.
 - c. B-Line.
 - d. Anvil International, Inc.
 - e. Or equal.
- C. Steel Beam Clamps:
1. Steel beam clamps shall be of malleable iron and conform to MSS SP 58.
- D. Inserts for Pipe Insulation:
1. Insulated pipe, larger than 1-1/2-inches in diameter, shall be supported by a rigid insert to protect the insulation. A steel metal saddle of sufficient gauge to carry the weight of the pipe and its fluid without deforming shall extend

2-inches minimum on each side of the rigid insert. The joints between insert and insulation shall be sealed before saddle is installed. Sizes up to 6-inches IPS shall be MSS SP 58, Type 40, and for sizes over 10-inches shall be MSS SP 58, Type 39.

E. Brackets:

1. Brackets for wall mounting shall conform to MSS SP 58 Type 32.

2.4 PAINTING

A. Clean and prime ferrous metal surfaces in the shop in accordance with the requirements of Section 09 91 00, Painting.

B. Field painting shall conform to the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.

B. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

C. Locate hanger, supports to prevent vibration or swaying and to provide for expansion and contraction.

1. Temperature differential specified in this Section.
2. Support piping independently so that equipment is not stressed by piping weight or expansion.
3. For Uninsulated Copper Pipe or Tubing: Clamps and supports, electroplated copper finish. Instrumentation tubing shall be supported in steel or aluminum troughs with covers. All tubing layout and connections shall be as approved by the manufacturer of the equipment.
4. Uncoated Hangers, Rods and Supports: Dip in zinc chromate primer before installation.
5. Maximum spacing for horizontal piping:
 - a. Steel 1-Inch and Smaller: Seven feet.
 - b. Steel 1-1/2-Inch and Larger: Ten feet.
 - c. Brass or Copper 3-Inch and Smaller: Seven feet.
 - d. Brass or Copper 4-Inch and Larger: Ten feet.
 - e. Additional supports at:
 - 1) Change in direction.
 - 2) Branch piping and runouts over five feet.
 - 3) Concentrated loads due to valves, strainers or other similar items.

- f. Maximum support spacing for plastic pipe at ambient temperature shall be one-half the above values.
- 6. Hanger types for horizontal piping, except as noted and shown:
 - a. Forged steel adjustable clevis type, rod support for all services.
 - b. Slide Bases:
 - 1) Pipe stand, brackets, trapeze or other equivalent structural support.
 - 2) For piping 2-inches or larger.
 - c. For pipe and covering provide:
 - 1) Saddles for rollers or slide bases.
 - 2) Protective shields or saddles for all other types of supports.
 - d. Threaded Steel Rods:
 - 1) Two inch vertical adjustment with two nuts each end for positioning and locking.
 - 2) Size hanger rods according to the schedule below, unless otherwise noted:

Nominal Pipe (Inches)	Rod Diameter (Inches)
2 and less	3/8
2-1/2 to 3-1/2	1/2
4	5/8
6	3/4
8 through 12	7/8
14 through 18	1
20 through 30	1-1/4

- 3) For Double Rod Hangers: One size smaller than above.
- 4) Connection to Structure for Piping to 2-Inches: Concrete inserts, or expansion shields in shear into sides of beams.
- 5) Connection to Structure for Piping 2-1/2-Inch or Larger: Concrete inserts, beam clamps or suitable bridging.
- 7. Vertical Piping:
 - a. Base Support: Base elbow or welded equivalent.
 - 1) Bearing plate on structural support.
 - b. Guides not to exceed:
 - 1) 25 feet for piping to 2-inches.
 - 2) 36 feet for piping 2-1/2-inches or larger.
 - c. Top Support:
 - 1) Special hanger or saddle in horizontal connection.
 - 2) Provisions for expansion.
 - d. Intermediate Supports: Steel pipe clamp at floor.
 - 1) Bolted and welded to pipe.
 - 2) Extension ends bearing on structural steel or bearing plates.
 - e. For Multiple Pipes: Coordinate guides, bearing plates and accessory steel.
- 8. Insulated Piping:
 - a. Horizontal Pipe Shields at Supports:

- 1) Minimum 120 degree arc.
 - 2) Length equal to diameter of insulation 12-inch minimum.
 - 3) To 6-Inch Pipe Size: No. 18 USSG galvanized steel.
- b. Vertical Pipe Shields at Guides:
- 1) Full 360 degree arc, securely banded.
 - 2) Length equal to diameter of insulation, 12-inch minimum.
 - 3) To 6-Inch Pipe Size: No. 18 USSG galvanized steel.
- D. Install items to be embedded before concrete placement.
- E. Fasten embedded items securely to prevent movement during concrete placement.
- F. Install hangers and support units on piping systems in accordance with manufacturer's recommendations.
- G. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations.
- H. Bring all pipe systems up to operating pressures and temperatures. Cycle systems to duplicate operating conditions. Correct all support malfunctions.

+ + END OF SECTION + +

SECTION 40 05 08

WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all floor pipes, pipe sleeves, wall pipes, other wall pieces, and escutcheons to complete the Work.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate with the installation of floor pipes, pipe sleeves, wall pipes, other wall pieces and escutcheons that must be installed with or within formwork, walls, partitions, ceilings and panels.

C. Related Sections:

1. Section 33 05 13, Manholes and Structures.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
 - a. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
 - b. ANSI B16.4, Gray-Iron Threaded Fittings.
2. American Water Works Association, (AWWA).
 - a. AWWA C104 (ANSI A21.4), Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. AWWA C110 (ANSI A21.10), Ductile-Iron and Gray-Iron Fittings, for Water.
 - c. AWWA C111 (ANSI A21.11), Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. AWWA C115 (ANSI A21.15), Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - e. AWWA C151 (ANSI A21.51), Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - f. AWWA C200, Steel Water Pipe 6-Inches and Larger.

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single wall pipes, floor pipes and pipe sleeves manufacturer.
 - 2. The wall pipes, floor pipes and pipe sleeves manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the wall pipes, floor pipes and pipe sleeves manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Detailed drawings and data on all wall and floor pipe, and pipe sleeves. Submit and coordinate these with Shop Drawings required for all piping systems.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wall and Floor Pipes:
 - 1. Material: Same as specified for the piping connected to wall or floor pipe, unless otherwise approved by ENGINEER.
 - 2. End Connections: As shown.
 - 3. Thickness: Same as specified for the piping connected to wall or floor pipe.
 - 4. Collars: Provide collars at mid-point of wall for anchorage and watertightness.
 - 5. Pipes ends shall be flush with wall face, unless otherwise shown.
 - 6. Drill and tap flanged ends and mechanical joint bells for studs. Provide studs of same material as connected piping, except submerged and buried studs shall be of Type 316 stainless steel.

- B. Pipe Sleeves:
 - 1. Ferrous and Plastic Pipe: Use standard weight galvanized steel pipe, unless otherwise shown.
 - 2. Copper Pipe: Use Type K hard drawn copper pipe, unless otherwise shown.
- C. Cast Wall Sleeves:
 - 1. Material: Ductile iron furnished with integral wall collar.
 - 2. Dimensions: As required for mechanical joint pipe to pass through sleeve. Length as required.
- D. Link Seals: Provide link type mechanical seals suitable for 20 psi working pressure, corrosive service and accessible from one side, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.
 - 1. Products and Manufacturers: Provide one of the following:
 - a. Link-Seal, as manufactured by Thunderline Corporation.
 - b. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wall and Floor Pipes: Install as shown and in accordance with approved Shop Drawings.
- B. Pipe Sleeves:
 - 1. Use sleeves wherever pipes pass through walls, partitions, floors, and roofs, unless otherwise shown.
 - 2. Extend all sleeves through floor slabs a minimum of 2-inches above finished floor.
 - 3. Anchor sleeves to concrete and masonry walls as shown or otherwise approved.
 - 4. All sleeves through walls shall be flush with wall face.
 - 5. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
 - 6. Use link type seals to seal sleeve against hydrostatic pressure. Size sleeves to provide annular space required to suit the link type mechanical seals that are used.
 - 7. Do not install sleeves and pipes through structural members, unless specifically shown and approved by ENGINEER.

8. Size sleeves to provide annular space as follows:

<u>Pipe Size</u>	<u>Sleeve ID Minus Pipe Or Insulation OD</u>
Less than 2-inches	1/2-inches to 3/4-inches
2-inches to 4-inches	3/4 inches to 1-1/4-inches.
6-inches to 12-inches	1-1/4 inches to 2-inches
Over 12-inches	2-inches to 3-inches

- C. Install wall and ceiling plates in accordance with the manufacturer's recommendations and approved Shop Drawings.

+ + END OF SECTION + +

SECTION 40 05 17

COPPER PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish copper pipe and fittings.
 - 2. Extent of piping is shown and indicated in the piping schedules in Section 33 05 05, Buried Piping Installation.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before copper pipe Work.
 - 2. Notify other contractors in advance of installation of copper pipe to provide other contractors with sufficient time to install items included in their contracts that will be installed with or before copper pipe Work.
- C. Related Sections:
 - 1. Section 33 05 05, Buried Piping Installation.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings: Classes 125 and 150.
 - 2. ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - 3. ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 4. ANSI/ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 5. ANSI/ASME B16.50, Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings.
 - 6. ANSI/ASME B18.2.1, Square and Hex Bolts and Screws, Inch Series.
 - 7. ANSI/ASME B18.2.2, Square and Hex Nuts.
 - 8. ASTM A194, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 9. ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 10. ASTM B32, Specification for Solder Metal.
 - 11. ASTM B68, Specification for Seamless Copper Tube, Bright Annealed.
 - 12. ASTM B88, Specification for Seamless Copper Water Tube.
 - 13. ASTM B251, Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.

14. ASTM B302, Specification for Threadless Copper Pipe, Standard Sizes.
15. ASTM D1330, Specification for Rubber Sheet Gaskets.
16. FS WW-U-516, Unions – Brass or Bronze.
17. NSF/ANSI 61, Drinking Water System Components - Health Effects.
18. AWWA C800, Underground Service Line Valves and Fittings.

1.3 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single copper pipe manufacturer.
 2. Copper pipe Supplier shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
- B. Regulatory Requirements:
 1. Pipe and fittings that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at the Site.
 2. Pipe and fittings materials and joint types shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following with Shop Drawings required under Section 33 05 05, Buried Piping Installation:
 1. Product Data:
 - a. Detailed data on pipe, fittings, and appurtenances.
- B. Informational Submittals: Submit the following:
 1. Certificates:
 - a. Submit certificate signed by manufacturer of each material that material conforms to applicable referenced standards and the Contract Documents.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 33 05 05, Buried Piping Installation.
- B. Maintain ASTM B68 pipe, fittings, and appurtenances free of scale and dirt during transportation, delivery, storage, and handling.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Potable Water Pipe:
 - 1. Pipe Materials: Comply with ASTM B88.
 - 2. For buried pipe and for exterior, exposed pipe, provide Type K, soft-annealed tube (roll).

2.2 JOINTS

- A. Refer to piping schedules at the end of Sections 33 05 05, Buried Piping Installation, for the service and joint type specified for each piping system.
- B. Unions for Potable Water Service: Shall be bronze, 250-pound class, conforming to FS WW-U-516.
- C. Potable Water Service Connections:
 - 1. All fittings, corporation stops and couplings shall conform to ASTM B88 and AWWA C800, as applicable.
 - 2. Product and Manufacture: Provide materials, equipment and appurtenances as manufactured by one of the following:
 - a. Mueller B-25000 Corporation Stops.
 - b. Mueller B-25204 Curb Stop/Valves.
 - c. Mueller H-10314 Extension Type Curb Boxes with No. 87081 Lid.
 - d. Mueller 82863 or 82864 Stationary Rods.
 - e. Mueller fittings and couplings.
 - f. Or equal.

2.3 MARKING

- A. Mark or label all materials with the following:
 - 1. Metal or alloy designation.
 - 2. Temper.
 - 3. Size and schedule.
 - 4. ASTM reference standard number.
 - 5. Name and location of Supplier.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to Section 33 05 05, Buried Piping Installation, for buried piping installation, disinfection, testing and cleaning.

++ END OF SECTION ++

SECTION 40 05 19

DUCTILE IRON PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
2. Extent of piping is shown on the Drawings. Piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:

1. Section 31 23 16.13, Trenching.
2. Section 09 91 00, Painting.
3. Section 33 05 05, Buried Piping Installation.
4. Section 40 05 05, Exposed Piping Installation.
5. Section 40 05 06, Couplers, Adapters, and Specials for Process Piping.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).
3. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
4. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
5. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
6. ASTM A354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
8. ASTM B117, Practice for Operating Salt Spray (Fog) Apparatus.
9. ASTM C283, Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
10. ASTM D714, Test Method for Evaluating Degree of Blistering of Paints.
11. ASTM D792, Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

12. ASTM D5162, Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates.
13. ASTM E96, Test Methods for Water Vapor Transmission of Materials.
14. ASTM G14, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
15. ASTM G62, Test Methods for Holiday Detection in Pipeline Coatings.
16. ASTM G95, Test Methods for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).
17. ANSI/AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
18. ANSI/AWWA C110, Ductile Iron and Gray Iron Fittings for Water.
19. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
20. ANSI/AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
21. ANSI/AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Service.
22. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
23. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
24. ANSI/AWWA C606, Grooved and Shouldered Type Joints.
25. European Standard (EN), EN 598: Ductile Iron Pipe, Fittings, Accessories and Their Joints for Sewerage Applications.
26. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
27. NACE RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
28. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
29. NSF/ANSI 61, Drinking Water System Components - Health Effects.
30. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
31. SSPC Painting Manual, Volume 1, Para. XIV.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
 - b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions , and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.

- c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.

B. Supply and Compatibility:

1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.

C. Regulatory Requirements:

1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation:

1. Shop Drawings:
 - a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General:
 - 1. Piping systems shall be suitable for their intended use.
 - 2. Joints shall be as specified in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by ENGINEER.
- B. Ductile Iron Pipe, Joints, and Fittings:
 - 1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
 - a. Pressure Rating: As specified in piping schedule in Section 40 05 05,
 - 2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
 - a. Pressure Rating: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
 - 3. Pipe Joints:
 - a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
 - 1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.
 - 2) Bolts: Comply with ANSI B18.2.1.
 - a) Exposed: ASTM A307, Grade B.
 - b) Buried or Submerged: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
 - 3) Nuts: Comply with ANSI B18.2.2.
 - a) Exposed: ASTM A563, Grade A, Heavy hex.
 - b) Buried or Submerged: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.
 - b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA

C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

- 1) Glands: Ductile iron.
 - 2) Gaskets: Plain tip.
 - 3) Bolts and Nuts: High strength, low alloy steel.
 - 4) Manufacturers: Provide products of one of the following:
 - a) Clow Water Systems Company
 - b) Atlantic States Cast Iron Pipe Company
 - c) Canada Pipe Company, Ltd.
 - d) McWane Cast Iron Pipe Company
 - e) Pacific States Cast Iron Pipe Company
 - f) Griffin Pipe Products Co.
 - g) American Cast Iron Pipe Co.
 - h) U.S. Pipe and Foundry Co.
 - i) Or equal.
- c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
- 1) Gaskets: Vulcanized SBR, unless otherwise specified.
 - 2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
 - 3) Products and Manufacturers: Provide one of the following:
 - a) Tyton or Fastite Joint by Clow Water Systems, Atlantic States Cast Iron Pipe Company, Canada Pipe Company, Ltd., McWane Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, and Griffin Pipe Products Company.
 - b) Fastite Joint by American Cast Iron Pipe Company.
 - c) Tyton Joint by U.S. Pipe and Foundry Company.
 - d) Or equal.
- d. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of ENGINEER.
- 1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:
 - a) Megalug, Series 1100, by EBBA Iron Sales, Inc.
 - b) MJ Coupled Joint, by American Cast Iron Pipe Co.
 - c) MJ Field Lok, by U.S. Pipe and Foundry Co.
 - d) Or equal.
 - 2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:
 - a) Super-Lock Joint Pipe, by Clow Water Systems, a division of McWane, Inc.
 - b) Lok-Ring Joint, or Flex-Ring Joint, by American Cast-Iron Pipe Company.
 - c) TR Flex Joint, by U.S. Pipe and Foundry Company.

- d) Snap-Lok, by Griffin Pipe Products Company.
 - e) Or equal.
 - 4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
 - a. Material: Ductile iron.
 - b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.
 - 5. Mechanical Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
 - a. Material: Ductile iron.
 - b. Glands: Ductile iron.
 - c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.
- C. Cement-mortar Lining:
 - 1. Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.
- D. Couplings:
 - 1. Refer to Section 40 05 06, Couplings, Adapters, and Specials for Process Piping.
- I. Specials:
 - 1. Transition Pieces:
 - a. Provide suitable transition pieces (adapters) for connecting to existing piping.
 - b. Unless otherwise shown or indicated, expose existing piping to determine material, dimensions, and other data required for transition pieces.
 - 2. Taps:
 - a. Provide taps where shown or required for small-diameter piping or instrumentation connections.
 - b. Provide corporation stops where shown or required.
 - c. Where pipe wall thickness or tap diameter will not allow engagement of two full threads, provide tapping saddle with outlet joints conforming to requirements of Paragraph 2.1.B.3.a of this Section for four-inch through 12-inch diameter pipe, and Paragraph 2.1.B.3.b. for 14-inch through 54-inch diameter pipe.
 - d. For flanged connections on tapping saddle outlet branch, counterbore flange in accordance with MSS SP-60 dimensions. Inside diameter of outlet shall be 1/4-inch greater than nominal diameter.

2.2 MARKING FOR IDENTIFICATION

- A. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
 - 1. Name or trademark of manufacturer.
 - 2. Weight, class or nominal thickness, and casting period.
 - 3. Country where cast.
 - 4. Year the pipe was produced.
 - 5. Letters “DI” or “Ductile” shall be cast or metal stamped
- B. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
 - 1. Flange manufacturer’s mark, size, and letters “DI” cast or stamped on the flanges.
 - 2. Fabricator’s mark if other than flange manufacturer.
 - 3. Length and weight.
- C. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify fittings with:
 - 1. Manufacturer’s identification.
 - 2. Pressure rating.
 - 3. Nominal diameters of openings.
 - 4. Country where cast.
 - 5. Number of degrees or fraction of the circle on bends.
 - 6. Letters “DI” or “Ductile” cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

- A. General Coating Requirements:
 - 1. Coating types are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
- B. Exposed Pipe and Fittings:
 - 1. Surface Preparation:
 - a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
 - b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.
 - c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
 - 2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09 91 00, Painting.

3. Field painting shall comply with Section 09 91 00, Painting.
- C. Buried Pipe and Fittings:
1. Asphaltic Coating: Where specified in piping schedule in Section 33 05 05, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

- A. For buried piping installation and testing, refer to Section 33 05 05, Buried Piping Installation.
- B. For exposed piping installation and testing, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 31

THERMOPLASTIC PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install thermoplastic piping and fittings.
2. Extent of piping is shown and shall be in accordance with piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before thermoplastic piping Work.

C. Related Sections:

1. Section 33 05 05, Buried Piping Installation.
2. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO, Standard Specifications for Highway Bridges.
2. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
3. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
4. ASTM D2464, Specification for Threaded Poly (Vinyl Chlorinated) (PVC) Plastic Pipe Fittings, Schedule 80.
5. ASTM D2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
6. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
7. ASTM D2513, Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
8. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
9. ASTM D2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
10. ASTM D683, Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

11. ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
12. ASTM D3035, Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
13. ASTM D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
14. ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
15. ASTM D3222, Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
16. ASTM D3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
17. ASTM D3311, Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patterns.
18. ASTM D3350, Specification for Polyethylene Plastic Pipe and Fittings Materials.
19. ASTM D4101, Specification for Polypropylene Injection and Extrusion Materials.
20. ASTM F437, Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
21. ASTM F438, Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
22. ASTM F439, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
23. ASTM F441/F441M, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
24. ASTM F442/F442M, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
25. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
26. ASTM F656, Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
27. ASTM F679, Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
28. ASTM F714, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
29. ASTM F1055, Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
30. ASTM F1336, Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.
31. ASTM F1674, Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
32. ASTM F1760, Specification for Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.
33. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In.-12 In. (100 mm-300 mm), for Water Transmission and Distribution

34. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
35. AWWA C905, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In.-48 In. (350 mm-1,200 mm).
36. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission.
37. AWWA C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm).
38. NSF 14, Plastic Piping Systems Components and Related Material.
39. ANSI/NSF 61, Drinking Water System Components - Health Effects.
40. Standards of U.S. Food and Drug Administration.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have a minimum of five years experience producing thermoplastic pipe and fittings substantively similar to the materials specified, and shall be able to submit documentation of satisfactory service in at least five completed installations in operation for at least five years each.
2. Installer:
 - a. Engage a single pipe installer who shall be responsible for all thermoplastic pipe Work, and who shall employ only tradesmen with specific skills and experience in the type of Work required.
 - b. Installer shall have a minimum of five years experience installing thermoplastic pipe and fittings substantively similar to the materials specified and substantively similar to or larger than the scope of thermoplastic piping Work on the Project, and shall be able to submit documentation of satisfactory experience in at least five completed installations in operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all materials included in this Section, regardless of component Supplier, from a single thermoplastic pipe Supplier. All pipe of each material type shall be furnished by the same manufacturer.
2. Thermoplastic pipe Supplier shall review and approve to prepare all Shop Drawings and other submittals for all materials furnished under this Section.
3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by thermoplastic pipe Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Submit piping layout Shop Drawings in accordance with Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
2. Product Data:

- a. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Submit manufacturer's certificate of compliance standards referenced in this Section.
 - 2. Source Quality Control Submittals:
 - a. When requested by ENGINEER, submit results of source quality control tests.
 - 3. Qualifications Statements:
 - a. Submit qualifications of manufacturer when requested by ENGINEER.
 - b. Submit qualifications of installer when requested by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 SERVICE CONDITIONS

- A. General:
 - 1. Pipe materials shall be suitable for services intended. Refer to piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
 - 2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
 - 3. Comply with NSF 14.
 - 4. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated on the Drawings.
 - 5. Pipe, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in ANSI/NSF 61 as being suitable for contact with potable water, and shall comply with requirements of the authorities having jurisdiction at the Site.

2.2 POLYVINYL CHLORIDE (PVC) PIPING

A. PVC Pipe – General Applications: Unless otherwise shown or indicated, PVC pipe shall comply with the following:

1. Manufacturers: Provide products of one of the following:
 - a. Ipex, Inc.
 - b. Spears Manufacturing Company.
 - c. Or equal.
2. Material: Unless otherwise specified, comply with the following:
 - a. Type and Grade: Type 1, Grade 1.
 - b. Wall Thickness: Schedule 80 complying with ASTM D1784 and ASTM D1785, and US Product Service PS 21-70 as having same outside diameter dimension as cast-iron pipe.
 - c. Temperature Rating: Rated for temperature to 140 degrees F.
 - d. Color: Gray.
3. Fittings: Type, grade, schedule, and color of fitting shall match the associated pipe.
 - a. Solvent Weld: Comply with ASTM D2467.
 - b. Threaded: Threaded fittings shall comply with ASTM D2464.
 - c. Flanged: Provide flanged fittings with Neoprene gaskets.
4. Joints:
 - a. Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.
 - b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.
 - c. Flanged: Provide with backup flange minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.

B. Buried PVC Pressure Pipe:

1. Manufacturers: Provide products of one of the following:
 - a. Ipex, Inc.
 - b. Diamond Plastics Corp.
 - c. Or equal.
2. Material:
 - a. Pipe shall comply with AWWA C900 or AWWA C905 (as applicable).
 - b. Material shall comply with ASTM D1784.
 - c. Wall Thickness: DR 18.
 - d. Fabricate pipe with cast-iron pipe equivalent outside diameter.
3. Fittings:
 - a. Comply with AWWA C900, AWWA C905, or AWWA C907, as applicable.

4. Joints:
 - a. Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
 - b. Jointing lubricant shall be as recommended by pipe manufacturer.
 - c. Provide elastomeric gaskets complying with ASTM F477 and ASTM D3139.
 - d. Restrained Joints: Provide restrained joints where shown or indicated.
 - 1) Comply with Section 33 05 05, Buried Piping Installation.
 - 2) Proprietary Joint Systems: Comply with ASTM F1674. Provide restrained joint system by one of the following for bell and spigot joint PVC piping:
 - a) Ebaa Iron Sales, Inc.: Series 1500 and Series 1600 Restraint Harness for C900 Pipe; Megalug Series 2500, 2800, and 1100HV Restraint Harness for C905 Pipe.
 - b) PV-LOK Series, by Sigma Corp.
 - c) Or equal.
- D. PVC Drain, Waste, and Vent (PVC-DWV) Pipe.
1. Manufacturers: Provide products of one of the following:
 - a. Chemtrol, manufactured by Nibco, Inc.
 - b. Spears Manufacturing Company.
 - c. Or equal.
 2. Material: In accordance with ASTM D1784. Unless otherwise shown or indicated, PVC-DWV pipe shall be:
 - a. Type and Grade: Type 1, Grade 1.
 - b. Wall Thickness: Schedule 40.
 - c. Color: White.
 3. Fittings: Manufactured in accordance with ASTM D2665 and ASTM D3311.
 - a. Solvent weld.
 - b. Spigot.
 4. Joints:
 - a. Solvent weld.

2.7 IDENTIFICATION

- A. Pipe material identification requirements are in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

2.8 SOURCE QUALITY CONTROL

- A. Shop Tests:
1. Pipe manufacturer shall maintain continuous quality control program.
 2. Where applicable and when requested by ENGINEER, submit results of source quality control tests specified in reference standards.

3. CPVC plastic molding materials used for manufacturing pipe and fittings under this Section shall be tested for compliance with ASTM D1784.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

- A. For buried piping installation, refer to Section 33 05 05, Buried Piping Installation.
- B. For exposed piping installation, refer to Section 40 05 05, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 33

HIGH DENSITY POLYETHYLENE PROCESS PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, test, and place in satisfactory service the High Density Polyethylene (HDPE) process pipe and fittings as shown.
2. The extent of HDPE pipe and fittings to be furnished is shown and in the piping schedules included in Section 33 05 05, Buried Piping Installation.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the HDPE process pipe Work.

C. Related Sections:

1. Section 31 23 16.13, Trenching.
2. Section 03 00 05, Concrete.
3. Section 09 91 00, Painting.
4. Section 33 05 05, Buried Piping Installation.
5. Section 40 05 19, Ductile Iron Process Pipe
6. Section 40 05 31, Thermoplastic Process Pipe.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, Inc., (ASTM).
 - a. ASTM D 638, Test Method for Tensile Properties of Plastics.
 - b. ASTM D 696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics between - 30°C and 30°C with a Vitreous Silica Dilatometer.
 - c. ASTM D 746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - d. ASTM D 790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - e. ASTM D 1238, Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.

- f. ASTM D 1248, Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - g. ASTM D 1505, Test Method for Density of Plastics by the Density-Gradient Technique.
 - h. ASTM D 1525, Test Method for Vicat Softening Temperature of Plastics.
 - i. ASTM D 1598, Test Method for Time-to-Failure of Plastic Pipe under Constant Internal Pressure.
 - j. ASTM D 1599, Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings.
 - k. ASTM D 1603, Test Method for Carbon Black in Olefin Plastics.
 - l. ASTM D 1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.
 - m. ASTM D 2122, Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
 - n. ASTM D 2240, Test Method for Rubber Property-Durometer Hardness.
 - o. ASTM D 2290, Test Method for Apparent Hoop Tensile Strength of Plastic Reinforced Plastic Pipe by Split Disk Method.
 - q. ASTM D 2412, Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 - r. ASTM D 2657, Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - s. ASTM D 2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
 - t. ASTM D 2837, Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
 - u. ASTM D 3035, Specification for Polyethylene (PE) Plastic Pipe (DR-PR), Based on Controlled Outside Diameter.
 - v. ASTM D 3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - w. ASTM D 3350, Specification for Polyethylene Plastics Pipe and Fittings Materials.
 - x. ASTM F 412, Terminology Relating to Plastic Piping Systems.
 - y. ASTM F 714, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - z. ASTM F 1248, Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.
2. American Water Works Association, (AWWA).
 - a. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inch, for Water Service.
 - b. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution.
 3. National Science Foundation, (NSF).
 - a. NSF 14, Plastics Piping Components and Related Materials.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of five years experience producing substantial similar type materials and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
2. HDPE process pipe and fittings shall be the product of a single manufacturer.
3. The HDPE process pipe and fittings manufacturer shall have an established Quality Assurance Program responsible for inspecting incoming and outgoing materials.
4. The HDPE process pipe and fittings manufacturer shall have an established Quality Assurance program responsible for assuring the long-term performance of materials and products.
5. The HDPE process pipe and fitting manufacturer shall maintain permanent Quality Assurance/Quality Control (QA/QC) records.

B. Installer's Qualifications:

1. Engage a single installer regularly engaged in HDPE process piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
2. Engage a single installer for the entire HDPE process piping system with undivided responsibility for performance and other requirements.

C. Component Supply and Compatibility:

1. The HDPE process pipe and fittings manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the HDPE process pipe and fittings manufacturer.

1.4 SUBMITTALS

A. Submit these with Shop Drawings required under Section 33 05 05, Buried Piping Installation.

B. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Details of piping system including location of supports, restraints, fittings, anchors, vents, low-point drains, termination assemblies and all accessories necessary for piping system.
 - b. Pipe laying schedules.

2. Product Data:
 - a. Details of construction, fabrication, and pipe materials.
 - b. Detailed procedures to be used in joining and installing piping system, including manufacturer's recommendations.
 3. Testing Plans, Procedures, and Testing Limitations:
 - a. Pipe testing procedures.
- C. Informational Submittals:
1. Certificates:
 - a. Materials Certificates of Conformance: Submit certificates of conformance with Referenced Standards as required in Article 2.4, below.
 - b. Upon shipment, CONTRACTOR shall furnish the HDPE pipe manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the Project are in accordance with the requirements of this Section and a manufacturer's warranty covering materials and workmanship of the HDPE piping.
 2. Suppliers Instructions:
 - a. Detailed procedures to be used in joining and installing piping system, including manufacturer's recommendations.
 3. Qualifications Statements:
 - a. Installer's qualifications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Sections 33 05 05, Buried Piping Installation.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. HDPE piping system shall be specifically designed, constructed, and installed for the service intended and shall comply with the following service conditions.

2.2 PHYSICAL PROPERTIES

- A. Materials used for the manufacture of polyethylene pipe and fittings shall meet the following physical property requirements:

Property	Unit	Test Procedure	Value
1. Material Designation	-	PPI/ASTM	-
2. PPI Material Listing	-	PPI TR-4	PE 3408
3. Material Classification	-	ASTM D 1248	III C 5 P34
4. Cell Classification	-	ASTM D 3350	345434C or 355434C
5. Density	g/cm ³	ASTM D 1505	>0.941
6. Melt Index (E)	g/10 min	ASTM D 1238	<0.15
7. Flexural Modulus	psi	ASTM D 790	>110,000
8. Tensile Strength	psi	ASTM D 638	<160,000
9. ESCR (C)	hours	ASTM D 1693	3,000 to 3,500
10. HDB	psi	ASTM D 2837	1,600 @ 23°C
11. UV Stabilizer (C)	percent carbon black	ASTM D 1603	2 to 3
12. Elastic Modulus	psi	ASTM D 638	110,000
13. Brittleness Temperature F		ASTM D 746	<-180
14. Vicat Softening Temp F		ASTM D 1525	255
15. Thermal Expansion in/in/ F		ASTM D 696	8 x 10E-5
16. Hardness	Shore D	ASTM D 2240	64
17. Molecular Weight Category -		-	Extra-High

- B. There shall be no evidence of splitting, cracking or breaking when the pipe is tested in accordance with Article 2.4, below.
- C. Ring Stiffness Constant (RSC) values for the pipe can be directly related to the pipe's class designation. (Nominal RSC of Class 40 pipe = 40, etc.). The minimum RSC is 90 percent of the nominal.
- D. The HDPE pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.
- E. Clean rework or recycled material generated by the manufacturer's own production may be used as long as the pipe or fittings produced meet all the requirements of this Section.

2.3 PIPE AND FITTINGS

- A. Dimensions:
 - 1. Pipe Dimensions: The nominal inside diameter of the pipe shall be true to the specified pipe size in accordance with AWWA C901 and AWWA C906. Standard laying lengths shall be 50 feet \pm 2-inches.
 - 2. Fitting Dimensions: Fittings such as couplings, wyes, tees, adapters, etc. for use in laying pipe shall have standard dimensions that conform to ASTM D 3261.
- B. Pipe and fittings shall be produced from identical materials, meeting the requirements of this Section, by the same manufacturer. Special or custom fittings may be exempted from this requirement.
- C. Pipe and fittings shall be pressure rated to meet the service pressure requirements specified by ENGINEER. Whether molded or fabricated, fittings shall be fully pressure rated to at least the same service pressure rating as the pipe to which joining is intended.
- D. Molded fittings shall meet the requirements of ASTM D 3261 and this Section. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the diameter and wall thickness specifications of the mating system pipe. Fitting markings shall include a production code from which the location and date of manufacture can be determined. The manufacturer shall provide an explanation of the production codes used.
- E. Reducing tees with branch diameters of 16-inches or less shall be saddle tees.
- F. Marking:
 - 1. Each standard and random length of pipe and fitting in compliance with this standard shall be clearly marked with the following information.
 - a. ASTM or AWWA Standard Designation.
 - b. Pipe Size.
 - c. Class and Profile Number.
 - d. Production Code.
 - e. Standard Dimension Ratio (SDR).

2.4 SOURCE QUALITY CONTROL

- A. At a minimum, incoming polyethylene materials shall be inspected for density in accordance with ASTM D 1505 and melt flow rate in accordance with ASTM D 1238. All incoming polyethylene materials shall be certified by the supplier. Certification shall be verified by CONTRACTOR and ENGINEER. Incoming

materials shall be approved by Manufacturer's Quality Assurance Program before processing into finished goods.

- B. Representative samples of polyethylene materials shall be tested against the physical property requirements required herein. Each extrusion line and molding machine shall be qualified to produce pressure rated products by taking representative production samples and performing sustained pressure tests in accordance with ASTM D 1598.
- C. Quality Assurance test for representative pipe and fitting samples shall include:

<u>Test</u>	<u>Standard</u>	<u>Pipe</u>	<u>Fittings</u>
Ring ESCR	ASTM F 1248	Yes	Not Applicable
Sustained pressure at 176°F/725 psi hoop stress: (f ₀ >100 h)	ASTM D 1598	Yes	Yes
Sustained pressure at 73°F/1,600 psi hoop stress: (f ₀ >1000 h)	ASTM D 1598	Yes	Yes

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Pipe may be rejected for failure to conform to these Specifications or following:
1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2-inches in length at either end of pipe which could be cut off and discarded. Pipes within one shipment shall be rejected if defects exist in more than five percent of shipment or delivery.
 2. Cracks sufficient to impair strength, durability or serviceability of pipe.
 3. Defects indicating improper proportioning, mixing, and molding.
 4. Damaged ends, where such damage prevents making satisfactory joint.
 5. Gouges or scrapes exceeding ten percent of the specified wall thickness.
- B. Acceptance of fittings, stubs or other specifically fabricated pipe sections shall be based on visual inspection at Site and documentation of conformance to these Specifications.
- C. CONTRACTOR to provide as-built of pipe end point and angle point coordinates and elevations prior to backfilling trench.

3.2 INSTALLATION

- A. Refer to Section 33 05 05, Buried Piping Installation.
- B. Heat Fusion of Pipe:
 - 1. HDPE pipe and fittings joints shall be heat fused by a qualified technician; trained by the manufacturer's representative in accordance with the manufacturer's recommended fusion procedures. Training must have occurred within the previous 12 months, or submittals verifying experience within the previous 12 months for all technicians performing heat fusion on polyethylene pipe and fittings.
 - 2. Weld in accordance with manufacturer's recommendation for butt fusion methods. Personnel operating fusion equipment shall be certified by the HDPE pipe manufacturer.
 - 3. The first butt fusion weld of each day's production welding and for each separate operator shall be tested by bent strap test method. No production welds shall be performed until successful completion of bent strap test.
 - 4. Butt fusion equipment for joining procedures shall be capable of meeting conditions recommended by HDPE pipe manufacturer including, but not limited to, temperature requirements, alignment, and fusion pressures. The equipment used for the heat fusion joints shall be capable of recording the heating and fusion pressures used to join the HDPE pipe, recording heater temperature, and storing this information for future retrieval (data logger). Each field fusion shall be recorded by such equipment and this information shall be made compiled into daily log reports. Log reports shall be submitted to CONTRACTOR and ENGINEER daily. Reports shall also include the results of the bent strap tests.
 - 5. For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.
 - 6. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade. Shop Drawings shall address locations and deflections of required fittings to prevent installation that exceeds a greater degree of bending than the manufacturer's recommended minimum bending radius for each size and class of HDPE pipe.
 - 7. Do not subject pipe to strains that will overstress or buckle piping or impose excessive stress on joints.
 - 8. Branch saddle fusions shall be joined in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment shall be of size to facilitate saddle fusion within trench.
 - 9. Before butt fusing pipe, inspect each length for presence of dirt, sand, mud, shavings, and other debris or animals. Remove debris from pipe.
 - 10. Cover open ends of fused pipe at the end of each day's Work. Cap to prevent entry by animals or debris.

C. Flange Jointing:

1. Use on flanged pipe connection sections.
2. Connect slip-on Type 316 stainless steel backup flanges with Type 316 stainless steel nuts and bolts.
3. Butt fuse fabricated flange adapters to pipe.
4. Observe following precautions in connection of flange joints.
 - a. Align flanges or flange/valve connections to provide tight seal. Require nitrile-butadiene gaskets if needed to achieve seal. Integral flange adapters and gaskets are required for flange/valve connections.
 - b. Place U.S. Standard round washers as may be required on some flanges in accordance with manufacturer's recommendations. Bolts shall be lubricated in accordance with manufacturer's recommendations.
 - c. Tighten flange bolts in sequence and accordance with manufacturer's recommendations. CAUTION: Do not over-torque bolts.
5. Pull bolt down by degrees to uniform torque in accordance with manufacturer's recommendation.
6. Install electrofusion couplers, where used, in accordance with manufacturer's specifications.

D. Pipe Placement:

1. Grade control equipment shall be of type to accurately maintain design grades and slopes during installation of pipe.
2. Dewatering: Remove standing water in trench before pipe installation.
3. Unless otherwise specifically stated, install pipe in accordance with manufacturer's recommendations.
4. Maximum lengths of fused pipe to be handled as one section shall be placed according to manufacturer's recommendations as to pipe size, pipe SDR, and topography so as not to cause excessive gouging or surface abrasion, but shall not exceed 400 feet.
5. Cap pipe sections longer than single joining (usually 50 feet) on both ends during placement, except during fusing operations.
6. Notify ENGINEER prior to installing pipe into trench and allow time for ENGINEER'S inspection.
 - a. Correct irregularities found during inspection.
7. Complete tie-ins within trench whenever possible to prevent overstressed connections.
8. Allow pipe sufficient time to adjust to trench temperature prior to testing, segment tie-ins or backfilling activity.
9. Install reducers adjacent to laterals and tees.
10. To reduce branch saddle stress, install saddles at slope equal to and continuous with lateral piping.
11. Pipe shall be snaked in trench to allow a minimum of 12-inches/100 feet for thermal contraction and expansion.
12. Allow extra length at future connection points to be cut to fit after backfill and prior to tie-in.

- E. Saddle tees 8-inches and smaller may be field fabricated. Field fabrication may only be performed by persons trained and certified by the manufacturer. Submit certification of qualified persons before fabricating any saddle tees. Saddle tees larger than 8-inches must be factory manufactured.

3.3 LEAKAGE TESTS

- A. Refer to Section 33 05 05, Buried Piping Installation.

+ + END OF SECTION + +

SECTION 40 05 53

PROCESS VALVES, FOUR-INCH DIAMETER AND LARGER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install process valves, four-inch diameter and larger, and appurtenances, complete and operational.
2. Valves for digester gas and air have been specifically identified. All other valves are for liquid service.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves Work.

C. Related Sections:

1. Section 05 05 33, Anchor Systems.
2. Section 09 91 00, Painting.
3. Section 33 05 05, Buried Piping Installation.
4. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Bearing Manufacturers Association (ABMA).
2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
3. ANSI B16.34, Valves-Flanged, Threaded and Welding end. (ASME B16.34).
4. ANSI/NSF 61 Drinking Water Components – Health Effects.
5. API STD 594, Check Valves, Flanged Lug, Wafer and Butt-Welding.
6. API STD 598, Valve Inspection and Testing.
7. API STD 609, Butterfly Valves: Double Flanged, Lug-Type and Wafer-Type.
8. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
9. ASTM A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
10. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both.

11. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
12. ASTM A276, Specification for Stainless Steel Bars and Shapes.
13. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
14. ASTM A351/A351M, Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.
15. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
16. ASTM A536, Specification for Ductile Iron Castings.
17. ASTM A564/A564M, Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
18. ASTM A743/A743 M, Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
21. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
22. ASTM B98/B98M, Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
24. ASTM B138/B138M, Specification for Manganese Bronze Rod, Bar and Shapes.
25. ASTM B265, Specification for Titanium and Titanium Alloy Strip, Sheet and Plate.
26. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
27. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.
28. AWWA C500, Metal-Seated Gate Valves for Water Supply Service.
29. AWWA C501, Cast-Iron Sluice Gates.
30. AWWA C502, Dry-Barrel Fire Hydrants.
31. AWWA C504, Rubber-Seated Butterfly Valves.
32. AWWA C507, Ball Valves, 6-inch through 48-inch.
33. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
34. AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
35. AWWA C540, Power-Actuating Devices for Valve and Slide Gates.
36. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
37. AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis.
38. FS TT-C-494, Coating Compound, Bituminous, Solvent Type, Acid-Resistant.
39. NEMA MG 1, Motors and Generators.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have minimum of five years of experience producing substantially similar materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.
2. Supplier of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of process valve Supplier is furnishing.
3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the process valve manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Installation drawings showing orientation of valve in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
2. Product Data:
 - a. Product data sheets.
 - b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.
 - c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Certificates of compliance with referenced standards, where applicable, including those of AWWA, NSF, and others required by ENGINEER.
2. Qualifications Statements:

- a. When requested by ENGINEER, submit manufacturer's qualifications demonstrating compliance with the Specifications, including list of existing installations with contact names and telephone number(s) for each.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Furnish operation and maintenance manuals.
- D. Maintenance Material Submittals: Submit the following:
 - 1. Spare Parts, Extra Stock Materials, and Tools:
 - a. Spare Parts and Extra Stock Materials: Furnish as specified for each valve type.
 - b. Tools: Furnish two sets of special tools (excluding metric tools, if applicable) for each size and type of valve furnished.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
 - 2. Inspect boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
 - 3. Conform to Section 01 65 00, Product Delivery Requirements.
- B. Storage and Protection:
 - 1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.
 - 2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Valves, General:
 - 1. Provide each valve with manufacturer's name and rated pressure cast in raised letters on valve body.
 - 2. Provide valves with brass or Type 316 stainless steel nameplate attached with Type 316 stainless steel screws. Nameplates shall have engraved letters displaying the following minimum information:

- a. Valve size.
 - b. Pressure and temperature ratings.
 - c. Application (other than water and wastewater).
 - d. Date of manufacture.
 - e. Manufacturer's name.
 3. Provide valves to turn **clockwise to close**, unless otherwise specified.
 4. Provide valves with permanent markings for direction to open.
 5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Gear actuator and valve components shall be able to withstand minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.
- B. Valve Materials:
1. Valve materials shall be suitable for the associated valve's service or application, as shown.
 2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
 3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.
 4. Clean and descale fabricated stainless steel items in accordance with ASTM A380 and the following:
 - a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.
 - b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.
- C. Valve Joints:
1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.
 2. Buried Valves: Unless otherwise specified, provide with mechanical or push-on joints, restrained or unrestrained, as required by piping with which valve is installed.
 3. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.2 RESILIENT-SEATED GATE VALVES

- A. Manufacturers: Provide products of one of the following:
 - 1. M&H Valve Company
 - 2. US Pipe and Foundry.
 - 3. Or equal.
- B. General:
 - 1. Provide valves conforming to AWWA C509 and as specified in this Section.
 - 2. Sizes: Four-inch through 12-inch diameter, 16-inch and 20-inch diameter.
 - 3. Type:
 - a. Provide non-rising stem (NRS) valves for buried service.
 - b. For interior and exposed service, provide outside screw and yoke (OS&Y) rising-stem valves, unless otherwise specified.
 - c. Provide position indicators for NRS valves used in exposed service.
 - 4. Minimum Rated Working Pressure:
 - a. Valves 12-inch Diameter and Smaller: 200 psig.
 - 5. Maximum Fluid Temperature: 150 degrees F.
 - 6. Provide valves with fully encapsulated resilient wedges, unless otherwise specified.
- C. Materials of Construction: Shall conform to AWWA C509 and shall be as follows:
 - 1. Valve Body, Bonnet, and Stuffing Box: Cast-iron.
 - 2. Wedge: Cast-iron, symmetrically and fully encapsulated with molded rubber having minimum 1/8-inch thickness.
 - 3. Stem: Manganese bronze.
 - 4. Rubber Items: Buna-N or other synthetic rubber suitable for the application.
 - 5. Internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts, and washers shall be Type 316 stainless steel.
- D. Interior Coating:
 - 1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.
- E. Testing:
 - 1. Test valves in valve manufacturer's shop in accordance with AWWA C509.

2.3 ECCENTRIC PLUG VALVES

- A. Manufacturers: Provide products of one of the following:
 - 1. DeZurik.
 - 2. Or equal.
- B. General:
 - 1. Provide eccentric-type plug valves each with rectangular ports.

2. Minimum Rated Working Pressure:
 - a. Valves 12-inch Diameter and Smaller: 175 psig.
 3. Maximum Fluid Temperature: 180 degrees F.
 4. Minimum Port Area:
 - a. Valves 20-inch Diameter and Smaller: **100** percent of nominal pipe area.
 5. Packing and packing gland shall be externally adjustable and accessible without disassembling valve and without removing the actuator.
 6. Valves shall provide drip-tight, bi-directional shutoff at rated pressures.
 7. Plug shall have cylindrical seating surface eccentrically offset from center of plug shaft. Interface between plug face and body seat, with plug in closed position, shall be externally adjustable in the field with valve in the line while under pressure.
 8. Plug shall be supported to top bearing by using spring that is externally adjustable.
 9. Plug valves shall allow pigging of the piping with line-size pigs.
- C. Materials of Construction:
1. Body: Cast Iron ASTM A126 Class B, or Ductile-iron ASTM A536 Grade 65-45-12.
 2. Plug:
 - a. Core: Cast Iron ASTM A126 Class B, or Ductile-iron, ASTM A536 Grade 65-45-12.
 - b. Plug Facing: Neoprene.
 - c. For valves up to eight-inch diameter, plugs shall be fully encapsulated with rubber. For valves larger than eight-inch diameter, provide plugs with rubber facing. Minimum thickness of rubber lining shall be 1/8-inch. Rubber hardness shall be a minimum of 70 (Shore A) durometer. Rubber-to-metal bond shall withstand minimum 75-pound pull conforming to ASTM D429 Method B.
 3. Seats: Minimum 1/8-inch welded overlay of minimum 90 percent pure nickel on surfaces contacting plug face. Seats shall provide contact area of at least 1/2-inch width all around.
 4. Stem Bearings: Sintered, oil impregnated, permanently lubricated of Type 316 stainless steel.
 5. Stem Seal: Multiple neoprene V-ring type.
 6. All internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts and washers shall be Type 316 stainless steel.
- D. Interior Coating and Lining:
1. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.
- E. Shop Testing:
1. Operational Tests:

- a. To demonstrate that complete assembly is workable, successfully operate each valve (with actuator mounted directly on valve) three times from fully closed to fully open position and reverse under no-flow condition.
2. Leakage Tests:
 - a. Test each valve for leaks while valve is in closed position.
 - b. Test valves at rated pressures. During test, valves shall be drip-tight. Test duration shall be at least five minutes for valves up to 20-inch diameter and ten minutes for valves larger than 20-inch diameter. Tests shall be repeated successfully with pressure in the unseating direction.
3. Hydrostatic Test: Test valves to an internal hydrostatic pressure equivalent to twice rated pressure of valve. During hydrostatic test, there shall be no leakage through metal, end joints, and shaft seal, nor shall any part be permanently deformed. Duration of hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least one minute for valves eight-inch diameter and smaller, three minutes for valves 10-inch through 20-inch diameter, and ten minutes for valves 24-inch diameter and larger.

2.4 SWING CHECK VALVES

- A. Manufacturers: Provide products of one of the following:
 1. APCO Willamette Valve & Primer Corp.
 2. Crispin Valve
 3. G.A. Industries.
- B. General:
 1. Provide valves conforming to AWWA C508 and as specified herein.
 2. Type: Resilient-seated.
 3. Rated Working Pressure:
 - a. Smaller than 12-inch Diameter: 175 psig.
 - b. 12-inch Diameter and Larger: 150 psig.
 4. Provide valves suitable for horizontal or vertical mounting.
 5. Check valves shall have clear waterway with full-open area equal to nominal pipe size.
 6. Provide check valves with outside adjustable weight and lever.
 7. Provide valves larger than six-inch diameter with adjustable air cushion chambers.
 8. Valve seats shall be mechanically attached and shall be field replaceable.
- C. Materials of Construction: All materials of construction shall conform to AWWA C508 and shall be as follows:
 1. Body, Disc, Cover and Gland: Cast-iron or ductile iron.
 2. Disc Arm: Ductile iron.
 3. Hinge Shaft: Type 316 stainless steel.

4. Hinge Shaft Bushings: Bronze, or Type 316 stainless steel for sewage service.
 5. Shaft End Plate: Type 316 stainless steel.
 6. Body Seat: Type 316 stainless steel.
 7. Follower Ring for Rubber Seat on Disc: Type 316 stainless steel.
 8. Disc Center Pin Assembly: Type 316 stainless steel.
 9. Air Cushion Chamber:
 - a. Chamber and Plunger: Bronze.
 - b. Linkages and Pins: Type 316 stainless steel.
 - c. Air Check Valve and Tubing: Brass or stainless steel.
 10. Rubber Items:
 - a. Applications Up to 180-degree F Fluid Temperature: Buna-N or other synthetic rubber suitable for the application.
 - b. Applications 180-degrees F and Greater Fluid Temperature: Viton, or other synthetic rubber suitable for the application.
 11. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.
 12. Gland Packing: Graphite and Kevlar.
- D. Interior Coating:
1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.
- E. Testing:
1. Test each valve in manufacturer's shop in accordance with AWWA C508.
 2. Allowable Leakage at Rated Pressures: Zero.

2.5 FIRE HYDRANTS

- A. Products and Manufacturers: Provide one of the following:
1. American Darling, Model: B62B
 2. United Fire Flo, Model: F-06
 3. A.P. Smith, Model: H205
 4. Metropolitan, Model: 250 M94
 5. Mueller, Model: Super Centurion 200
- B. General:
1. All materials shall meet the American Water Works association Standard Specifications in addition to the following specifications:
 2. Fire hydrants shall be furnished in accordance with the latest issue of AWWA specifications C-502-80 "Dry Barrel Hydrants", U/L Listed and FM approved, and shall meet the following specific requirements and exceptions to the above mentioned standard specifications, without deviation.
 3. Rated Working Pressure: 175 psig, minimum.
 4. Rated Hydrostatic Test Pressure: 400 psig, minimum.

5. Fire hydrants shall be suitable for a 5'-6" bury and shall have a 6" MJ base with mega-lug gland.
6. Hydrants shall open left.
7. Main valve opening shall be 5 1/4".
8. Color shall be red with silver bonnets and caps.

C. Construction:

1. Type: Three-way fire hydrants with two hose nozzles and one pumper nozzle.
2. Nozzles:
 - a. Provide one 4.5-inch diameter pumper nozzle and two 2.5-inch diameter hose nozzles with NFPA threads.
 - b. Nozzles shall be O-ring sealed, threaded, and retained with stainless steel locks. Nozzles shall be field replaceable.
3. Main Valve and Drainage Assembly:
 - a. Opening: 5.25-inch diameter.
 - b. Main valve shall be compression type provided with upper and lower metal plates and lower valve plate nut.
 - c. Barrel drainage shall be through dual drain valves. Opening and closing of main valve shall cause force-flush of dual drain ports.
 - d. Main valve seat ring shall be easily replaceable from above-ground.
4. Provide an oil filled reservoir for lubrication of stem threads and bearing surfaces. Oil shall be U.S. Food and Drug Administration approved and ANSI/NSF 61-listed, and shall flow freely in temperature range of -60 to 158 degrees F.
5. Provide traffic flange in barrel and safety coupling in stem.
6. Inlet Connection: Six-inch diameter mechanical joint, restrained.

D. Materials of Construction: Materials of construction shall conform to the requirements of AWWA C502 and shall be as follows:

1. Upper and Lower Barrels, Shoe, and Bonnet: Cast-iron.
2. Stem and Accessories:
 - a. Upper and Lower Stems: Steel.
 - b. Operating Nut: Bronze.
 - c. Safety Coupling: Stainless steel.
3. Nozzles:
 - a. Pumper and Hose Nozzles: Bronze.
 - b. Nozzle Caps: Cast-iron.
 - c. Cap Chains: Steel.
4. Main Valve Assembly:
 - a. Main Valve: Rubber.
 - b. Upper Valve Plate: Bronze.
 - c. Lower Valve Plate and Nut: Cast-iron.
5. Drain Valves:
 - a. Drain Ring Housing: Cast-iron.
 - b. Drain Ring: Bronze.
6. O-ring Gaskets: Rubber.

7. External Assembly Bolts: Steel.
 8. Internal Pins and Other Hardware: Stainless steel, ASTM A276.
- E. Testing:
1. Test each fire hydrant in manufacturer's shop in conformance with AWWA C502.
- F. Interior Coating:
1. Hydrants shall be coated on the interior. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.
- G. Exterior Painting:
1. Below- and above-ground painting shall be as specified under Article 2.9 of this Section and Article 2.10 of this Section.
 2. Hydrants shall be painted according to the following criteria:
 - a. Body: Red
 - b. Bonnet: Silver

2.6 APPURTENANCES FOR BURIED METALLIC VALVES

- A. Wrench Nuts:
1. Provide wrench nuts on buried valves of nominal two-inch size, in accordance with AWWA C500.
 2. Arrow indicating direction of opening the valve shall be cast on the nut along with the word "OPEN".
 3. Material: Ductile iron.
 4. Secure nut to stem by mechanical means.
- B. Extension Stems for Non-Rising Stem Gate Valves and Quarter-turn Buried Valves:
1. Provide extension stems to bring operating nut to six inches below valve box cover.
 2. Materials of Stems and Stem Couplings: Type 316 stainless steel.
 3. Maximum Slenderness Ratio (L/R): 100
 4. Provide top nut and bottom coupling of ductile iron or cast-iron with pins and set screws of Type 316 stainless steel.
- C. Valve Boxes:
1. Valve boxes shall be as indicated and as required.
 2. Type: Heavy-duty, suitable for highway loading, two-piece telescopic, and adjustable. Lower section shall enclose valve operating nut and stuffing box and rest on valve bonnet.
 3. Material: Cast-iron or ductile iron.
 4. Coating: Two coats of asphalt varnish conforming to FS TT-C-494.
 5. Marking: As required for service.

2.7 ANCHORAGES AND MOUNTING HARDWARE

A. General:

1. Comply with Section 05 05 33, Anchor Systems, except as modified in this Section.
2. Obtain bolts, nuts, and washers for connection of valve and appurtenances to concrete structure or other structural members from valve Supplier.
3. Bolts, nuts, and washers shall be of ample size and strength for purpose intended. Anchorages in concrete shall be at least 5/8-inch diameter.
4. Provide stem guide anchorages of required strength to prevent twisting and sagging of guides under load.
5. Materials: Provide bolts and washers of Type 316 stainless steel and nitrided nuts. Bolts shall have rolled threads. Bolts and nuts shall be electropolished to remove burrs.

2.8 TOOLS, LUBRICANTS, AND SPARE PARTS

A. Provide the following T-handle operating wrenches for buried valves:

1. Length of T-Handle Operating Wrench: 5 feet.
2. Quantity: 2.

B. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion. Lubricants for equipment associated with conveying potable water or water that will be treated to become potable shall be food-grade and ANSI/NSF 61-listed.

2.9 PAINTING OF EXPOSED VALVES, HYDRANTS, AND APPURTENANCES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in manufacturer's shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09 91 00, Painting.

2.10 PAINTING OF BURIED VALVES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined or bearing surfaces of buried valves, shall be painted in valve manufacturer's shop with two coats of asphalt varnish conforming to FS TT-C 494.

2.11 TAPPING SLEEVES AND VALVES

A. Mechanical Joint Tapping Sleeves:

1. Shall consist of a split ring ductile iron body with mechanical joint ends on the main and a flange on the branch.
2. Outlet flange dimensions and drilling comply with ANSI B16.1, class 125 and with MSS SP-60.

3. The Contractor shall be responsible for verifying the outside diameter of the pipe to be tapped.

B. Tapping Valves:

1. Standard self tapping type valves shall have one flange and one mechanical joint end. Shall be resilient wedge tapping type.
2. Iron wedge shall be symmetrical and fully encapsulated with molded rubber. No iron shall be exposed.
3. Stem shall be non rising type.
4. Body shall be epoxy coated.
5. Meets or exceeds requirements of ANSI/AWWA C509, certified to ANSI/NSF 61 standard.
6. The valves shall conform to the requirements hereinbefore specified for gate valves and shall be furnished with a 2-inch square operating nut.

C. Manufacturers:

1. Mueller Co., Decatur, IL
2. American Valve and Hydrant, Birmingham, AL
3. Kennedy Valve, Elmira, NY
4. US Pipe, Chattanooga, TN
5. Or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Install valves and appurtenances in accordance with:
 - a. Supplier's instructions and the Contract Documents.
 - b. Requirements of applicable AWWA standards.
 - c. Applicable requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
3. Position swing check valves and butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.

B. Exposed Valves:

1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
 2. Operators:
 - a. Install valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by ENGINEER.
 - b. Avoid placing operators at angles to floors or walls.
 - c. Orient chain operators out of way of walking areas.
 - d. Install valves so that indicator arrows are visible from floor level.
 - e. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.
 3. Floor Stands and Stems:
 - a. Install floor stands as shown and as recommended by manufacturer.
 - b. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by manufacturer.
 - c. Provide sleeves where operating stems pass through floor. Extend sleeves two inches above floor.
- C. Buried Valves:
1. Install valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four feet on all sides of box, or to undisturbed trench face if less than four feet.
 2. Provide flexible coupling next to each buried valve.
- D. Plug Valves:
1. Install plug valves that are in horizontal liquid piping with stem horizontal and plugs on top when valve is open. Plug shall be on upstream end when valve is closed.
 2. Install plug valves that are in vertical liquid piping with plug at top when closed or as recommended by valve Supplier.
 3. Supplier shall tag or mark plug valves to indicate proper mounting position.

3.3 FIELD QUALITY CONTROL

- A. Field Tests:
1. Adjust all parts and components as required to provide correct operation of valves.
 2. Conduct functional field test on each valve in presence of ENGINEER to demonstrate that each valve operates correctly.
 3. Verify satisfactory operation and controls of motor operated valves.
 4. Demonstrate satisfactory opening and closing of valves at specified criteria requiring not more than 40 pounds effort on manual actuators.
 5. Test ten percent of valves of each type by applying 200 pounds effort on manual operators. There shall be no damage to gear actuator or valve.

+ + END OF SECTION + +

SECTION 40 42 13

INSULATION AND FREEZE PROTECTION OF PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install insulation on all new piping, fittings, valves, and all accessories at the following locations.
 - 1. Valve Vault, exposed force main piping: Insulation shall be cellular glass insulation with weatherproof PVC jacket.
- B. The valve vault Force Main piping shall be electrically heat traced. Electric heat tracing cable, power connection kit, thermostat, branch circuit protection devices, in-line splices, end of circuit terminations, and caution labels shall be provided as specified in this Section.
- C. Coordination: Insulation shall not be installed until piping has been field tested and approved by ENGINEER and OWNER.
- D. Related Work Specified Elsewhere:
 - 1. Section 09 9100 - Painting.
 - 2. Section 26 00 05 – Electrical Work.
 - 3. Division 40, Applicable Sections of Process Integration

1.2 QUALITY ASSURANCE

- A. Manufacturer's and Installer's Qualifications: Manufacturer and installer shall have a minimum of 5 years experience of producing substantially similar materials and shall show evidence of at least 5 installations in satisfactory operation.
- B. Design Criteria: Insulation systems including covering, mastics, adhesives, sealers and facings shall have the following fire hazard classifications:
 - 1. Flame spread, 25 maximum.
 - 2. Fuel contributed, 50 maximum.
 - 3. Smoke developed, 50 maximum.
- C. Source Quality Control: Perform the following tests and inspections at the factory:
 - 1. Flame spread.
 - 2. Smoke developed.
 - 3. Fuel contributed.

- D. Requirements of Regulatory Agencies:
 - 1. Permits: CONTRACTOR shall obtain and pay for all required permits, fees, inspections and approvals by authorities having jurisdiction.
 - 2. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:
 - a. State of Pennsylvania Building Code and Energy Conservation Code.
 - 3. Underwriters' Laboratories, Incorporated.
 - 4. National Fire Protection Association.
- E. Reference Standards: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified:
 - 1. Federal Specification HH-1-558B, Insulation Blocks, Boards, Blankets, Felts, Sleeving, Pipe Fitting Covering.
 - 2. ASTM C 547, Mineral Fiber Preformed Pipe Insulation.
 - 3. ASTM E 84, Surface Burning Characteristics of Building Materials.
- F. Field Measurements: Take field measurements where required prior to installation to ensure proper fitting of Work.

1.3 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Manufacturer's literature, illustrations, specifications, and engineering data to include the following:
 - a. Thermal properties.
 - b. Physical properties.
 - c. Fire hazard ratings.
 - d. Facing information.
 - e. Installation instructions.
 - f. Jointing recommendations for butt joints and longitudinal seam.
 - 2. Drawings showing fabrication methods, assembly, installation details and accessories.
 - 3. Electric heating cable installation instructions and fabrication details.
 - 4. Data sheets for each electric heating cable with the following information:
 - a. Heater catalog number.
 - b. Heater length.
 - c. Voltage required.
 - d. Ampere load (initial and operating).
 - e. Total output in watts.
 - f. Thermostats, end terminations, and splices.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Material: Material shall be delivered to the job site in corrugated cartons.
- B. Storage of Material:
 - 1. Store material in clean, dry area, out of the weather.
 - 2. Material shall be tightly covered to protect against dirt, water, mechanical injury or chemical damage.
 - 3. Material shall remain in original cartons until time of installation.

1.5 JOB CONDITIONS

- A. Protection:
 - 1. All material applied in one day shall have the vapor barrier applied the same day and any exposed ends shall be temporarily protected with a moisture barrier and sealed to the pipe.
 - 2. Insulating materials shall, at all times, be protected from moisture.
 - 3. Material shall be warehoused on or near the job site and drawn from this protected area as used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cellular Glass Insulation:
 - 1. Product and Manufacturer: Provide insulation products of one of the following:
 - a. FOAMGLAS Super K insulation, as manufactured by Pittsburgh Corning Corporation.
 - b. Or equal.
 - 2. Type: Cellular glass insulation.
 - 3. Density: 7.5 lbs per cubic foot.
 - 4. Minimum Thickness: 4-inch.
 - 5. Compressive Strength: 87 lbs. per square inch.
 - 6. Linear Coefficient of Thermal Expansion: 5.0×10^{-6} / degree F.
 - 7. Specified Heat: 0.19 Btu/pound-degree F.
 - 8. Thermal Conductivity (at 50 degrees F): 0.28 Btu-inch/hr-ft²-degree F.
 - 9. Strapping Tape: As recommended by insulation manufacturer.
- B. Weatherproof Insulation Jacket:
 - 1. Manufacturer: Provide Weatherproof Insulation Jackets of one of the following:
 - a. CertainTeed Products Corporation.
 - b. Childers Products Company, Lock-On and Strap-On.

- c. Or equal.
 - 2. Type: Smooth PVC jacket.
 - 3. Moisture Barrier: Polycraft.
 - 4. Bands: 2-inch aluminum bands with wing seals.
 - 5. Fittings:
 - a. Type: Pre-molded high impact PVC fittings.
- C. Electric Heat Trace Cable:
- 1. Self-regulating heat trace cable for maintenance of fluid temperature of 40 degrees F at an outdoor ambient temperature of –10 degrees F.
 - 2. All equipment shall be UL or FM approved.
 - 3. The heat trace cable assembly shall consist of two nickel-plated copper bus wires surrounded by a semi-conductive heating matrix. Heating matrix shall be covered by a cross-linked polyolefin insulating jacket and a tinned copper braid. An additional polyolefin overjacket shall cover the tinned copper braid to aid in protecting the braid from corrosion.
 - 4. Install the heat trace cable as a single circuit. The 18-inch diameter Drainage Force Main shall be insulated at the Primary Clarifier Influent Channel from a point 3.5 feet below grade to the discharge of the pipe.
 - 5. The heat trace cable shall be capable of exposure to the following conditions without damage to the heating element:
 - a. Maximum maintenance temperature: 112 degrees F.
 - b. Maximum intermittent exposure temperature: 162 degrees F.
 - c. Minimum bending radius: 1.25 inches.
 - 6. Service voltage: 120 vac.
 - 7. Power output at –10 degrees F: 9 watts per foot.
 - 8. Product and Manufacturer:
 - a. RSX 3-1 OJ as manufactured by Thermon Manufacturing Company.
 - b. Or equal.
- D. Electrically Heat Traced Thermostat:
- 1. Thermostat shall be mechanical, single pole, single throw, remote bulb with 6-foot capillary encased in flexible stainless steel armor.
 - 2. Thermostate shall have an adjustable set-point with 35 to 235 degrees F range calibrated dial.
 - 3. Thermostat enclosure shall be NEMA 4X polycarbonate, gasketed, and FM approved for single phase, 120 volt, 60 hertz power.
 - 4. Each electric heat trace circuit shall have its own thermostat.
 - 5. Product and Manufacturer:
 - a. E4X-35235 as manufactured by Thermon Manufacturing Company.
 - b. Or equal.
- E. Electric Heat Trace Power or Splice Connection Box:
- 1. Power connection box shall include a non-metallic, NEMA 4X junction box, gaskets, watertight grommets, mounting base, splice lugs, grounding lugs, wire connectors, grounding conductor, and stainless steel banding and fasteners..

2. Product and Manufacturer:
 - a. PCA-1 as manufactured by Thermon Manufacturing Company.
 - b. Or equal.
- F. Electric Heat Trace End-of-Circuit Termination Kit:
 1. Each circuit shall be terminated using an end-of-circuit termination kit.
 2. Product and Manufacturer:
 - a. ET-6C by Thermon Manufacturing Company
 - b. Or equal.
- G. Miscellaneous Heat Trace Components:
 1. Heat trace cable shall be attached continuously to the pipe with 2-inch wide aluminum tape. Aluminum tape shall be AL-20P manufactured by Thermon Manufacturing Company or equal.
 2. Provide caution labels every five feet per horizontal run of pipe. Label shall be readily visible from ground level and shall state, "ELECTRIC HEAT TRACING – CAUTION".

PART 3 - EXECUTION

3.1 INSPECTION

- A. Insure that surfaces of pipes, valves, fittings, and accessories are clean and dry before applying insulation.

3.2 PREPARATION

- A. Ensure that piping and equipment has been inspected and released for application of insulation. Exposed piping should be tested before insulation is applied.

3.3 INSTALLATION

- A. Pipe insulation shall be continuous through walls and floor openings except where walls or floors are required to be fire stopped or required to have a fire resisting rating.
- B. Where hangers are in direct contact with low temperature piping the hanger and supporting rod shall be wrapped with foil-faced blanket insulation and vapor sealed. Hanger rod insulation and vapor barrier shall extend up to the rod a minimum distance equal to the diameter of the pipe.
- C. Install insulation so as to make surfaces smooth, even, substantially flush with adjacent insulation and installed in a manner to maintain the integrity of the vapor barrier.
- D. Follow manufacturer's application instructions for all materials used.
- E. Provide insulation protection shields for insulated piping supported by pipe hangers.
- E. Install and coat Urethane Foam insulation as specified and in accordance with the manufacturer's recommendations.
- F. Install cellular glass insulation and jacketing in accordance with the insulation manufacturer's instructions.

3.4 ELECTRIC HEAT TRACE CABLE INSTALLATION

- A. Cable shall be carefully located to preclude subsequent damage coincident with normal operations and maintenance.
- B. Cable installation shall begin at the cold junction and work toward the hot junction, allowing extra cable as required.
- C. The cable shall be covered with a parallel pass of aluminum foil tape.
- D. The installed heat trace cable shall be covered with thermal insulation as rapidly as possible. Install thermal insulation in accordance with requirements of this Section.
- E. Electric heat tracing shall not be used as a current carrying conductor to jump from one pipe to another.

3.5 FIELD QUALITY CONTROL

- A. Ensure that insulation is dry when installed, and before and during application of any finish, coating or jacket.
- B. After application of the insulation jacket, visually inspect all laps, seams, and butt strips to ensure that these areas are sealed from water entry in accordance with the specifications and manufacturer's product data sheets.
- C. Perform, record, and submit to ENGINEER results of insulation resistance tests on all heat trace cable upon receipt of the cable, both before and immediately after installation of the piping's thermal insulation. Minimum acceptable reading should be 20 megaohms per circuit regardless of length.

+ + END OF SECTION + +

SECTION 40 60 05

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, start-up and place in satisfactory operation a complete and operating instrumentation and control system.
- B. The Contractor shall retain the services of a pump supplier who shall be responsible to provide the following major elements:
 - 1. Pump Control System
 - 2. The Pump Control System will consist of the following key items:
 - a. Conductive Level Sensors Probe
 - b. Level Floats
 - c. Integrated Pump Control System, including the Operator Interface Terminals (OIT) and configuration software.
 - d. Backup relay control system
 - e. Autodialer/Monitoring System
 - f. Training, checkout, and startup.
- C. Contractor shall be responsible to provide the field instruments, panels and associated services as specified herein.
- D. In order to centralize responsibility, it is required that all equipment provided under this Section be furnished by a single system supplier as specified in Article 1.3, below. Contractor shall guarantee and be the source of information on all equipment, materials, and appurtenances furnished regardless of the manufacturing and supply source of the equipment.
- E. All equipment, materials, and appurtenances, as well as all signal and power wiring and cable runs and interconnections, shall be in strict accordance with the requirements of Section 26 00 05, Electrical Work, and in accordance with the manufacturer's recommendations, unless specified otherwise herein.

F. Related Sections:

1. Section 26 00 05, Electrical Work
2. Section 40 21 39.13, Submersible End Suction Pumps.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
2. American Petroleum Institute, (API).
3. American Water Works Association, (AWWA).
4. Environmental Protection Agency, (EPA).
5. Institute of Electrical and Electronic Engineers, (IEEE).
6. The Instrumentation, Systems and Automation Society, (ISA).
7. Military Standards, (MIL).
8. National Electrical Code, (NEC).
9. National Electrical Manufacturers' Association, (NEMA).
10. Nuclear Regulatory Commission, (NRC).
11. National Fire Protection Association, (NFPA).
12. Occupational Safety and Health Administration, (OSHA).
13. Scientific Apparatus Manufacturers Association, (SAMA).
14. Underwriters Laboratories, Incorporated, (UL).
15. Local and State Building Codes and Ordinances.
16. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.3 QUALITY ASSURANCE

A. General:

1. All equipment, components and materials required shall be furnished by a single Supplier who shall assume the responsibility for adequacy and performance of all items.
2. The Supplier shall identify those system components which are not of his manufacture.
3. The Supplier shall supply his company's Quality Assurance Plan (QA), and for components which are not of his manufacture, the component manufacturer's Quality Assurance Plan.
4. The Pump Control System and Conductive Level Sensors Probe shall be compatible from the same manufacturer.

B. Supplier's Qualifications:

1. Shall be a financially sound firm having at least five years continuous experience in designing, implementing, supplying and supporting instrumentation and control systems for municipal wastewater facilities which

are comparable to the Project in terms of hardware, software, cost and complexity.

2. Shall have a demonstrated experience record of successful instrumentation and control system equipment installations.
3. Shall have in existence at the time of bid advertisement, an experienced engineering and technical staff capable of designing, supplying, implementing and supporting the instrument and control system and handling the submittal and training requirements.
4. Shall be capable of providing training for Owner's personnel in instrumentation and process control applications and in operation, programming and maintenance of the control system and equipment.
5. Shall have a record of prompt shipments in accordance with Contract obligations required for previous projects.
6. Shall have a demonstrated record of prompt positive response to system failures at the field.
7. Shall maintain a fully qualified service facility within a radius of 60 miles of the Site. During period of the warranty, the supplier shall guarantee timely response to all service calls (on-Site within 24 hours to correct all critical failures, within 72 hours to correct all non-critical failures and problems). Incurred expense for this service, inclusive of the cost of all materials and replacement parts, shall be born by Contractor.
8. Shall have a UL approved panel shop.

C. Manufacturer's Qualifications: The manufacturers of the Integrated Pump Control System provided under this Section and other equipment Sections shall have experience in producing similar equipment, shall show evidence of installations in satisfactory operation, and shall meet the following qualifications:

1. Shall provide and manufacture instrumentation and control system components which are of fully developed, field proven standardized designs.
2. Shall have a system of traceability of the manufactured unit through production and testing in compliance with MIL-STD'S.
3. Shall have a system of "Burn-In" for all critical components and available supportive documentation in compliance with MIL STD'S.
4. Shall have a demonstrated record of prompt positive response to field failures.
5. Shall have a documented program of failure analysis.
6. Shall have a warranty covering parts and labor and in the case of microprocessor-based components and appurtenances, a guaranteed availability clause (99.99 percent minimum).
7. Shall have a record of prompt shipments in accordance with Contract obligations.
8. Shall have a quality assurance organization which complies with MIL-STD 9858A and shall apply MIL-HDBK-217D, SAMA Handbook PMC-32-1981 and SAMA Standard PMC 32.1-1976 for reliability calculations, as required.
9. Shall have a documented product safety policy relevant to all products proposed for this Contract.

D. Supplier's Responsibilities:

1. Contractor shall retain the system supplier to assume the responsibilities specified below. However, execution of these specified duties by the system Supplier shall not relieve Contractor of the ultimate responsibility for providing a fully functional instrumentation and control system equipment that meets all the requirements specified.
 - a. Preparation, assembly and correction of all instrumentation and control equipment submittals in accordance with the Contract Documents and procedures.
 - b. Proper interfacing of the instrumentation and control equipment with field equipment, instruments, devices and panels, including required interfacing with package control systems furnished by other equipment.
 - c. Review, approval and coordination with manufacturers, suppliers and other contracts of Shop Drawings for equipment, valves, and piping for the purpose of ensuring proper interface of hardware, locations and installation of in-line instruments and instrument taps.
 - d. Direct, detailed supervision of the installation of the instruments, panels, consoles, cabinets, wiring and other components as well as related wiring and piping connections.
 - e. Calibration, testing (Factory and Field) and start-up of the system.
 - f. Handling of all warranty obligations for the instrumentation and control system components.
 - g. Training of Owner's personnel in operation and maintenance (including calibration and troubleshooting) of the instrumentation and control equipment.

- E. Provide only new materials throughout, conforming to standards established by Underwriter's Laboratories (UL), Inc., and so marked or labeled, together with Manufacturer's brand or trademark.

1.4 SUBMITTALS

A. Shop Drawings:

1. General:
 - a. Shop Drawing submittals are to be in accordance with the requirements of the Contract Documents.
 - b. Shop Drawings shall be submitted in complete packages grouped to permit review of related items.
 - c. Review of Shop Drawings will be for conformance with Contract Documents and with regard to functions specified.
 - d. Proposed graphics layouts shall be submitted for review and comments. All graphic display and process reports shall be subject to modification from Contractors suggested format within the limits of the software

package. Contractor shall perform such modifications as part of the Project Scope.

2. Submittal Requirements:

- a. Product information for all sensors/transducers and field instruments shall include the following:
 - 1) Manufacturer's product name and model number, including manufacturer's name and address.
 - 2) Instrument tag number from Contract Documents.
 - 3) Data sheets and catalog literature. Provide data sheets as shown in ISA-S20-1981. For instruments not included in S20, submit data sheets using a format similar to those shown.
 - 4) Description of construction features.
 - 5) Performance and operation data.
 - 6) Installation and mounting details, instructions and recommendations.
 - 7) Service requirements.
 - 8) Dimensions.
- b. Panels, Consoles and Cabinets Information:
 - 1) Layout Drawings, include the following:
 - a) Front, rear, and internal panel views to scale.
 - b) Dimensional information.
 - c) Tag number and functional name of components mounted in and on panel, console or cabinet.
 - d) Product information on all panel components.
 - e) Nameplate location and legend including text, letter size and colors to be used.
 - f) Location of anchoring connections and holes.
 - g) Location of external wiring and/or piping connections.
 - h) Mounting and installation details (coordinate with actual application).
 - i) Proposed layouts and sizes of graphic display panels and alarm annunciator panels.
 - 2) Wiring and/or piping diagrams, include the following:
 - a) Name of panel, console or cabinet.
 - b) Wiring sizes and types.
 - c) Piping sizes and types.
 - d) Terminal strip numbers.
 - e) Color coding.
 - f) Functional name and manufacturer's designation for components to which wiring and piping are connected.
 - 3) Electrical control schematics in accordance with NEPA "79" Standards.
 - 4) Plan showing equipment layout in each area.
- c. Field wiring and piping diagrams, include the following:
 - 1) Wiring and piping sizes and types.
 - 2) Terminal strip numbers.

- 3) Color coding.
 - 4) Conduits in which wiring is to be located.
 - 5) Locations, functional name and manufacturer's designation of items to which wiring and/or piping are connected.
 - 6) Point-to-point wiring diagrams.
3. Software Information:
- a. First Submittal: System Description:
 - 1) Control strategy narrative for the pump station.
 - 2) Screen shots of all Operator Interface Displays as configured for station.
 - b. Second Submittal: System Software Documentation: Preliminary software documentation within four weeks prior to expected initiation of testing. Submittal shall be for Owner and Engineer information only and shall not be subject to formal approval action. Software documentation shall include the following, as a minimum:
 - 1) Final Control Narrative
 - 2) Complete hard copies of all programming.
 - 2) Complete listing of external and internal I/O address assignments, register assignments and preset constant values along with function point descriptions. Also, list all unused/undefined I/O and data table registers available.
 - 3) Screen shots incorporating any comments during the submittal review.
- E. Control System Operation and Maintenance Manuals:
1. Furnish Operation and Maintenance Manuals in accordance with Section 01 78 23, Operation and Maintenance Data, and the supplemental requirements below.
 2. The Operation and Maintenance Manuals shall include the following:
 - a. Name, address and telephone number of the instrumentation and control system supplier's local service representative.
 - b. Copy of all approved submittal information and system Shop Drawings as specified herein with corrections made to reflect actual system as tested and delivered to the Site for installation. Half-size black line reproductions shall be provided for all Shop Drawings larger than 11 by 17-inches.
 - c. Complete up-to-date system software documentation.
 - d. Manufacturer's Original Copies of Installation, Assembly and Operations Manuals. Manuals shall include the following information:
 - 1) General descriptive information covering the basic features of the equipment.
 - 2) Physical description covering layout and installation requirements and all environmental constraints.
 - 3) Functional and operational descriptions covering the procedures for operation, start-up, shut-down.
 - 4) Maintenance procedures covering checkout, troubleshooting, and servicing; checkout procedures shall provide the means to verify the

satisfactory operation of equipment, troubleshooting procedures shall serve as a guide in determining faulty components and servicing procedure shall cover requirements and recommended time schedule for calibration, cleaning, lubrication and other housekeeping and Preventive Maintenance procedures.

- 5) Wiring, schematic and logic diagrams.
- 6) Safety considerations relating to operation and maintenance procedures.

F. Record Drawings and Documentation:

1. Contractor and system Supplier shall revise all system Shop Drawing submittals to reflect as-built conditions in accordance with the requirements of the Contract Documents and the supplemental requirements below.
2. Six copies of all revised Shop Drawings and documentation shall be submitted to the Engineer to replace out-dated drawings and documentation contained in the System Operation and Maintenance Manuals. Half-size black line sets shall be provided for all drawings larger than 11 by 17-inches. Specific instructions for out-dated drawing removal and replacement shall be provided with the Record Drawing submittal.
3. Half-size black line prints of wiring diagrams applicable to each control panel shall be placed inside a clear plastic envelope and stored in a suitable print pocket or container inside each control panel.
4. Submit mylar reproducibles of the point-to point interconnection wiring diagrams updated to reflect final as-built equipment information and as-installed field installation information.

G. Reports:

1. Two copies of the following reports shall be submitted to Engineer:
 - a. Factory Test Reports.
 - b. Installation Inspection, Field Calibration, and Field Testing Reports.

1.5 GENERAL DESIGN REQUIREMENTS

A. Power Supplies:

1. Each pump station is serviced by utility voltage (See Electrical Drawings). Incoming power breakers and transformer equipment as well as equipment associated with 3-phase power for the pumping equipment shall be coordinated and size for these voltages.
2. All electrically powered equipment and devices associated with the pump station control system shall be suitable for operation on 115 volt 10 percent, 60 Hz 2 Hz power. If a different voltage or closer regulation are required, a suitable regulator or transformer shall be provided at no additional cost to the Owner.
3. Appropriate power supplies shall be furnished by Contractor for all two-wire transmitters. Power supplies shall be mounted in enclosures and installed in the appropriate Control Room or field panel, as shown.

4. Design all power supplies for a minimum of 130 percent of the maximum simultaneous current draw.
 5. A power on-off switch or an air circuit breaker shall be furnished for each item requiring electrical power.
- B. Analog Signal Requirements:
1. The control system shall be designed to use 4 to 20 mADC analog signals, unless otherwise specified.
 2. Signal converters and repeaters shall be provided where required. Power supplies shall be sized adequately for signal converter and repeater loads.
 3. Signals shall be isolated from ground.
 4. Signals shall not have a transient DC voltage exceeding 300 volts over one millisecond nor a DC component over 300 volts.
- C. Miscellaneous:
1. All instrumentation components shall be heavy-duty types, designed for continuous service. The system is to contain products of a single manufacturer, when possible, and to consist of equipment models which are currently in production. All equipment provided is to be of modular construction and be capable of field expansion through the installation of plug-in circuit cards and additional cabinets as necessary. Design all logic and control loops to fail-safe.
 2. All instrumentation components shall be designed to return automatically to accurate measurement within 15 seconds upon restoration of power after a power failure or when transferred to standby power supply.
 3. Surge protection shall be provided for all instruments and all other control system components which could be damaged by electrical surges. Lightning arresters shall be provided on both ends of communication lines external to the building, including leased telephone lines.
 4. All field-mounted instruments and system components shall be designed for installation in humid and corrosive service conditions. All field mounted instrument enclosures, junction boxes and appurtenances shall conform to NEMA 4X requirements, unless otherwise specified.
 5. All relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are not an acceptable alternate.
 6. All panel mounted instruments, switches, and other devices shall be selected and arranged to present a pleasing coordinated appearance. All front of panel mounted devices shall be of the same manufacturer and model line.
 7. All components furnished, including field and rear of panel instruments, shall be tagged with the item number and nomenclature indicated in the Contract Documents and/or approved Shop Drawings.
 8. Ranges and scales specified herein shall be coordinated to suit equipment actually furnished.
 9. Field-mounted devices shall be treated with an anti-fungus spray.
 10. Field-mounted devices shall be protected from exposure to high temperature and freezing temperatures.

D. Environmental Conditions:

1. The control system shall be designed and constructed for continuous operation under the following temperature and humidity conditions:
 - a. Indoor locations for instruments:
 - 1) Ambient Temperature: 0 F to 120°F.
 - 2) Relative Humidity: 100 percent, maximum.

1.6 FACTORY TESTING

A. General:

1. Contractor shall submit information on factory testing procedures to verify that testing shall fulfill the requirements as specified herein. Contractor shall provide two weeks notice to the Engineer prior to the testing so that witnessing of the test may be observed. Witnessing will be at the Engineer's option.
2. Owner and Engineer may elect to be present at Contractor's facilities during operational test of system equipment, either for individual units or as an integrated system. Presence of Owner and Engineer during testing does not relieve Contractor from conforming to the requirements of the Contract Documents and shall in no way imply acceptance of the equipment.
3. When the factory tests have been successfully completed, a Factory Test Report shall be submitted to Engineer. The equipment shall not be shipped until Notice of Acceptance of the test is received by Contractor.
4. A combined factory test for all four completed panels shall be performed. All inspections and system operational tests shall be performed as outlined below.
5. A successful test will be defined as all components within the respective control panel, being tested and certified for its intended function.

B. Inspection:

1. All panels, consoles and cabinets shall be inspected. Inspection shall include, but not be limited to the following:
 - a. Nameplates and tags.
 - b. Wire sizes and color coding.
 - c. Terminal block contact ratings and numbers.
 - d. Annunciator and terminal block spares.
 - e. Proper wiring practices and grounding.
 - f. Enclosure flatness, finish and color.

C. System Operational Testing:

1. All input/output devices and components shall be tested to verify operability and basic calibration.
2. All system hardware components equipment shall be tested to verify proper operation of the equipment as stand alone units. Test shall include, but not be limited to, the following:
 - a. AC/DC power checks.

- b. Power fail/restart tests.
 - c. Diagnostics checks.
 - d. Test demonstrating that all specified equipment functional capabilities are working properly.
3. All system components shall be tested to verify that communication between units is working properly.
4. Testing of autodialer unit.

1.7 STORAGE AND HANDLING

- A. Each manufacturer or supplier securely attach the tag number and instructions for proper field handling and installation to each instrument prior to packaging.
- B. Each manufacturer or supplier package control cabinets and instrumentation to protect against shipping damage, dust, moisture, and atmospheric contaminants. Include a shipping label which contains the following information:
 1. Tag number, equipment number and description.
 2. Instructions for unloading transporting, storing and handling at the Site.
- C. Receive control cabinets and instrumentation at the Site. Inspect control cabinets and instrumentation for damage in shipment and return damaged control cabinets and instrumentation to the manufacturer.
- D. Do not store control cabinets and instrumentation out-of-doors. Provide dry, heated permanent storage facilities and pay storage costs.

PART 2 - PRODUCTS

2.1 PUMP CONTROL PANEL

- A. Control panels and associated NEMA requirements are listed below:

Panel Designation	Panel Description	Panel Type
PCP	Pump Station Control Panel	NEMA 12

- B. General Construction Requirements:
 1. Provide all electrical components and devices, support hardware, fasteners, interconnecting wiring and/or piping required to make the control panels complete and operational units.
 2. Locate and install all devices and components so that connections can be easily made and so that there is ample room for servicing each item.
 3. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.

4. Provide sub-panels for installation of all relays and other internally mounted components.
5. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.
6. Provide copper grounding studs for all panel equipment.
7. Provide the following convenience accessories inside of each panel:
 - a. One 120 VAC, 20 A duplex, grounding type receptacle.
 - b. One 120 VAC fluorescent light fixture with 20 watt lamp and protective plastic shield.
 - c. One 120 VAC, 20 A, snap switch, to turn on the light, mounted in an outlet box with a cover and located so that it is easily accessible from access door.
 - d. The service light with switch and duplex receptacle shall have its own circuit breaker.
8. The Integrated Pump Control System (IPCS) panel shall be provided under this Section and allow for at least 4 digital inputs, 4 digital outputs and 1 analog input beyond present needs. Nothing shall be mounted in space/locations reserved for future use. All vendor panels shall conform to the requirements of this Section.
9. Contractor shall be responsible for the detailed layout and design of the panels in accordance with standard practice and techniques. Cutouts and design are to be based on instrument Supplier's requirements. The actual layout shall be subject to approval by Engineer.
10. All panels are to be provided under this Section, unless specified otherwise.
11. The bottom 12-inches of free standing panels shall be free of all devices, including terminal strips, to provide ease of installation and testing.
12. No device shall be mounted less than 36-inches above the operating floor level, unless otherwise specified.
13. Panels shall be UL approved.

C. Identification Tags:

1. Provide laminated plastic nameplate for identification of panels. Use self-tapping stainless steel screw for fastening.
2. Panel identification nameplates to have 1/2-inch high letter engravings. Use self-tapping stainless steel screw for fastening.
3. Tag all internally mounted components.
4. Tag all electrical components and devices mounted within control panels with embossed plastic tape labels.
5. Numerically code terminals on terminal strips.
6. Color code and/or numerically code wiring as required by applicable standards. Wires shall be identified at each end with permanent number codes.

D. Construction Features:

1. Control panels NEMA 12 rated:

- a. Fabricate enclosures using minimum 14 gage steel for wall or frame mounted enclosures and minimum 12 gage for free standing enclosures. Steel shall be free of pitting and surface blemishes.
- b. Continuously weld all exterior seams and grind smooth. Also, surface grind complete removal of corrosion, burrs, sharp edges and mill scale.
- c. Reinforce sheet steel with steel angles where necessary to adequately support equipment and ensure rigidity and to preclude resonant vibrations.
- d. Panel shall be flat within 1/16-inch over a 24-inch by 24-inch area, or flat within 1/8-inch for a larger surface. Flatness shall be checked by using a 72-inch long straight edge. Out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.
- e. Use pan type construction for doors. Door widths shall not exceed 36 inches.
- f. Mount doors with full length heavy duty piano hinge with stainless steel hinge pins.
- g. Provide oil resistant gasket completely around each door or opening.
- h. Provide handle-operated, oil-tight, key-lockable three point stainless steel latching system with rollers on latch-rods for easy door closing.
- i. Use stainless steel fasteners throughout.
- j. Provide interior mounting panels and shelves constructed of minimum 12 gage steel with a white enamel finish.
- k. Provide steel print pocket with white enamel finish.
- l. Provide enclosure mounting supports as required for floor, frame, or wall mounting.
- m. Provide all holes and cutouts for installation of conduit and equipment. Cable and piping to enter the enclosure through the bottom unless otherwise noted. All conduit and piping openings and all conduits shall be sealed watertight.
- n. Completely clean all interior and exterior surfaces so they are free of corrosive residue, oil, grease and dirt. Zinc phosphatize for corrosion protection.
- o. One coat of primer shall be applied to all interior and exterior surfaces immediately after corrosion protection has been applied. Exterior surfaces shall then be given sufficient coats of primer surface, applied with sanding and cleaning between coats, until a Grade 1 finish can be produced on the finish coat.
- p. All interior surfaces shall be painted with 2 coats of semi-gloss white polyurethane enamel.
- q. All exterior surfaces shall be painted with a minimum of 3 finish coats of polyurethane enamel to ultimately produce a Grade 1 finish (super smooth; completely free of imperfections). Color to be selected by Engineer from complete selection of standard and custom color charts furnished by the manufacturer. Provide one extra quart of touch-up paint for each exterior finish color.

- r. Primer and finish paint shall be compatible and shall be a low VOC, high solids polyurethane enamel, Hi-Solids Polyurethane B65 W300 Series as manufactured by Sherwin-Williams, Inc. or equal.
- s. Provide one extra quart of touch-up paint for each exterior finish color.

E. Electrical Systems:

- 1. Control of Environment:
 - a. Provide 120 VAC strip heaters, as required, to maintain temperature 10°F above ambient for condensation prevention inside panels.
 - b. Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers, if required, to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure.
 - c. Provide documentation if any of the above are deemed unnecessary.
- 2. Power Source and Internal Power Distribution:
 - a. General: Panel power supply source type, voltage, and circuit number shall be as shown.
 - b. The panels shall be provided with an internal 120 VAC power distribution with separate circuit breakers, sized as required, to distribute power.
 - c. Power Supply: Protection of all 120 VAC instrument power supply lines shall be provided. Cabinet(s)/panel(s) and the like shall be protected by isolation transformers and surge suppressors.
- 3. Electrical Systems:
 - a. Internal wiring shall be Type MTW and THW stranded copper wire with thermoplastic insulation rated for 600 V at 85°C for single conductors, color coded and labeled with wire identification.
 - b. For DC panel signal wiring, use No. 18 minimum AWG shielded. For DC field signal wiring, terminal strips shall be capable of handling No. 12 wiring (minimum).
 - c. For AC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by NEC and NFPA Standards.
 - d. Separate and shield DC signal wiring from power and control wiring by a minimum of 6-inches.
 - e. Group or bundle parallel runs of wire using covered troughs. Maximum bundle size shall be 1-inch. Troughs shall have 40 percent spare capacity.
 - f. Install wire troughs along horizontal or vertical routes to present a neat appearance. Angled runs are not acceptable.
 - g. Adequately support and restrain all wiring runs to prevent sagging or other movement.
 - h. Terminate all field wiring using forked, insulated, crimp-on connectors (soldered type not acceptable) at 600 V rated barrier type terminal strips (mount on Din rails.) with screwed connections and permanently affixed numeric identifiers beside each connection. Identifiers to be self-stick,

plastic tape strips with permanent type, machine printed numbers. Provide Phoenix Contact or equal.

- i. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device.
 - j. All alarms generated external to the panel, spare alarm, and repeat contacts shall be wired out to terminal blocks.
 - k. For internal component-to-component wiring only, compression type terminal blocks (mounted on Din rails) are acceptable. Provide Phoenix Contact or equal.
 - l. Provide spare terminals equal in number to 20 percent of the terminals used for each type of wiring (e.g., DC signal and AC power).
 - m. Provide a separate terminal for grounding each shielded cable.
 - n. Use separate 5/16-inch diameter copper grounding studs for instrument signal cable shields and AC power.
 - o. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
 - p. When DC power and/or low voltage AC power is required, provide and install the necessary power supplies and transformers in the panel.
 - q. Provide circuit breakers to protect each circuit, with no more than six instruments on a single circuit.
 - r. Provide complete wiring diagram showing "as built" circuitry. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.
4. Surge Protection:
- a. General: Surge protection shall be provided to protect the electronic instrumentation and control system from surges propagating along the signal and power supply lines. The protection systems shall be such that the protection level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in suitable metallic cases, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and where practical each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate junction box (compatible with the area designation) coupled to the enclosure.
 - b. Provide formal lightning and surge protection devices for all signal lines, data highways, and power interfaces with IPCS's at remote Sites. For signal lines, data highways, power feeds to control panels and IPCS hardware, provide formal lightning and surge protection devices for all lines that originate or are routed outside a building on any part of the existing or proposed circuit, on in either buried or exposed raceways. Provide formal lightning and surge protection for all transmitters installed under this Contract in an outside environment.
 - c. Lightning and surge protection devices shall be standard manufactured products comprising multi-component networks or hybrid circuits. The

units shall incorporate gas filled discharge tubes, and zener diodes providing full protection from line to line and from line to ground. Units shall be din-rail mounted, rated for a 10KA maximum surge current and voltage suitable for the type of circuit being protected. Reaction time shall be in the order of nanoseconds.

- d. For signal lines provide Telematic DP/SP or SD Series, as manufactured by MTL, or equal.
 - e. For Data highways provide Telematic data communications protectors, as manufactured by MTL; or the Protector, as manufactured by ITD, or equal.
 - f. For outside transmitters provide Telematic Model TP48, as manufactured by MTL, or equivalent unit provided by the transmitter manufacturer.
 - g. For AC power lines provide Telematic Model MA 20, as manufactured by MTL, or equal.
- 5. Circuit Disconnect Switch: Refer to Section 26 00 05 Part 2.3 E.
 - 6. Grounding Systems: Refer to Section 26 00 05 Part 2.5.
 - 7. Transformer: Provide voltage transformer in each panel to step down incoming 3-phase power at each site to 120VAC control voltage.
- F. The following switches and indicating lights shall be provided on the control panel front.
- 1. Light: Pump #1 On.
 - 2. Light: Pump #2 On.
 - 3. Light: Panel power On.
 - 4. Switch: Duty Pump Selector #1/2.
 - 5. Switch: Primary / Backup Control

2.2 PUSHBUTTONS AND INDICATING LIGHTS

- A. General:
- 1. Pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type.
 - 2. Type:
 - a. Pushbuttons and Indicating Lights: Heavy duty, oil tight, round.
 - b. Common, push-to-test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton.
 - 3. Provide legend plate for indication of switch, pushbutton or light function.
 - 4. Mounting: Flush mounted on control panel front, unless otherwise noted.
 - 5. NEMA rated to match panel in which mounted.
- B. Pushbuttons:
- 1. Type: Provide momentary type pushbuttons required to perform intended functions specified and as shown.

- C. Indicating Lights:
1. Type: Light-Emitting Diode (LED).
 2. Lamps: 2.2 volt, long life (20,000 hours minimum).
 3. Common, push to test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton.
 4. Lens Colors:
 - a. Green for indication of "OPEN", "ON", "RUNNING".
 - b. Red for indication of "CLOSED", "OFF" (ready), "STOPPED".
 - c. Amber for indication of equipment malfunction process trouble and alarms (e.g., "HIGH LEVEL", "LOW LEVEL", etc.).
 - d. Blue for indication of electrical control power "ON".
- D. Products and Manufacturers: Provide one of the following:
1. Cutler-Hammer, Type E30.
 2. Allen Bradley, Series 800.
 3. Or equal.

2.3 CONTROL RELAYS

- A. Type: General purpose, plug-in type rated for continuous duty.
- B. Construction Features:
1. Coil Voltages: 24 VDC and 120 VAC, as required.
 2. Contacts:
 - a. Silver cadmium oxide, gold flashed except in cases for switching low energy circuits (less than 200 ma) where fine silver, gold flashed contacts shall be provided.
 - b. Rating: Compatible with AC or DC throughout voltage and current of devices simultaneously operated by contacts, but not less than the following:
 - 1) Silver cadmium oxide, gold flashed not less than five amperes resistive at 120 VAC or 28 VDC continuous.
 - 2) Fine silver, gold flashed not less than three amperes resistive at 120 VAC or 28 VDC continuous.
 3. Relays to have clear plastic dust cover.
 4. Relays shall be UL recognized.
- C. Products and Manufacturers: Provide one of the following:
1. Type R and/or Type K, as manufactured by Square D Company.
 2. Or equal.

2.4 INTEGRATED PUMP CONTROL SYSTEM

- A. General: The Integrated Pump Control System (IPCS) shall provide “Out of the box” control of a typical pump station, with an intuitive user-interface. The product shall come with pre-built configuration parameters which are selectable via the user interface and a PC configuration program, including but not limited to:
1. Setpoint adjustment for pump activation/deactivation and level alarms.
 2. Level sensing conductive probe.
 - a. Redundant level device handling.
 3. Selectable between fill / empty.
 4. Functionality for advanced pump control of up to 9 pumps including grouping and alternation.
 5. Station optimization including.
 - a. Max off time (odor reduction).
 - b. Maximum pumps to run (overload protection).
 - c. Maximum starts per hour (pump protection).
 - d. Inter-pump start and stop delays.
 - e. Maximum run time (turn off inefficient or partially blocked pumps).
 - f. Blocked pump detection.
 - g. Well washer controls.
 - h. Well clean out (periodic pump down to snore point).
 6. Multiple profiles of setpoints for spill management, off peak pumping, tariffing, etc.
 7. Datalogger.
 8. 3-phase supply monitoring and supply protection.
 - a. Under-voltage.
 - b. Over-voltage.
 - c. Phase fail.
 - d. Phase rotation.
 9. Monitoring of dc supply, battery voltage, and internal temperature.
 10. Motor protection & power module including:
 - a. Over- and under-current.
 - b. Ground/earth fault.
 - c. Insulation resistance testing for motor windings.
 - d. KVA, kW and power factor measurement.
 11. Calculated flow via draw down test.
 12. VFD control algorithm.
- B. Programmability:
1. The product shall have the option of IEC61131-3 PLC programming language to interact with (or replace) pump control module.

C. Input/Output points:

1. The I/O shall be expandable to many hundreds of I/O points per unit. Available I/O types shall include:
 - a. Digital inputs (voltage free input), also configurable as counters. The Digital Inputs shall be selectable as pump station specific I/O to reduce components in the panel and therefore save cost
 - b. Digital outputs (240V, 5A resistive).
 - c. Analog inputs (10bit).
 - d. Analog outputs (10bit).
2. Specific I/O for motor protection and monitoring: The product shall have sufficient I/O cards to minimise additional components which include:
 - a. Insulation resistance test (IRT) to 1000v.
 - b. 3-phase current monitoring, derived from CT's, 0.5% resolution.
 - c. 3-phase supply monitoring, 0.5% resolution. Up to 630V phase to phase.

D. Operator Interface Terminal:

1. The Pump Control System shall include a Operator Interface Terminal (OIT) for operations and configuration. The display shall provide status of most aspects of the pump station, control of pumps, resetting of faults, and configuration of parameters.
2. Status: The following parameters shall be displayed on the main screen:
 - a. Level.
 - b. Setpoints for alarms and pump start/stop.
 - c. Pump running/stopped.
 - d. Pump available.
 - e. 3-phase current for each motor (when motor protection card installed).
 - f. Pump fault.
 - g. 3-phase supply.
3. The screen shall have buttons to allow the user to access Faults, History, Information and Settings.
4. Information screens: The following parameters shall be available via a user key press from the main screen:
 - a. Hours Run accumulators for each pump & the station with the following comparisons.
 - 1) Last minutes run.
 - 2) This hour, last hour.
 - 3) Today, yesterday.
 - 4) This week, last week.
 - 5) Total hours run.
 - b. Starts accumulators for each pump & the station with the following comparisons.
 - 1) This hour, last hour.
 - 2) Today, yesterday.
 - 3) This week, last week.

- 4) Total hours run.
- c. Flow values, either derived from calculations or via a flowmeter, including inflow, pump flow rate, total volume.
- d. Any overflow information, including start time, duration, estimated volume.
- e. Insulation resistance value for each motor.
- f. Status of all I/O.

E. Control:

- 1. The following aspects of the system, as a minimum, shall be controlled intuitively through the OIT:
 - a. Pump mode, for each pump, between Auto/ Manual (Hand)/ Off.
 - b. Pump fault reset.
 - c. Level alarm reset.

F. Fault screen

- 1. The main screen shall include a Fault button which takes the user to a Fault screen and allows them to check all current and unacknowledged alarms.
- 2. The fault screen will detail the fault (e.g. contactor fail, seal fault, motor overtemp, over-current, etc) along with date/time each fault occurred and cleared.
- 3. A reset option for a fault will be presented to the user when faults can be acknowledged/reset.

G. History screen

- 1. The main screen shall include a History button which takes the user to a History screen and allows them to check all faults and events along with date/time. The History screen shall include the ability to filter to view only faults, only events, or narrow down to events relating to specific types of data.

H. Configuration

- 1. The user interface should allow intuitive configuration of the system, including as a minimum:
 - a. Set-points, including alarm and pump setpoints.
 - b. Enable/disable level alarms (so that for example, the low level alarm can be easily activated or deactivated).
 - c. Start, stop and alarm delays.
 - d. Alternation/ fixed sequence and grouping of pumps where necessary.
 - e. Configure I/O
 - 1) Assign primary/backup level to any input, e.g. 4-20mA or conductive probe.
 - 2) Assign pre-defined (or user-defined) faults, e.g. thermal overload, contactor fail, to any digital input.
 - 3) Zero and span analog inputs.
 - 4) Set Digital outputs to change state with any digital tag in the system.

- 5) Set Analog outputs to follow any analog value, including primary level.
- f. Fault configuration
 - 1) Set each fault as either: display only; manual/SCADA restart; auto restart with configurable restart time.
- g. Pump station optimisation parameters such as:
 - 1) Max off time (odor reduction)
 - 2) Maximum pumps to run (overload protection)
 - 3) Maximum starts per hour (pump protection)
 - 4) Inter-pump start and stop delays
 - 5) Maximum run time (turn off inefficient or partially blocked pumps)
 - 6) Well washer controls
 - 7) Well clean out (periodic pump down)
- h. Supply protection
 - 1) Under- and over-voltage alarm points
 - 2) DC-supply alarm point
- i. Motor protection parameters, including under- and over-current, ground/earth fault, phase fail.
- j. Communications ports, speeds and addresses.
2. The configuration of the unit will also allow the user to save a known good configuration on the unit itself that they can revert back to at any time.

I. Maintainability

1. The supplier shall also demonstrate that their system is maintainable in the future, especially that future applications do not incur any user-interface development cost on the customer. I.e., the user-interface shall be an integral part of the system.

J. Communications

1. Physical: The product shall include:
 - a. Ground/earth fault.
 - b. Ethernet 10Mbit/s.
 - c. Multiple RS232 ports to 115kBit/s.
2. Media: The system shall support a variety of communications networks including:
 - a. Private radio over RS232.
 - b. PSTN.
 - c. Wireless LAN.
 - d. Cellular voice and cellular data.
3. Protocols: The communications protocol will be an open protocol such as DNP3 which includes:
 - a. Change of state reporting.
 - b. Native date/time and quality stamps for each data point.
 - c. Event buffering for different classes of data.

d. Modbus master/slave protocol will also be provided.

K. Additional Features

1. Furnish an input that will accept a contact from the front-of-panel Primary / Backup Pump Control Switch. In the Primary position, the system shall operate off of the IPCS.
2. Furnish an output that will activate whenever the IPCS probe fails or any other condition occurs making the IPCS inoperable. This output shall trigger an automatic failover to the backup float control system.
3. In addition to standard monitoring and control functionality provided with the IPCS unit, furnish and configure the following minimum alarm points for the system:
 - a. Pump #1 Fail
 - b. Pump #2 Fail
 - c. Level High (probe)
 - d. Level High High (float)
 - e. Level Low (probe)
 - f. Level Low Low (float)
 - g. System in Backup (generate if Primary/Backup switch is in "Backup")
 - h. Power Failure
 - i. Communication Failure to Central Station

L. Manufactures;

1. MultiSmart Pump Controller by MultiTrode.
2. Or equal.

2.5 LEVEL CONDUCTIVE PROBE

- A. General: Remove existing Level Sensor as shown on Contract Drawings and replace with new Conductivity Probe as specified below.
- B. The probe shall be constructed from PVC 32mm tubing with molded sensor units at regular intervals along the probe. Each sensor unit will be PVC injected to prohibit ingress of moisture, and the sensor material will be Avesta SMO254 stainless steel.
- C. Probe Length: Probe shall be 1.5 m.
- D. Mounting:
 1. The probe will be mounted in a turbulent area of the wet well, suspended on its own cable and connected to a 6mm stainless steel hook which would hang from a 30mm stainless steel angle containing a polyurethane squeegee pad positioned in the opening into the wet well, so that the probe can be removed without entering the wet well. Provide an extended bracket mounting kit if required.
 2. The squeegee will have a 30mm hole and slot, enabling the probe to be pulled through and cleaned.

3. Probe cable shall be run in a separate conduit away from any high voltage cables.
- E. Sensors:
1. 10 sensors will be spaced along the length of the probe assembly, and each will be individually connected to a correspondingly numbered PVC/PVC .75mm flexible cable.
 2. The molded sensor unit will contain two Avesta sensors mounted on opposite sides of sensor unit. Each Avesta sensor will be 24mm high and no wider than 2 mm, and will protrude from the surface of the PVC.
 3. The probe shall be pressure injected with an epoxy resin to encapsulate all internal components and connections to form a rigid, homogenous unit.
 4. Each sensor unit containing the two Avesta sensors will be rotated 90 degrees to the previous sensor unit to eliminate tracking between sensors.
- F. Cable:
1. The cable will be encoded with number and text along the entirety of the cable and at intervals not greater than 200mm, for identification. This cable will be dark blue in color, with the cores light blue.
 2. The flexible cables shall be capable of supporting the weight of the probe and cable, without the need for additional support.
 3. The cable shall be secured to the top of the probe by a synthetic rubber compression fitting.
- G. Intrinsic Safety Barrier:
1. Provide intrinsic safety barrier in Pump Control Panel to separate Safe and Hazardous areas.
- H. Manufacturers:
1. MultiTrode Probe by MultiTrode;
 2. Approved Equal.

2.6 LEVEL SWITCH - FLOAT TYPE

- A. General: Float type Level Switches shall be capable of detecting fluid level and initiating a signal.
- B. Type: Direct acting float.
- C. Required Features:
1. Rated for NEMA 7 location, non-mercury.
 2. Sealed SPDT control switch (rotating steel ball type), rated for 5 amps at 120 volts. Ball shall be hermetically sealed in a steel capsule and epoxy sealed in the float housing.
 3. High impact, corrosion resistant, polypropylene float material.
 4. Heavy duty, flexible 18 gauge, 3 connector, neoprene jacketed cable with waterproof connection. Cable length as required.
 5. Not sensitive to rotation.
 6. Operating Temperature: Up to 140°F.
 7. Provide manufacturer-provided mounting option, utilizing either chain, cable weight or mounting bracket to suit installation.

- D. Product and Manufacturer: Provide one of the following:
1. Conery Mfg
 2. Flygt
 3. Or equal.

2.7 BACKUP LEVEL FLOAT CONTROL SYSTEM

- A. General: For Pump Station Control System, provide components to allow backup float control should the Integrated Pump Control System fail. The backup float control system shall consist of two floats and relays as required to perform the following actions:
1. Activation of the High High Level Float: If the High High Level Float activates, both pumps shall turn on. They shall keep pumping until the Low Low Level Float is activated.
 2. Activation of the Low Low Level Float: If the Low Low Level Float activates, both pumps shall shut off. They shall remain off until the High High Level Float is activated.
- B. Two conditions shall activate the backup system:
1. Failure of the IPCS probe or other input or output that renders the IPCS inoperable. This failure condition should cause the IPCS to generate an alarm that will be sent back to the central control station. This same alarm shall trigger an automatic failover to the backup float control system. This failover shall occur regardless of the position of the front-of-panel Primary / Backup Pump Control Switch.
 2. The front-of-panel Primary / Backup Pump Control Switch is manually placed in the "Backup" position. This will cause the backup float control system to assume control of the pump station.

2.8 AUTODIALER/MONITORING SYSTEM

- A. Coordinate with Owner and High School Contractor to ensure the pump station has communication connectivity as specified herein. The High School Contractor shall provide a CAT 5E analog phone line within the former Concession Stand (Storage Room) for connection to the SAS Alarm Panel provided by the Pump Station Contractor as specified herein.
- B. The Town has standardized pump station security with SAS Security Systems, Inc., 67 Pleasant Street, Watertown, MA. Contractor shall procure a new SAS Alarm Panel and Magnetic switch and installation/checkout services from SAS Alarms.
1. Contact: Mark Warner 617-924-2100
- C. Alarm panel shall be installed in the free standing enclosure located in the former Concession Stand (Storage Room).

- D. Provide all necessary conduit and wire to transmit alarms to central monitoring station through the communication line provided by the High School Contractor.
- E. Alarm panel shall have the ability to alarm 12 separate alarms (3 are spares), at a minimum, through a dry contact provided at the Integrated Pump Control System (IPCS). The following alarms will be provided as a minimum:
 - 1. Pump #1 Fail
 - 2. Pump #2 Fail
 - 3. Level High (probe)
 - 4. Level High High (float)
 - 5. Level Low (probe)
 - 6. Level Low Low (float)
 - 7. System in Backup (generate if Primary/Backup switch is in “Backup”)
 - 8. Power Failure
 - 9. Intrusion
- F. SAS Alarm panel shall include the installation of the following equipment provided by SAS Alarms:
 - 1. Magnetic Switches – for intrusion detection, on the valve vault and wet well hatches.
- G. Testing and Training
 - 1. Each point shall be tested by simulating the alarm and confirming dial-out.
 - 2. Owner’s personnel shall be instructed in the operation of the alarm system.

2.9 STARTER & CURRENT TRANSFORMER EQUIPMENT

- A. For each pump (total of 2), furnish:
 - 1. Magnetic Starters and Overload Relays: Refer to Section 26 00 05 Part 2.4. Size starters and relays for motor sizes shown on the drawings.
 - 2. Current Transformers: The Integrated Pump System Controller is designed to accept 3-phase or single phase current monitoring inputs, derived from CT’s, at 0.5% resolution. For each pump, furnish a current transformer sized for the current draw of the installed motor.
- B. For each panel (total of 1), furnish:
 - 1. Current Transformers: The Integrated Pump System Controller is designed to accept 3-phase or single phase power monitoring inputs. For each pump panel, furnish a power monitor suitable to respective voltage and current draw.

2.10 SPARE PARTS AND TEST EQUIPMENT

- A. Furnish and deliver the following spare parts and test equipment:
 - 1. One dozen each type of fuse, relay, input/output card power supply and lamp used.

2. One of each type of IPCS I/O Module or card used.
- B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the conditions under which the Work is to be installed and notify the engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Environmental Requirements:
1. No instrument shall be scheduled to be installed in an area where active construction can cause it to be damaged, unless Contractor provides adequate protection for said instrument.
 2. Miscellaneous hardware such as fittings, fasteners, screws, etc., shall be of Type 316 stainless steel and shall be suitable for the service intended. Pipe stands shall be provided for fastening of instruments, as required. They shall be pipe threaded with flange bolted to slab. Use carbon steel piping and flanges with epoxy painting conforming to the requirements of Section 09 91 00, Painting.
- B. Installation of Instrumentation:
1. Field mounted instruments shall be secured to stands or brackets in accordance with the manufacturer's recommendations and the approved Shop Drawings:
 2. Sensors shall be located generally where shown. Exact locations shall be confirmed in the field.
 3. All devices shall be installed such that they are readily accessible for service and do not cause potential tripping hazards.
- C. Material of Construction:
1. All cable, conduits, stands, supports and appurtenances shall be in accordance with manufacturer's recommendations, approved Shop Drawings and as shown.

3.3 PROCESS CONTROL DESCRIPTIONS

- A. The pump station control system shall be governed by the front-of-panel control switch: Primary or Backup.

1. BACKUP: In the “Backup” position, the system shall run off the floats and relay system. This system shall be used in emergency conditions only or for maintenance of the Primary control system.
2. PRIMARY: In the “Primary” position, the station can be operated in two modes: MANUAL and AUTOMATIC. Normal operation shall be in AUTOMATIC shall run as described below.
 - a. PRIMARY Manual Operation:
 - i. When the system is in manual mode (operator selectable through SCADA), each pump can be operated manually by placing the respective pump selector switch in HAND position on the Pump Control Screen. Once the HAND position is activated, the pump will run.
 - ii. The pump will be stop by depressing the “Stop” pushbutton on the Pump Control Screen.
 - iii. In the manual mode, the following interlocks will still remain operational and will shutdown the associated pump:
 1. Wet well low level.
 - b. PRIMARY Automatic Operation:
 - i. On rising level:
 1. When the level reach the “Lead pump to run” setpoint, after a field-adjustable time delay, the lead pump at the pump station will be call to run.
 2. If level continues to rising and reaches the “lag pump to run” setpoint, after a field-adjustable time delay, the lag pump at the pump station will be call to run
 3. If level continues to rising and reaches the “Wet well high level alarm” setpoint, after a field-adjustable time delay, an alarm will be displayed at the pump station and sent to the OWNERS On-Call personnel.
 - ii. When the level is falling
 1. If the level is falling and reaches the “lag pump to stop” setpoint, after a field-adjustable time delay, lag pump will shut off and the lead pump will continue running.
 2. If the level continues to fall and reaches the “lead pump to stop” setpoint, after a field-adjustable time delay, lead pump will shut off.
 3. If the level keep falling and reaches the “Wet well low level” setpoint, after a field-adjustable time delay, an alarm will be displayed at the pump station and sent to the OWNERS On-Call personnel. Both pumps shall not be allowed to run in any mode.

3.4 SYSTEM CHECKOUT

- A. Contractor shall furnish the following documentation to the Owner and Engineer as proof of readiness to begin checkout.

- 1 Completed calibration sheets for each installed instrument showing three point calibration, signed by a factory authorized serviceman.
- B. Contractor shall give written notification to the Owner and Engineer 14 days in advance of his readiness to begin system checkout and shall schedule system checkout on dates agreed on by the Owner and Engineer.
- C. Contractor shall have a written procedure for checkout. This written procedure shall be submitted to the Owner and Engineer for approval one month prior to the beginning of checkout. Contractor shall submit for approval a written procedure for commissioning to the Owner and Engineer at the same time.
- D. At the system checkout, Contractor shall have:
 - 1 Completed calibration sheets and procedures outlined in 3.4.A and 3.4.C.
 - 2 Test instruments, as required.
- E. It shall be Contractor's responsibility to record the results of systems checkout, effect whatever remedial action is required and arrange for re-inspection to review said remedial action, at no additional cost to the Owner.
- F. The completion of the above does not relieve Contractor from guarantees specified elsewhere in this Section.

3.5 SERVICES AND OPERATOR INSTRUCTION

- A. Contractor shall furnish all repairs or replacement of defective materials, equipment or workmanship, including with respect to equipment, the services of factory-trained servicemen.
- B. Contractor shall furnish, as part of this Contract, a one-year service contract covering parts and labor for the complete system. Service contract shall be with nearest "Authorized dealer/service representative" for on-Site service.
- C. In addition to the calibration required for checkout, provide two additional calibrations on all instruments. The first re-calibration shall be approximately six months after acceptance of the system, and the second shall be approximately eleven months after acceptance. As part of each calibration, provide two copies of the calibration sheets, a detailed list of deficiencies (should any be found), and a statement that the entire system is in proper operation and condition (except for the deficiencies noted) and shall be turned over to the Owner.

3.6 CALIBRATION, START-UP AND TESTING

- A. Field verify the calibration and performance of each instrument prior to start-up of the associated equipment, and document on a separate sheet for each.
 1. For each calibration certification sheet, include the following information:
 - a. Project name.

- b. Tag number and description.
 - c. Manufacturer.
 - d. Model and serial number.
 - e. Date, time and person who performed calibration.
 - f. Calibration data to include.
 - 1) Input, output, and error at 0, 25, 75, and 100 percent of span for analog instruments.
 - 2) Switch setting, contact action and deadband, if applicable, for discrete elements.
 - g. Space for comments.
 - h. Space for sign off and date.
2. System Check-Out and Start-Up Responsibilities:
- a. Contractor shall retain the services of the System Supplier to supervise and/or perform check-out and start-up of all system components. As part of these services, the System Supplier shall include for those equipment items not manufactured by him the services of an authorized manufacturer's representative to check the equipment installation and place the equipment in operation. The manufacturer's representative shall be thoroughly knowledgeable about the installation, operation and maintenance of the equipment.
 - b. Check and approve the installation of all instrumentation and control system components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.
 - c. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in the Work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.
 - d. Contractor shall provide all test equipment necessary to perform the testing during system checkout and start-up.
 - e. Contractor and System Supplier shall be responsible for initial operation of monitoring and control system and shall make any required changes, adjustment or replacements for operation, monitoring and control of the various processes and equipment necessary to perform the functions intended.
 - f. Contractor shall furnish to the Engineer certified calibration reports for field instruments and panel mounted devices specified in this Section as soon as calibration is completed.
 - g. Contractor shall furnish Engineer an Installation Inspection Report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by authorized representatives of both Contractor and the System Supplier.
 - h. Instrumentation and Control System Field Test:

- 1) Following the instrumentation and control system checkout and initial operation, Contractor, under the supervision of the System Supplier, shall perform a complete system test to verify that all equipment and programmed software is operating properly as a fully integrated system, and that the intended instrumentation and control functions are fully implemented and operational. Any defects or problems found during the test shall be corrected by Contractor and then retested to demonstrate proper operation.
- 2) Following demonstration of all system functions, the instrumentation and control system, including field sensors/transducers and instruments, and telemetry system shall be running and fully operational for a continuous 48 hour period.

3.7 INSTRUMENTATION AND CONTROL SYSTEM TRAINING

A. General:

1. Contractor shall retain the services of the System Supplier to provide operation and maintenance training for all instrumentation and control system equipment as specified herein.
2. For equipment items not manufactured by the System Supplier, he shall provide for on-Site training by an authorized representative of the equipment manufacturer as part of his services. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.
3. Contractor shall be responsible for all costs associated with training and shall provide all required materials, texts and required supplies.
4. Training shall conform to the requirements of Section 01 79 23, Instruction of Operations and Maintenance Personnel.

B. On-Site Training:

1. Primary Sensors/Transducers and Field Instruments:
 - a. Provide on-Site operation and maintenance training by System Supplier and the equipment manufacturer representatives prior to placing the equipment in continuous operation. The services of equipment manufacturer's representatives shall be provided for a minimum of 4 hours for each type of instrument.
2. Training shall accomplish the following:
 - a. Provide instruction covering use and operation of the equipment to perform the intended functions.
 - b. Provide instruction covering procedures for routine, preventive and troubleshooting maintenance, including equipment calibration.
 - c. Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall monitoring and control system.
 - d. Provide classes and field training as to how to change process control and alarm set points in all microprocessor based controllers and transmitters.

Maintenance personnel shall be trained to enter passwords, programming or configuration data, etc.

+ + END OF SECTION + +

SECTION 43 21 39.13

SUBMERSIBLE END SUCTION PUMPS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish and install extra-heavy duty submersible, end suction centrifugal pumps complete and operational with motors, control equipment, and accessories as shown and specified. Anchorage devices are included in the scope of this Section.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/HI 1.3, Standard for Centrifugal Pumps for Design and Application.
2. ANSI/HI 1.4, Standard for Centrifugal Pumps for Installation, Operation, and Maintenance.
3. ANSI/HI 1.6, Centrifugal Pump Tests.
4. ANSI/HI 9.1-9.5, Standard for Pumps – General Guidelines for Types, Definitions, Application, Sound Measurement, and Decontamination.
5. ANSI/HI 9.6.2, Standard for Centrifugal and Vertical Pumps for Allowable Nozzle Loads.
6. ANSI/HI 9.6.3, Standard for Centrifugal and Vertical Pumps for Allowable Operating Region.
7. ANSI/HI 9.6.5, Centrifugal and Vertical Pumps for Condition Monitoring
8. ANSI/HI 9.8, Pump Intake Design.
9. ANSI/HI 11.6, Submersible Pump Tests.
10. IEEE 85, Airborne Sound Measurements- Rotating Electrical Machinery.
11. NEMA MG-1, Motors and Generators.

1.3 QUALITY ASSURANCE

A. Supplier's Qualifications:

1. Supplier shall have a minimum of five years experience producing substantially similar equipment to that required for the Project and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section, regardless of component Supplier, from one submersible end suction pump manufacturer.
2. Submersible end suction pump Supplier shall review and approve or prepare all Shop Drawings and submittals for all components provided under this Section.
3. All components shall be suitable for specified service conditions and shall be integrated

into overall assembly by the submersible end suction pump Supplier.

C. Certifications

1. Certification of Compliance:

- a. Obtain certification of compliance with the Contract Documents from the submersible end suction pump manufacturer on manufacturer letterhead; certification by manufacturer's representatives is not acceptable.
- b. Certification shall be worded as follows:
“[Insert manufacturer's name] proposes to supply equipment included in Section 43 21 39.13 for the Town of Wilmington, MA, Jefferson Road Pump Station. We have examined the Contract Documents and understand of the Project requirements insofar as they affect the proposed products. We certify that the products will operate satisfactorily under the conditions described in the Contract Documents and that the products meet the requirements of the Contract Documents:

[List exceptions, deviations or changes necessary or recommended to accommodate the proposed products.]

We further certify that the products to be furnished shall conform to the standards listed in Section 43 21 39.13, Submersible End Suction Pumps, of the Contract Documents.

[List exceptions, deviations or changes necessary to accommodate the proposed products.]

Authorized Signature & Title

Date

- c. Provide justification for exceptions, variations, deviations, or changes. ENGINEER will determine whether exceptions, deviations, and changes are acceptable. Exceptions, variations, deviations, and changes may result in rejection of products.
- d. Provide certification before submitting Shop Drawings. Shop Drawings will not be reviewed prior to receipt of certification.
- e. Acceptance of certification shall not relieve CONTRACTOR of responsibility for adequacy of all products.
- f. Submittal of certification shall not relieve CONTRACTOR and Supplier of requirement to comply with submittal procedures in the Contract Documents.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Shop Drawings of pump controls specified in this Section, including panel layout and wiring diagrams.
2. Product Data:

- a. Manufacturer's literature, illustrations, specifications, paint certification (if required) and engineering data including; dimensions, materials, size, weight, and part lists for all components in sufficient detail to allow an item-by-item comparison with the Contract Documents.
 - b. Pump performance data and curves showing overall pump efficiencies, required net positive suction head (NPSH), allowable suction lift, flow rate, head, brake horsepower, motor horsepower, speed, and shut-off head. Curves shall range from minimum flow to shut-off head at for full speed and all speed curves specified.
 - c. Motor Data: Furnish certified motor data sheet for previously tested, electrically duplicate motor to that specified, including the following:
 - 1) Speed-torque relationship.
 - 2) Efficiency at 1/2, 3/4, and full load.
 - 3) Power factor at 1/2, 3/4, and full load.
 - 4) Slip at full load.
 - 5) Running light, full load and locked rotor current.
 - 6) Temperature rises and results of dielectric tests.
 - 7) Bearing type and lubrication medium
 - 8) Insulation class and temperature ratings.
 3. Testing Plans, Procedures, and Testing Limitations:
 - a. Provide pump Supplier's proposed shop testing plan, including complete list of testing facility limitations.
 - b. Provide proposed field testing plan.
- B. Informational Submittals:
1. Certificates: Provide certificate of compliance as specified in this Section.
 2. Manufacturer Instructions:
 - a. Provide Supplier's instructions for handling and installing products.
 - b. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.
 3. Field Quality Control Submittals:
 - a. Results of field testing.
 - b. Submit a written report of the results of each visit to Site by pump manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.
 4. Qualifications Statements:
 - a. Provide Supplier's qualifications as specified in Quality Assurance article of this specification.
- C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Manuals:
 - a. Submit complete operation and maintenance manuals, including shop and field test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Provide operation and maintenance manuals per Section 01 78 23, Operations and Maintenance Data.
 2. Warranty Documentation:

- a. Manufacturer's Standard Warranty.
- b. Special Warranty, as specified.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Prior to shipping, completely inspect products to assure that components are complete and comply with all requirements. Box or crate products as required to prevent damage during shipment. Protect machined surfaces and matching connections to prevent damage.
2. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
3. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
4. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:

1. Keep all products off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion and deterioration.
2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

1.6 WARRANTY

A. Special Warranty on Submersible End Suction Pumps:

1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, at OWNER's option, remove, or replace materials or equipment specified in this Section and found to be defective for a period of one year after date of Substantial Completion. Replacement value of items regularly subject to wear in normal use, such as seals, bearings, impellers, rotors, and stator, may be prorated

PART 2 – PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. System Description:

1. Pumps shall be submersible end suction centrifugal slide rail-mounted type. Pumps shall be constructed for operation under complete submersion, partial submersion, and dry conditions. Each pump shall be suitable for its intended service.
2. Pumps shall comply with ANSI/HI 1.3, ANSI/HI 9.6.3, and ANSI/HI 9.8.

B. Design and Performance Criteria: Each pump shall comply with the following

Design Conditions	Pump
Location:	Jefferson Road
Use:	Continuous
Fluid Pumped:	Raw Sewage
Number Required:	2
Discharge Dia. (in.):	6
Impeller Diameter (in):	7.3
* Design Flow (gpm)	262
* Design Total Head (ft)	52
Minimum Pump Efficiency,	56
Head at Zero Flow (ft)	102
** Motor Size (hp) and Maximum Speed (rpm):	7.5/1800
Motor Voltage/Phase/Hertz	460/3/60

Notes:

* At maximum speed.

** At all points on pump curve, pump horsepower shall not exceed specified motor horsepower.

2.2 MANUFACTURERS

A. Products and Manufacturers: Provide products of one of the following:

1. Flygt Corporation, Model NP3102 SH 3~Adaptive 256.
2. Barnes, Series 4XSHD.
3. Or equal.

2.3 DETAILS OF CONSTRUCTION

A. Pump Materials and Construction (Extra Heavy Duty):

1. General:
 - a. Construct pumps for fluid service specified.
 - b. Construct pumps and appurtenances, including cable, for continuous submerged operation without leakage in specified depth of water.
2. Pump Body and Externals:
 - a. Stator casing, oil casing, sliding bracket, volute, and impeller shall be close-grained, gray cast iron.
 - b. Provide lifting eye or stainless steel lifting bail on each pump capable of bearing weight of pump during removal and installation.
 - c. Securely fasten to each pump brass or stainless steel nameplate engraved with pump manufacturer's name, pump model and serial number, pump's rated flow and head, speed, and other pertinent data.
 - d. External Hardware: Bolts, nuts, and cap screws shall have hexagonal heads and be Type 316 stainless steel.
3. Impeller shall be gray cast iron, ASTM A-48 Class 35B, dynamically balanced, semi-

open, multi-vane, back swept, screw-shaped, non-clog design. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw.

4. Shaft: Stainless steel.
5. Seals: Single-mechanical upper seal and single-mechanical lower seal..
6. Bearings: Anti-friction, grease- or oil-lubricated with minimum B-10 life of 100,000 hours.

B. Motors for Extra Heavy Duty Pumps:

1. Motor shall be stainless steel solid shaft, ball bearing type. Motor casing shall be air-filled or oil-filled and watertight with moisture resistant Class H, 180 degrees C insulation. Voltage, phase, and frequency shall be as specified in "Design and Performance Criteria" in this Section.
2. Motor shall be NEMA Design B, normal starting torque, normal slip, squirrel cage induction type, continuous duty.
3. Isolate cable entry with internal terminal board.
4. Motor shall be capable of continuous operation in a non-submerged condition without damage. Pump and motor shall be capable of intermittent operation up to 15 starts per hour in non-submerged condition, without damage.
5. Motor shall be non-overloading for entire pump operating curve, shall have 1.15 service factor, and provide full rated horsepower with a voltage unbalance of three percent. Motors for use with variable frequency drives shall have insulation system constructed in compliance with or exceeding NEMA MG-1 Part 31.
6. Motor cable shall be suitable for submersible duty and be so indicated by code or legend permanently applied to cable.
7. Motor thrust bearings shall be capable of continuous thrust loads under all conditions of pump operation from zero head to shut-off. Anti-friction bearings shall be rated for B-10 life of 100,000 hours.
8. Motor Sensors:
 - a. For supplemental motor protection, each pump motor shall be equipped with at least three thermal sensors embedded in stator windings and wired to the associated control panel.
 - b. Provide leakage sensor in lower part of stator housing, wired to leads in motor's watertight terminal chamber.
 - c. Motor sensor cables shall be provided with an electromagnetic compatibility filter in the motor terminal box.
9. Motors shall have built-in thermal overload protection.

C. Accessories: Provide the following for each pump unless otherwise specified.

1. Anchor bolts and anchorage devices per Section 05 05 33, Anchor Systems.
2. Discharge Elbow: Conforming to Section 40 05 19, Ductile Iron Process Pipe.
3. Pump Removal System:
 - a. Pumps shall automatically and positively mate with associated discharge piping when pump is lowered into place. Pumps shall be removable for inspection or service without requiring removal of bolts, nuts, or other fastenings.
 - b. Provide for each pump guide rails of extra-heavy Type 304 stainless steel.
 - c. Provide each pump with chain of high-tensile strength, proof-tested, stainless steel

chain. Provide sufficient length of chain for removing pump from wet well without requiring supplementary cords, cables, or chains. Connect chain to lifting eye or bail on pump with stainless steel, adjustable closure D-ring or similar hardware acceptable to ENGINEER. On opposite end of chain from pump, provide stainless steel, adjustable closure D-ring or similar hardware acceptable to ENGINEER. Chain and hardware shall be sized to sustain all tensile stresses during lifting of pump. For each pump, provide one suitable hook or bracket on wall just below operating floor to which chain will be hooked when not used for hoisting.

- d. Pump manufacturer shall provide guide rail brackets, self sealing flange, stainless steel cable or chain (as applicable) holder with support grip, and other items necessary for complete guide-in, pump removal system.
4. Provide one portable pump hoist for each set of pumps furnished. Hoist shall have capacity sufficient to hoist one associated pump at a time, and shall include suitable wall socket.
5. Access Frames and Covers: Provide with each pump rectangular 6061 T6 aluminum alloy access frame and cover complete with heavy-duty stainless-steel hinges and locking hasp. Cover shall be capable of AASHTO H-20 live loading and have safety checked or abrasive, non-slip surface. Opening sizes shall be as shown on the Drawings. Access frames and covers shall conform to Section 05 54 63, Floor Access Hatch Covers.

2.4 CONTROLS

- A. Provide pumps with controls in accordance with Section 40 60 05, Instrumentation and Control for Process Systems.

2.5 PRESSURE GAUGES

- A. Bourdon Tube Pressure Element Type, Liquid Filled Gauges (for pressure ranges of 15 psi and greater and vacuum ranges to 30-inch Hg):
 1. Performance Requirements:
 - a. Accuracy: ± 0.5 percent of span (ANSI B40.1 Grade 2A).
- B. Construction Features:
 1. Case:
 - a. Solid front design constructed of glass filled polyester.
 - b. Color: Black.
 2. Ring: Threaded, glass filled polyester.
 3. Full blowout back.
 4. Window: Glass.
 5. Dial: White with black marking; 270 degree scale.
 6. Bourdon Tube and Socket: Type 316 Stainless Steel, heliarc welded, unless otherwise specified in the Field Instrument List.
 7. Movement: Cam and roller movement, 300 series stainless steel.
 8. Size: 4-1/2-inch.
 9. Connection: 1/4-inch male NPT back or bottom, as required.
 10. Mounting: Stem, flush panel or wall mounting, as required.
 11. Adjustable pointer.

12. Externally accessible zero adjustment.
 13. Built-in overload and underload movement stops.
 14. Pressure Snubber: Sintered stainless steel snubber threaded into gauge socket or in external stainless-steel housing with 1/4-inch NPT male and female connections.
 15. Filling Liquid: Silicone oil.
 16. Process Isolation: Provide gauge cocks or ball valves for process isolation.
 17. Provide diaphragm seal, except for air or potable water applications.
- C. Products and Manufactures: Provide one of the following:
1. Series 900, as manufactured by Helicoid.
 2. Or equal.

2.6 FINISHING

- A. Shop Finishing:
1. At the factory, pumps, motors, and appurtenances shall receive manufacturer's standard finish paint system suitable for service conditions specified in this Section. Finish color of pumps in dry pit service shall be same as color of related process piping.
 2. Coat machined, polished, and non-ferrous surfaces with corrosion prevention compound.
- B. Field painting shall conform to Section 09 91 00, Painting. Touch-up of factory-applied finishes shall be compatible with factory-applied finish and specified service conditions. Dry pit pumps with factory-applied finish that does not match color of related piping shall be field-painted to match color of related process piping.

2.7 SOURCE QUALITY CONTROL

- A. Pump Shop Tests: Shop Test all pumps provided under this Section.
1. Hydrostatically test pump bodies per ANSI/HI 1.6, to the greater of: twice specified pump discharge head at Design Point No. 1, or 1.5 times pump's shutoff head.
 2. Performance Test: Operate each pump assembly from zero to maximum capacity as shown on pump curve in approved Shop Drawing. Present results of test in plot of test curves showing head, flow, horsepower, efficiency, and current. Obtain data at minimum of five evenly spaced capacity points along curve including shut-off, design points, and minimum head for which pump is designed to operate. Conduct tests per ANSI/HI 1.6 and ANSI/HI 11.6.
 3. Each test shall be witnessed by professional engineer registered and licensed in the state where pumps are fabricated, who may be an employee of pump manufacturer. Professional engineer shall sign, date, and seal all copies of test results and shall certify that hydrostatic tests were performed. Professional engineer's name and registration number shall be clearly legible on the seal.
 4. Do not ship products from factory until ENGINEER has accepted test results.
- B. Motor Tests and Data:
1. For each motor, provide an inspection report for job motor or a previously tested electrically duplicate motor. Provide the following minimum data:
 - a. Running light current.
 - b. Locked rotor current.

- c. Winding resistance measurement.
- d. High potential test.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install products in conformance with manufacturer's instructions and recommendations, and the Contract Documents.
- B. Anchorages:
 - 1. Install pumps on concrete bases. Provide anchorages in new or existing concrete, as applicable, per equipment manufacturer's recommendations and the Contract Documents. Equipment manufacturer shall supply templates to facilitate location of anchorages for equipment. CONTRACTOR shall coordinate with Supplier to assure timely receipt of required templates.
 - 2. For pumps installed in dry pit applications, install grout between pump and concrete base per recommendations of pump manufacturer.
- C. General:
 - 1. Conform to ANSI/HI 1.4.
 - 2. Perform all fitting required for installation. Set products accurately in location, alignment, and elevation, plumb and true.
 - 3. Provide utility connections per the Contract Documents. Support piping and valves independent of pump. Verify that utilities and valves are tested and operational before placing equipment into operation. When pumps are connected to piping with rigid hardware, connection of discharge nozzle to piping shall conform to ANSI/HI 9.6.2.
 - 4. Align and adjust products and piping in presence of ENGINEER
 - 5. Provide for initial operation lubricants recommended by equipment manufacturer
 - 6. Prior to energizing motor driven equipment, rotate drive motor by an external source to demonstrate free operation of mechanical parts. Do not energize equipment until safety devices are installed, connected, and functional.
- D. Field painting shall conform to Section 09 91 00, Painting.
- E. Conform to Section 01 75 11, Checkout and Startup Procedures.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:

1. Following installation, CONTRACTOR and qualified field service representative of equipment manufacturer shall conduct operating tests of all equipment, functions, and controls at Site, in presence of ENGINEER. Should tests result in malfunction, make necessary repairs, revisions, and adjustments and restart test from beginning. Repeat tests and repairs, revisions, and adjustments until, in opinion of ENGINEER, installation is complete and equipment is functioning properly and accurately, and is ready for permanent operation.
 2. Field Operating Test:
 - a. Set level floats at required depths.
 - b. Field test equipment and its controls in local mode, followed by demonstrating proper operation and controls in automatic mode. Demonstrate that each part and component of system individually and all parts and components together function properly in manner intended. Total duration of testing shall be four hours, continuous and uninterrupted, in automatic mode. All testing equipment and manpower shall be by CONTRACTOR.
 - c. Demonstrate operation of all alarms (local and remote) as applicable.
 - d. Conform to applicable provisions of ANSI/HI 9.6.5.
- B. Manufacturer's Services: Provide qualified, factory-trained serviceman to perform the following:
1. Instruct CONTRACTOR in installing equipment.
 2. Inspect and adjust equipment after installation and ensure proper operation.
 3. Test-operate the products in presence of ENGINEER and verify that equipment conforms to Contract Documents.
 4. Instruct OWNER's personnel in operating and maintaining the products.
 5. Manufacturer's representative shall make a minimum of three visits, with a minimum of four hours onsite for each visit. First visit shall be for assistance in installing equipment; second visit shall be for checking completed installation and start-up of system; third visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.
 6. Training: Furnish services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of products. Training requirements, duration of instruction, and other qualifications shall be per Section 01 79 23, Instruction of Operations and Maintenance Personnel.
 7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to Site shall be included in the Contract Price.

+ + END OF SECTION + +



CHARLES D. BAKER
Governor

KARYN E. POLITO
Lt. Governor

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
DEPARTMENT OF LABOR STANDARDS

Prevailing Wage Rates

**As determined by the Director under the provisions of the
Massachusetts General Laws, Chapter 149, Sections 26 to 27H**

ROSALIN ACOSTA
Secretary
MICHAEL FLANAGAN
Director

Awarding Authority: Town of Wilmington
Contract Number: **City/Town:** WILMINGTON
Description of Work: Construction of 3,490 feet of gravity sewer main, a duplex submersible sanitary pumping station, and 4,150 feet of force main to provide sanitary service along Middlesex Avenue and Jefferson Road.
Job Location: Middlesex Ave (Rt 62), Jefferson Rd, Wilmington

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 criminal penalties.
-

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>	06/01/2021	\$35.95	\$12.91	\$14.82	\$0.00	\$63.68
	08/01/2021	\$35.95	\$13.41	\$14.82	\$0.00	\$64.18
	12/01/2021	\$35.95	\$13.41	\$16.01	\$0.00	\$65.37
(3 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2021	\$36.02	\$12.91	\$14.82	\$0.00	\$63.75
	08/01/2021	\$36.02	\$13.41	\$14.82	\$0.00	\$64.25
	12/01/2021	\$36.02	\$13.41	\$16.01	\$0.00	\$65.44
(4 & 5 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2021	\$36.14	\$12.91	\$14.82	\$0.00	\$63.87
	08/01/2021	\$36.14	\$13.41	\$14.82	\$0.00	\$64.37
	12/01/2021	\$36.14	\$13.41	\$16.01	\$0.00	\$65.56
ADS/SUBMERSIBLE PILOT <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$103.05	\$9.40	\$23.12	\$0.00	\$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.75	\$8.60	\$16.64	\$0.00	\$60.99
	12/01/2021	\$36.66	\$8.60	\$16.64	\$0.00	\$61.90
	06/01/2022	\$37.56	\$8.60	\$16.64	\$0.00	\$62.80
	12/01/2022	\$38.41	\$8.60	\$16.64	\$0.00	\$63.65
	06/01/2023	\$39.31	\$8.60	\$16.64	\$0.00	\$64.55
	12/01/2023	\$40.21	\$8.60	\$16.64	\$0.00	\$65.45
For apprentice rates see "Apprentice- LABORER"						
ASBESTOS REMOVER - PIPE / MECH. EQUIPT. <i>HEAT & FROST INSULATORS LOCAL 6 (BOSTON)</i>	12/01/2020	\$38.10	\$12.80	\$9.45	\$0.00	\$60.35
ASPHALT RAKER <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.73	\$13.75	\$15.80	\$0.00	\$80.28
	12/01/2021	\$51.88	\$13.75	\$15.80	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.73	\$13.75	\$15.80	\$0.00	\$80.28
	12/01/2021	\$51.88	\$13.75	\$15.80	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BARCO-TYPE JUMPING TAMPER <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
BLOCK PAVER, RAMMER / CURB SETTER <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.75	\$8.60	\$16.64	\$0.00	\$60.99
	12/01/2021	\$36.66	\$8.60	\$16.64	\$0.00	\$61.90
	06/01/2022	\$37.56	\$8.60	\$16.64	\$0.00	\$62.80
	12/01/2022	\$38.41	\$8.60	\$16.64	\$0.00	\$63.65
	06/01/2023	\$39.31	\$8.60	\$16.64	\$0.00	\$64.55
	12/01/2023	\$40.21	\$8.60	\$16.64	\$0.00	\$65.45
For apprentice rates see "Apprentice- LABORER"						
BOILER MAKER <i>BOILERMAKERS LOCAL 29</i>	01/01/2020	\$46.10	\$7.07	\$17.98	\$0.00	\$71.15

Apprentice - BOILERMAKER - Local 29

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	\$29.97	\$7.07	\$11.69	\$0.00	\$48.73
2	65	\$29.97	\$7.07	\$11.69	\$0.00	\$48.73
3	70	\$32.27	\$7.07	\$12.59	\$0.00	\$51.93
4	75	\$34.58	\$7.07	\$13.49	\$0.00	\$55.14
5	80	\$36.88	\$7.07	\$14.38	\$0.00	\$58.33
6	85	\$39.19	\$7.07	\$15.29	\$0.00	\$61.55
7	90	\$41.49	\$7.07	\$16.18	\$0.00	\$64.74
8	95	\$43.80	\$7.07	\$17.09	\$0.00	\$67.96

Notes:

Apprentice to Journeyworker Ratio:1:4

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING) <i>BRICKLAYERS LOCAL 3 (LOWELL)</i>	02/01/2021	\$53.61	\$11.39	\$21.41	\$0.00	\$86.41
	08/01/2021	\$55.01	\$11.39	\$21.57	\$0.00	\$87.97
	02/01/2022	\$55.59	\$11.39	\$21.57	\$0.00	\$88.55

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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Apprentice - BRICK/PLASTER/CEMENT MASON - Local 3 Lowell

Effective Date - 02/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.81	\$11.39	\$21.41	\$0.00	\$59.61
2	60	\$32.17	\$11.39	\$21.41	\$0.00	\$64.97
3	70	\$37.53	\$11.39	\$21.41	\$0.00	\$70.33
4	80	\$42.89	\$11.39	\$21.41	\$0.00	\$75.69
5	90	\$48.25	\$11.39	\$21.41	\$0.00	\$81.05

Effective Date - 08/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.51	\$11.39	\$21.57	\$0.00	\$60.47
2	60	\$33.01	\$11.39	\$21.57	\$0.00	\$65.97
3	70	\$38.51	\$11.39	\$21.57	\$0.00	\$71.47
4	80	\$44.01	\$11.39	\$21.57	\$0.00	\$76.97
5	90	\$49.51	\$11.39	\$21.57	\$0.00	\$82.47

Notes:

Apprentice to Journeyworker Ratio:1:5

BULLDOZER/GRADER/SCRAPER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
For apprentice rates see "Apprentice- OPERATING ENGINEERS"	12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88
CAISSON & UNDERPINNING BOTTOM MAN <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2021	\$41.82	\$8.60	\$17.72	\$0.00	\$68.14
For apprentice rates see "Apprentice- LABORER"	12/01/2021	\$42.83	\$8.60	\$17.72	\$0.00	\$69.15
CAISSON & UNDERPINNING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2021	\$40.67	\$8.60	\$17.72	\$0.00	\$66.99
For apprentice rates see "Apprentice- LABORER"	12/01/2021	\$41.68	\$8.60	\$17.72	\$0.00	\$68.00
CAISSON & UNDERPINNING TOP MAN <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2021	\$40.67	\$8.60	\$17.72	\$0.00	\$66.99
For apprentice rates see "Apprentice- LABORER"	12/01/2021	\$41.68	\$8.60	\$17.72	\$0.00	\$68.00
CARBIDE CORE DRILL OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
CARPENTER <i>CARPENTERS -ZONE 2 (Eastern Massachusetts)</i>	03/01/2021	\$43.54	\$9.40	\$18.95	\$0.00	\$71.89
	09/01/2021	\$44.19	\$9.40	\$18.95	\$0.00	\$72.54
	03/01/2022	\$44.79	\$9.40	\$18.95	\$0.00	\$73.14
	09/01/2022	\$45.44	\$9.40	\$18.95	\$0.00	\$73.79
	03/01/2023	\$46.04	\$9.40	\$18.95	\$0.00	\$74.39

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - CARPENTER - Zone 2 Eastern MA

Effective Date - 03/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.77	\$9.40	\$1.73	\$0.00	\$32.90
2	60	\$26.12	\$9.40	\$1.73	\$0.00	\$37.25
3	70	\$30.48	\$9.40	\$13.76	\$0.00	\$53.64
4	75	\$32.66	\$9.40	\$13.76	\$0.00	\$55.82
5	80	\$34.83	\$9.40	\$15.49	\$0.00	\$59.72
6	80	\$34.83	\$9.40	\$15.49	\$0.00	\$59.72
7	90	\$39.19	\$9.40	\$17.22	\$0.00	\$65.81
8	90	\$39.19	\$9.40	\$17.22	\$0.00	\$65.81

Effective Date - 09/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.10	\$9.40	\$1.73	\$0.00	\$33.23
2	60	\$26.51	\$9.40	\$1.73	\$0.00	\$37.64
3	70	\$30.93	\$9.40	\$13.76	\$0.00	\$54.09
4	75	\$33.14	\$9.40	\$13.76	\$0.00	\$56.30
5	80	\$35.35	\$9.40	\$15.49	\$0.00	\$60.24
6	80	\$35.35	\$9.40	\$15.49	\$0.00	\$60.24
7	90	\$39.77	\$9.40	\$17.22	\$0.00	\$66.39
8	90	\$39.77	\$9.40	\$17.22	\$0.00	\$66.39

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 \$30.72/ 3&4 \$36.75/ 5&6 \$55.37/ 7&8 \$61.45

Apprentice to Journeyworker Ratio:1:5

CARPENTER WOOD FRAME	04/01/2021	\$23.16	\$7.21	\$4.80	\$0.00	\$35.17
CARPENTERS-ZONE 3 (Wood Frame)	04/01/2022	\$23.66	\$7.21	\$4.80	\$0.00	\$35.67
	04/01/2023	\$24.16	\$7.21	\$4.80	\$0.00	\$36.17

All Aspects of New Wood Frame Work

Apprentice - CARPENTER (Wood Frame) - Zone 3**Effective Date - 04/01/2021**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$13.90	\$7.21	\$0.00	\$0.00	\$21.11
2	60	\$13.90	\$7.21	\$0.00	\$0.00	\$21.11
3	65	\$15.05	\$7.21	\$0.00	\$0.00	\$22.26
4	70	\$16.21	\$7.21	\$0.00	\$0.00	\$23.42
5	75	\$17.37	\$7.21	\$3.80	\$0.00	\$28.38
6	80	\$18.53	\$7.21	\$3.80	\$0.00	\$29.54
7	85	\$19.69	\$7.21	\$3.80	\$0.00	\$30.70
8	90	\$20.84	\$7.21	\$3.80	\$0.00	\$31.85

Effective Date - 04/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$14.20	\$7.21	\$0.00	\$0.00	\$21.41
2	60	\$14.20	\$7.21	\$0.00	\$0.00	\$21.41
3	65	\$15.38	\$7.21	\$0.00	\$0.00	\$22.59
4	70	\$16.56	\$7.21	\$0.00	\$0.00	\$23.77
5	75	\$17.75	\$7.21	\$3.80	\$0.00	\$28.76
6	80	\$18.93	\$7.21	\$3.80	\$0.00	\$29.94
7	85	\$20.11	\$7.21	\$3.80	\$0.00	\$31.12
8	90	\$21.29	\$7.21	\$3.80	\$0.00	\$32.30

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
 Step 1&2 \$17.63/ 3&4 \$19.95/ 5&6 \$27.22/ 7&8 \$29.54

Apprentice to Journeyworker Ratio:1:5

CEMENT MASONRY/PLASTERING

01/01/2020

\$45.23

\$12.75

\$22.41

\$0.62

\$81.01

BRICKLAYERS LOCAL 3 (LOWELL)

Apprentice - CEMENT MASONRY/PLASTERING - Lowell**Effective Date - 01/01/2020**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.62	\$12.75	\$15.41	\$0.00	\$50.78
2	60	\$27.14	\$12.75	\$17.41	\$0.62	\$57.92
3	65	\$29.40	\$12.75	\$18.41	\$0.62	\$61.18
4	70	\$31.66	\$12.75	\$19.41	\$0.62	\$64.44
5	75	\$33.92	\$12.75	\$20.41	\$0.62	\$67.70
6	80	\$36.18	\$12.75	\$21.41	\$0.62	\$70.96
7	90	\$40.71	\$12.75	\$22.41	\$0.62	\$76.49

Notes:

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

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CHAIN SAW OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$51.73	\$13.75	\$15.80	\$0.00	\$81.28
	12/01/2021	\$52.88	\$13.75	\$15.80	\$0.00	\$82.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
COMPRESSOR OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$33.40	\$13.75	\$15.80	\$0.00	\$62.95
	12/01/2021	\$34.19	\$13.75	\$15.80	\$0.00	\$63.74
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DELEADER (BRIDGE) <i>PAINTERS LOCAL 35 - ZONE 2</i>	01/01/2021	\$52.06	\$8.25	\$22.75	\$0.00	\$83.06

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.03	\$8.25	\$0.00	\$0.00	\$34.28
2	55	\$28.63	\$8.25	\$6.16	\$0.00	\$43.04
3	60	\$31.24	\$8.25	\$6.72	\$0.00	\$46.21
4	65	\$33.84	\$8.25	\$7.28	\$0.00	\$49.37
5	70	\$36.44	\$8.25	\$19.39	\$0.00	\$64.08
6	75	\$39.05	\$8.25	\$19.95	\$0.00	\$67.25
7	80	\$41.65	\$8.25	\$20.51	\$0.00	\$70.41
8	90	\$46.85	\$8.25	\$21.63	\$0.00	\$76.73

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

DEMO: ADZEMAN <i>LABORERS - ZONE 2</i>	06/01/2021	\$40.82	\$8.60	\$17.57	\$0.00	\$66.99
	12/01/2021	\$41.83	\$8.60	\$17.57	\$0.00	\$68.00
	06/01/2022	\$42.83	\$8.60	\$17.57	\$0.00	\$69.00
	12/01/2022	\$43.83	\$8.60	\$17.57	\$0.00	\$70.00
	06/01/2023	\$44.83	\$8.60	\$17.57	\$0.00	\$71.00
	12/01/2023	\$46.08	\$8.60	\$17.57	\$0.00	\$72.25
For apprentice rates see "Apprentice- LABORER"						
DEMO: BACKHOE/LOADER/HAMMER OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2021	\$41.82	\$8.60	\$17.57	\$0.00	\$67.99
	12/01/2021	\$42.83	\$8.60	\$17.57	\$0.00	\$69.00
	06/01/2022	\$43.83	\$8.60	\$17.57	\$0.00	\$70.00
	12/01/2022	\$44.83	\$8.60	\$17.57	\$0.00	\$71.00
	06/01/2023	\$45.83	\$8.60	\$17.57	\$0.00	\$72.00
	12/01/2023	\$47.08	\$8.60	\$17.57	\$0.00	\$73.25
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DEMO: BURNERS <i>LABORERS - ZONE 2</i>	06/01/2021	\$41.57	\$8.60	\$17.57	\$0.00	\$67.74
	12/01/2021	\$42.58	\$8.60	\$17.57	\$0.00	\$68.75
	06/01/2022	\$43.58	\$8.60	\$17.57	\$0.00	\$69.75
	12/01/2022	\$44.58	\$8.60	\$17.57	\$0.00	\$70.75
	06/01/2023	\$45.58	\$8.60	\$17.57	\$0.00	\$71.75
	12/01/2023	\$46.83	\$8.60	\$17.57	\$0.00	\$73.00
For apprentice rates see "Apprentice- LABORER"						
DEMO: CONCRETE CUTTER/SAWYER <i>LABORERS - ZONE 2</i>	06/01/2021	\$41.82	\$8.60	\$17.57	\$0.00	\$67.99
	12/01/2021	\$42.83	\$8.60	\$17.57	\$0.00	\$69.00
	06/01/2022	\$43.83	\$8.60	\$17.57	\$0.00	\$70.00
	12/01/2022	\$44.83	\$8.60	\$17.57	\$0.00	\$71.00
	06/01/2023	\$45.83	\$8.60	\$17.57	\$0.00	\$72.00
	12/01/2023	\$47.08	\$8.60	\$17.57	\$0.00	\$73.25
For apprentice rates see "Apprentice- LABORER"						
DEMO: JACKHAMMER OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2021	\$41.57	\$8.60	\$17.57	\$0.00	\$67.74
	12/01/2021	\$42.58	\$8.60	\$17.57	\$0.00	\$68.75
	06/01/2022	\$43.58	\$8.60	\$17.57	\$0.00	\$69.75
	12/01/2022	\$44.58	\$8.60	\$17.57	\$0.00	\$70.75
	06/01/2023	\$45.58	\$8.60	\$17.57	\$0.00	\$71.75
	12/01/2023	\$46.83	\$8.60	\$17.57	\$0.00	\$73.00
For apprentice rates see "Apprentice- LABORER"						
DEMO: WRECKING LABORER <i>LABORERS - ZONE 2</i>	06/01/2021	\$40.82	\$8.60	\$17.57	\$0.00	\$66.99
	12/01/2021	\$41.83	\$8.60	\$17.57	\$0.00	\$68.00
	06/01/2022	\$42.83	\$8.60	\$17.57	\$0.00	\$69.00
	12/01/2022	\$43.83	\$8.60	\$17.57	\$0.00	\$70.00
	06/01/2023	\$44.83	\$8.60	\$17.57	\$0.00	\$71.00
	12/01/2023	\$46.08	\$8.60	\$17.57	\$0.00	\$72.25
For apprentice rates see "Apprentice- LABORER"						
DIRECTIONAL DRILL MACHINE OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
	12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$68.70	\$9.40	\$23.12	\$0.00	\$101.22
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$73.60	\$9.40	\$23.12	\$0.00	\$106.12
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER/SLURRY (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$103.05	\$9.40	\$23.12	\$0.00	\$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
DRAWBRIDGE OPERATOR (Construction) <i>DRAWBRIDGE - SEIU LOCAL 888</i>	07/01/2020	\$26.77	\$6.67	\$3.93	\$0.16	\$37.53

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ELECTRICIAN	03/01/2021	\$55.41	\$13.00	\$20.01	\$0.00	\$88.42
<i>ELECTRICIANS LOCAL 103</i>	09/01/2021	\$56.84	\$13.00	\$20.06	\$0.00	\$89.90
	03/01/2022	\$58.04	\$13.00	\$20.09	\$0.00	\$91.13
	09/01/2022	\$59.48	\$13.00	\$20.13	\$0.00	\$92.61
	03/01/2023	\$60.67	\$13.00	\$20.17	\$0.00	\$93.84

Apprentice - *ELECTRICIAN - Local 103*

Effective Date - 03/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$22.16	\$13.00	\$0.66	\$0.00	\$35.82
2	40	\$22.16	\$13.00	\$0.66	\$0.00	\$35.82
3	45	\$24.93	\$13.00	\$15.13	\$0.00	\$53.06
4	45	\$24.93	\$13.00	\$15.13	\$0.00	\$53.06
5	50	\$27.71	\$13.00	\$15.57	\$0.00	\$56.28
6	55	\$30.48	\$13.00	\$16.01	\$0.00	\$59.49
7	60	\$33.25	\$13.00	\$16.46	\$0.00	\$62.71
8	65	\$36.02	\$13.00	\$16.90	\$0.00	\$65.92
9	70	\$38.79	\$13.00	\$17.34	\$0.00	\$69.13
10	75	\$41.56	\$13.00	\$17.80	\$0.00	\$72.36

Effective Date - 09/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$22.74	\$13.00	\$0.68	\$0.00	\$36.42
2	40	\$22.74	\$13.00	\$0.68	\$0.00	\$36.42
3	45	\$25.58	\$13.00	\$15.15	\$0.00	\$53.73
4	45	\$25.58	\$13.00	\$15.15	\$0.00	\$53.73
5	50	\$28.42	\$13.00	\$15.59	\$0.00	\$57.01
6	55	\$31.26	\$13.00	\$16.04	\$0.00	\$60.30
7	60	\$34.10	\$13.00	\$16.48	\$0.00	\$63.58
8	65	\$36.95	\$13.00	\$16.93	\$0.00	\$66.88
9	70	\$39.79	\$13.00	\$17.37	\$0.00	\$70.16
10	75	\$42.63	\$13.00	\$17.83	\$0.00	\$73.46

Notes: :

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

Apprentice to Journeyworker Ratio:2:3***

ELEVATOR CONSTRUCTOR	01/01/2021	\$63.47	\$15.88	\$19.31	\$0.00	\$98.66
<i>ELEVATOR CONSTRUCTORS LOCAL 4</i>	01/01/2022	\$65.62	\$16.03	\$20.21	\$0.00	\$101.86

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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Apprentice - ELEVATOR CONSTRUCTOR - Local 4

Effective Date - 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.74	\$15.88	\$0.00	\$0.00	\$47.62
2	55	\$34.91	\$15.88	\$19.31	\$0.00	\$70.10
3	65	\$41.26	\$15.88	\$19.31	\$0.00	\$76.45
4	70	\$44.43	\$15.88	\$19.31	\$0.00	\$79.62
5	80	\$50.78	\$15.88	\$19.31	\$0.00	\$85.97

Effective Date - 01/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.81	\$16.03	\$0.00	\$0.00	\$48.84
2	55	\$36.09	\$16.03	\$20.21	\$0.00	\$72.33
3	65	\$42.65	\$16.03	\$20.21	\$0.00	\$78.89
4	70	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
5	80	\$52.50	\$16.03	\$20.21	\$0.00	\$88.74

Notes:

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

Apprentice to Journeyworker Ratio:1:1

ELEVATOR CONSTRUCTOR HELPER	01/01/2021	\$44.43	\$15.88	\$19.31	\$0.00	\$79.62
ELEVATOR CONSTRUCTORS LOCAL 4	01/01/2022	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"						
FENCE & GUARD RAIL ERECTOR	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
LABORERS - ZONE 2	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY	05/01/2021	\$45.88	\$13.50	\$15.70	\$0.00	\$75.08
OPERATING ENGINEERS LOCAL 4	11/01/2021	\$46.88	\$13.50	\$15.70	\$0.00	\$76.08
	05/01/2022	\$48.03	\$13.50	\$15.70	\$0.00	\$77.23
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY	05/01/2021	\$47.40	\$13.50	\$15.70	\$0.00	\$76.60
OPERATING ENGINEERS LOCAL 4	11/01/2021	\$48.41	\$13.50	\$15.70	\$0.00	\$77.61
	05/01/2022	\$49.57	\$13.50	\$15.70	\$0.00	\$78.77
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY	05/01/2021	\$22.91	\$13.50	\$15.70	\$0.00	\$52.11
OPERATING ENGINEERS LOCAL 4	11/01/2021	\$23.51	\$13.50	\$15.70	\$0.00	\$52.71
	05/01/2022	\$24.18	\$13.50	\$15.70	\$0.00	\$53.38
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FIRE ALARM INSTALLER <i>ELECTRICIANS LOCAL 103</i>	03/01/2021	\$55.41	\$13.00	\$20.01	\$0.00	\$88.42
	09/01/2021	\$56.84	\$13.00	\$20.06	\$0.00	\$89.90
	03/01/2022	\$58.04	\$13.00	\$20.09	\$0.00	\$91.13
	09/01/2022	\$59.48	\$13.00	\$20.13	\$0.00	\$92.61
	03/01/2023	\$60.67	\$13.00	\$20.17	\$0.00	\$93.84
For apprentice rates see "Apprentice- ELECTRICIAN"						
FIRE ALARM REPAIR / MAINTENANCE <i>LOCAL 103</i> / COMMISSIONING <i>ELECTRICIANS</i>	03/01/2021	\$42.11	\$13.00	\$17.88	\$0.00	\$72.99
	09/01/2021	\$43.77	\$13.00	\$18.00	\$0.00	\$74.77
	03/01/2022	\$45.27	\$13.00	\$18.12	\$0.00	\$76.39
	09/01/2022	\$46.99	\$13.00	\$18.24	\$0.00	\$78.23
	03/01/2023	\$48.54	\$13.00	\$18.37	\$0.00	\$79.91
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"						
FIREMAN (ASST. ENGINEER) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$41.31	\$13.75	\$15.80	\$0.00	\$70.86
	12/01/2021	\$42.26	\$13.75	\$15.80	\$0.00	\$71.81
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FLOORCOVERER <i>FLOORCOVERERS LOCAL 2168 ZONE I</i>	03/01/2021	\$48.59	\$9.40	\$19.25	\$0.00	\$77.24
	09/01/2021	\$49.39	\$9.40	\$19.25	\$0.00	\$78.04
	03/01/2022	\$50.19	\$9.40	\$19.25	\$0.00	\$78.84

Apprentice - FLOORCOVERER - Local 2168 Zone I

Effective Date - 03/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.30	\$9.40	\$1.79	\$0.00	\$35.49
2	55	\$26.72	\$9.40	\$1.79	\$0.00	\$37.91
3	60	\$29.15	\$9.40	\$13.88	\$0.00	\$52.43
4	65	\$31.58	\$9.40	\$13.88	\$0.00	\$54.86
5	70	\$34.01	\$9.40	\$15.67	\$0.00	\$59.08
6	75	\$36.44	\$9.40	\$15.67	\$0.00	\$61.51
7	80	\$38.87	\$9.40	\$17.46	\$0.00	\$65.73
8	85	\$41.30	\$9.40	\$17.46	\$0.00	\$68.16

Effective Date - 09/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.70	\$9.40	\$1.79	\$0.00	\$35.89
2	55	\$27.16	\$9.40	\$1.79	\$0.00	\$38.35
3	60	\$29.63	\$9.40	\$13.88	\$0.00	\$52.91
4	65	\$32.10	\$9.40	\$13.88	\$0.00	\$55.38
5	70	\$34.57	\$9.40	\$15.67	\$0.00	\$59.64
6	75	\$37.04	\$9.40	\$15.67	\$0.00	\$62.11
7	80	\$39.51	\$9.40	\$17.46	\$0.00	\$66.37
8	85	\$41.98	\$9.40	\$17.46	\$0.00	\$68.84

Notes: Steps are 750 hrs.
 % After 09/1/17; 45/45/55/55/70/70/80/80 (1500hr Steps)
 Step 1&2 \$33.03/ 3&4 \$39.64/ 5&6 \$59.08/ 7&8 \$65.73

Apprentice to Journeyworker Ratio:1:1

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FORK LIFT/CHERRY PICKER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.73	\$13.75	\$15.80	\$0.00	\$80.28
	12/01/2021	\$51.88	\$13.75	\$15.80	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GENERATOR/LIGHTING PLANT/HEATERS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$33.40	\$13.75	\$15.80	\$0.00	\$62.95
	12/01/2021	\$34.19	\$13.75	\$15.80	\$0.00	\$63.74
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) <i>GLAZIERS LOCAL 35 (ZONE 2)</i>	01/01/2021	\$41.56	\$8.25	\$22.75	\$0.00	\$72.56

Apprentice - GLAZIER - Local 35 Zone 2

Effective Date - 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.78	\$8.25	\$0.00	\$0.00	\$29.03
2	55	\$22.86	\$8.25	\$6.16	\$0.00	\$37.27
3	60	\$24.94	\$8.25	\$6.72	\$0.00	\$39.91
4	65	\$27.01	\$8.25	\$7.28	\$0.00	\$42.54
5	70	\$29.09	\$8.25	\$19.39	\$0.00	\$56.73
6	75	\$31.17	\$8.25	\$19.95	\$0.00	\$59.37
7	80	\$33.25	\$8.25	\$20.51	\$0.00	\$62.01
8	90	\$37.40	\$8.25	\$21.63	\$0.00	\$67.28

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

HOISTING ENGINEER/CRANES/GRADALLS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.73	\$13.75	\$15.80	\$0.00	\$80.28
	12/01/2021	\$51.88	\$13.75	\$15.80	\$0.00	\$81.43

Apprentice - OPERATING ENGINEERS - Local 4

Effective Date - 06/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$27.90	\$13.75	\$0.00	\$0.00	\$41.65
2	60	\$30.44	\$13.75	\$15.80	\$0.00	\$59.99
3	65	\$32.97	\$13.75	\$15.80	\$0.00	\$62.52
4	70	\$35.51	\$13.75	\$15.80	\$0.00	\$65.06
5	75	\$38.05	\$13.75	\$15.80	\$0.00	\$67.60
6	80	\$40.58	\$13.75	\$15.80	\$0.00	\$70.13
7	85	\$43.12	\$13.75	\$15.80	\$0.00	\$72.67
8	90	\$45.66	\$13.75	\$15.80	\$0.00	\$75.21

Effective Date - 12/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$28.53	\$13.75	\$0.00	\$0.00	\$42.28
2	60	\$31.13	\$13.75	\$15.80	\$0.00	\$60.68
3	65	\$33.72	\$13.75	\$15.80	\$0.00	\$63.27
4	70	\$36.32	\$13.75	\$15.80	\$0.00	\$65.87
5	75	\$38.91	\$13.75	\$15.80	\$0.00	\$68.46
6	80	\$41.50	\$13.75	\$15.80	\$0.00	\$71.05
7	85	\$44.10	\$13.75	\$15.80	\$0.00	\$73.65
8	90	\$46.69	\$13.75	\$15.80	\$0.00	\$76.24

Notes:

Apprentice to Journeyworker Ratio:1:6

HVAC (DUCTWORK)	02/01/2021	\$51.67	\$13.65	\$24.57	\$2.70	\$92.59
<i>SHEETMETAL WORKERS LOCAL 17 - A</i>	08/01/2021	\$53.42	\$13.65	\$24.57	\$2.75	\$94.39
	02/01/2022	\$55.17	\$13.65	\$24.57	\$2.80	\$96.19
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (ELECTRICAL CONTROLS)	03/01/2021	\$55.41	\$13.00	\$20.01	\$0.00	\$88.42
<i>ELECTRICIANS LOCAL 103</i>	09/01/2021	\$56.84	\$13.00	\$20.06	\$0.00	\$89.90
	03/01/2022	\$58.04	\$13.00	\$20.09	\$0.00	\$91.13
	09/01/2022	\$59.48	\$13.00	\$20.13	\$0.00	\$92.61
	03/01/2023	\$60.67	\$13.00	\$20.17	\$0.00	\$93.84
For apprentice rates see "Apprentice- ELECTRICIAN"						
HVAC (TESTING AND BALANCING - AIR)	02/01/2021	\$51.67	\$13.65	\$24.57	\$2.70	\$92.59
<i>SHEETMETAL WORKERS LOCAL 17 - A</i>	08/01/2021	\$53.42	\$13.65	\$24.57	\$2.75	\$94.39
	02/01/2022	\$55.17	\$13.65	\$24.57	\$2.80	\$96.19
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (TESTING AND BALANCING - WATER)	03/01/2021	\$57.94	\$11.70	\$20.24	\$0.00	\$89.88
<i>PIPEFITTERS LOCAL 537</i>						
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HVAC MECHANIC	03/01/2021	\$57.94	\$11.70	\$20.24	\$0.00	\$89.88
<i>PIPEFITTERS LOCAL 537</i>						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HYDRAULIC DRILLS LABORERS - ZONE 2	06/01/2021	\$35.75	\$8.60	\$16.64	\$0.00	\$60.99
	12/01/2021	\$36.66	\$8.60	\$16.64	\$0.00	\$61.90
	06/01/2022	\$37.56	\$8.60	\$16.64	\$0.00	\$62.80
	12/01/2022	\$38.41	\$8.60	\$16.64	\$0.00	\$63.65
	06/01/2023	\$39.31	\$8.60	\$16.64	\$0.00	\$64.55
	12/01/2023	\$40.21	\$8.60	\$16.64	\$0.00	\$65.45
For apprentice rates see "Apprentice- LABORER"						
INSULATOR (PIPES & TANKS) HEAT & FROST INSULATORS LOCAL 6 (BOSTON)	09/01/2020	\$49.00	\$13.80	\$17.14	\$0.00	\$79.94
	09/01/2021	\$51.40	\$13.80	\$17.14	\$0.00	\$82.34
	09/01/2022	\$53.85	\$13.80	\$17.14	\$0.00	\$84.79

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

Effective Date - 09/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.50	\$13.80	\$12.42	\$0.00	\$50.72
2	60	\$29.40	\$13.80	\$13.36	\$0.00	\$56.56
3	70	\$34.30	\$13.80	\$14.31	\$0.00	\$62.41
4	80	\$39.20	\$13.80	\$15.25	\$0.00	\$68.25

Effective Date - 09/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.70	\$13.80	\$12.42	\$0.00	\$51.92
2	60	\$30.84	\$13.80	\$13.36	\$0.00	\$58.00
3	70	\$35.98	\$13.80	\$14.31	\$0.00	\$64.09
4	80	\$41.12	\$13.80	\$15.25	\$0.00	\$70.17

Notes:

Steps are 1 year

Apprentice to Journeyworker Ratio:1:4

IRONWORKER/WELDER IRONWORKERS LOCAL 7 (LAWRENCE AREA)	09/16/2020	\$44.25	\$8.10	\$25.10	\$0.00	\$77.45
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Apprentice - IRONWORKER - Local 7 Lawrence

Effective Date - 09/16/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$26.55	\$8.10	\$25.10	\$0.00	\$59.75
2	70	\$30.98	\$8.10	\$25.10	\$0.00	\$64.18
3	75	\$33.19	\$8.10	\$25.10	\$0.00	\$66.39
4	80	\$35.40	\$8.10	\$25.10	\$0.00	\$68.60
5	85	\$37.61	\$8.10	\$25.10	\$0.00	\$70.81
6	90	\$39.83	\$8.10	\$25.10	\$0.00	\$73.03

Notes:

Structural 1:6; Ornamental 1:4

Apprentice to Journeyworker Ratio:

JACKHAMMER & PAVING BREAKER OPERATOR	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
LABORERS - ZONE 2	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95

For apprentice rates see "Apprentice- LABORER"

LABORER	06/01/2021	\$35.00	\$8.60	\$16.64	\$0.00	\$60.24
LABORERS - ZONE 2	12/01/2021	\$35.91	\$8.60	\$16.64	\$0.00	\$61.15
	06/01/2022	\$36.81	\$8.60	\$16.64	\$0.00	\$62.05
	12/01/2022	\$37.66	\$8.60	\$16.64	\$0.00	\$62.90
	06/01/2023	\$38.56	\$8.60	\$16.64	\$0.00	\$63.80
	12/01/2023	\$39.46	\$8.60	\$16.64	\$0.00	\$64.70

Classification			Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate	
Apprentice - LABORER - Zone 2									
Effective Date -			06/01/2021						
Step	percent			Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate	
1	60			\$21.00	\$8.60	\$16.64	\$0.00	\$46.24	
2	70			\$24.50	\$8.60	\$16.64	\$0.00	\$49.74	
3	80			\$28.00	\$8.60	\$16.64	\$0.00	\$53.24	
4	90			\$31.50	\$8.60	\$16.64	\$0.00	\$56.74	
Effective Date -			12/01/2021						
Step	percent			Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate	
1	60			\$21.55	\$8.60	\$16.64	\$0.00	\$46.79	
2	70			\$25.14	\$8.60	\$16.64	\$0.00	\$50.38	
3	80			\$28.73	\$8.60	\$16.64	\$0.00	\$53.97	
4	90			\$32.32	\$8.60	\$16.64	\$0.00	\$57.56	
Notes:									
Apprentice to Journeyworker Ratio:1:5									
LABORER: CARPENTER TENDER				06/01/2021	\$35.00	\$8.60	\$16.64	\$0.00	\$60.24
LABORERS - ZONE 2				12/01/2021	\$35.91	\$8.60	\$16.64	\$0.00	\$61.15
				06/01/2022	\$36.81	\$8.60	\$16.64	\$0.00	\$62.05
				12/01/2022	\$37.66	\$8.60	\$16.64	\$0.00	\$62.90
				06/01/2023	\$38.56	\$8.60	\$16.64	\$0.00	\$63.80
				12/01/2023	\$39.46	\$8.60	\$16.64	\$0.00	\$64.70
For apprentice rates see "Apprentice- LABORER"									
LABORER: CEMENT FINISHER TENDER				06/01/2021	\$35.00	\$8.60	\$16.64	\$0.00	\$60.24
LABORERS - ZONE 2				12/01/2021	\$35.91	\$8.60	\$16.64	\$0.00	\$61.15
				06/01/2022	\$36.81	\$8.60	\$16.64	\$0.00	\$62.05
				12/01/2022	\$37.66	\$8.60	\$16.64	\$0.00	\$62.90
				06/01/2023	\$38.56	\$8.60	\$16.64	\$0.00	\$63.80
				12/01/2023	\$39.46	\$8.60	\$16.64	\$0.00	\$64.70
For apprentice rates see "Apprentice- LABORER"									
LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER				06/01/2021	\$35.09	\$8.60	\$16.70	\$0.00	\$60.39
LABORERS - ZONE 2				12/01/2021	\$36.00	\$8.60	\$16.70	\$0.00	\$61.30
				06/01/2022	\$36.90	\$8.60	\$16.70	\$0.00	\$62.20
				12/01/2022	\$37.75	\$8.60	\$16.70	\$0.00	\$63.05
				06/01/2023	\$38.65	\$8.60	\$16.70	\$0.00	\$63.95
				12/01/2023	\$39.55	\$8.60	\$16.70	\$0.00	\$64.85
For apprentice rates see "Apprentice- LABORER"									

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LABORER: MASON TENDER <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
LABORER: MULTI-TRADE TENDER <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.00	\$8.60	\$16.64	\$0.00	\$60.24
	12/01/2021	\$35.91	\$8.60	\$16.64	\$0.00	\$61.15
	06/01/2022	\$36.81	\$8.60	\$16.64	\$0.00	\$62.05
	12/01/2022	\$37.66	\$8.60	\$16.64	\$0.00	\$62.90
	06/01/2023	\$38.56	\$8.60	\$16.64	\$0.00	\$63.80
	12/01/2023	\$39.46	\$8.60	\$16.64	\$0.00	\$64.70
For apprentice rates see "Apprentice- LABORER"						
LABORER: TREE REMOVER <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.00	\$8.60	\$16.64	\$0.00	\$60.24
	12/01/2021	\$35.91	\$8.60	\$16.64	\$0.00	\$61.15
	06/01/2022	\$36.81	\$8.60	\$16.64	\$0.00	\$62.05
	12/01/2022	\$37.66	\$8.60	\$16.64	\$0.00	\$62.90
	06/01/2023	\$38.56	\$8.60	\$16.64	\$0.00	\$63.80
	12/01/2023	\$39.46	\$8.60	\$16.64	\$0.00	\$64.70
This classification applies to the removal of standing trees, and the trimming and removal of branches and limbs when related to public works construction or site clearance incidental to construction . For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
MARBLE & TILE FINISHERS <i>BRICKLAYERS LOCAL 3 - MARBLE & TILE</i>	02/01/2021	\$42.57	\$11.39	\$20.14	\$0.00	\$74.10
	08/01/2021	\$43.69	\$11.39	\$20.30	\$0.00	\$75.38
	02/01/2022	\$44.16	\$11.39	\$20.30	\$0.00	\$75.85

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

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

Effective Date - 02/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.29	\$11.39	\$20.14	\$0.00	\$52.82
2	60	\$25.54	\$11.39	\$20.14	\$0.00	\$57.07
3	70	\$29.80	\$11.39	\$20.14	\$0.00	\$61.33
4	80	\$34.06	\$11.39	\$20.14	\$0.00	\$65.59
5	90	\$38.31	\$11.39	\$20.14	\$0.00	\$69.84

Effective Date - 08/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.85	\$11.39	\$20.30	\$0.00	\$53.54
2	60	\$26.21	\$11.39	\$20.30	\$0.00	\$57.90
3	70	\$30.58	\$11.39	\$20.30	\$0.00	\$62.27
4	80	\$34.95	\$11.39	\$20.30	\$0.00	\$66.64
5	90	\$39.32	\$11.39	\$20.30	\$0.00	\$71.01

Notes:

Apprentice to Journeyworker Ratio:1:3

MARBLE MASONS,TILELAYERS & TERRAZZO MECH	02/01/2021	\$55.77	\$11.39	\$22.08	\$0.00	\$89.24
BRICKLAYERS LOCAL 3 - MARBLE & TILE	08/01/2021	\$57.17	\$11.39	\$22.24	\$0.00	\$90.80
	02/01/2022	\$57.74	\$11.39	\$22.24	\$0.00	\$91.37

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

Effective Date - 02/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.89	\$11.39	\$22.08	\$0.00	\$61.36
2	60	\$33.46	\$11.39	\$22.08	\$0.00	\$66.93
3	70	\$39.04	\$11.39	\$22.08	\$0.00	\$72.51
4	80	\$44.62	\$11.39	\$22.08	\$0.00	\$78.09
5	90	\$50.19	\$11.39	\$22.08	\$0.00	\$83.66

Effective Date - 08/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.59	\$11.39	\$22.24	\$0.00	\$62.22
2	60	\$34.30	\$11.39	\$22.24	\$0.00	\$67.93
3	70	\$40.02	\$11.39	\$22.24	\$0.00	\$73.65
4	80	\$45.74	\$11.39	\$22.24	\$0.00	\$79.37
5	90	\$51.45	\$11.39	\$22.24	\$0.00	\$85.08

Notes:

Apprentice to Journeyworker Ratio:1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES)	06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
OPERATING ENGINEERS LOCAL 4	12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
MECHANICS MAINTENANCE	06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
OPERATING ENGINEERS LOCAL 4	12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
MILLWRIGHT (Zone 2)	03/01/2021	\$39.42	\$8.58	\$21.57	\$0.00	\$69.57
MILLWRIGHTS LOCAL 1121 - Zone 2	01/03/2022	\$40.67	\$8.58	\$21.57	\$0.00	\$70.82
	01/02/2023	\$41.92	\$8.58	\$21.57	\$0.00	\$72.07

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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Apprentice - MILLWRIGHT - Local 1121 Zone 2

Effective Date - 03/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$21.68	\$8.58	\$5.72	\$0.00	\$35.98
2	65	\$25.62	\$8.58	\$17.93	\$0.00	\$52.13
3	75	\$29.57	\$8.58	\$18.98	\$0.00	\$57.13
4	85	\$33.51	\$8.58	\$20.01	\$0.00	\$62.10

Effective Date - 01/03/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$22.37	\$8.58	\$5.72	\$0.00	\$36.67
2	65	\$26.44	\$8.58	\$17.93	\$0.00	\$52.95
3	75	\$30.50	\$8.58	\$18.98	\$0.00	\$58.06
4	85	\$34.57	\$8.58	\$20.01	\$0.00	\$63.16

Notes: Step 1&2 Appr. indentured after 1/6/2020 receive no pension, but do receive annuity. (Step 1 \$5.72, Step 2 \$6.66)
Steps are 2,000 hours

Apprentice to Journeyworker Ratio:1:5

MORTAR MIXER LABORERS - ZONE 2	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
OILER (OTHER THAN TRUCK CRANES,GRADALLS) OPERATING ENGINEERS LOCAL 4	06/01/2021	\$23.40	\$13.75	\$15.80	\$0.00	\$52.95
	12/01/2021	\$23.98	\$13.75	\$15.80	\$0.00	\$53.53
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
OILER (TRUCK CRANES, GRADALLS) OPERATING ENGINEERS LOCAL 4	06/01/2021	\$28.26	\$13.75	\$15.80	\$0.00	\$57.81
	12/01/2021	\$28.94	\$13.75	\$15.80	\$0.00	\$58.49
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
OTHER POWER DRIVEN EQUIPMENT - CLASS II OPERATING ENGINEERS LOCAL 4	06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
	12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PAINTER (BRIDGES/TANKS) PAINTERS LOCAL 35 - ZONE 2	01/01/2021	\$52.06	\$8.25	\$22.75	\$0.00	\$83.06

Apprentice - PAINTER Local 35 - BRIDGES/TANKS**Effective Date -** 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.03	\$8.25	\$0.00	\$0.00	\$34.28
2	55	\$28.63	\$8.25	\$6.16	\$0.00	\$43.04
3	60	\$31.24	\$8.25	\$6.72	\$0.00	\$46.21
4	65	\$33.84	\$8.25	\$7.28	\$0.00	\$49.37
5	70	\$36.44	\$8.25	\$19.39	\$0.00	\$64.08
6	75	\$39.05	\$8.25	\$19.95	\$0.00	\$67.25
7	80	\$41.65	\$8.25	\$20.51	\$0.00	\$70.41
8	90	\$46.85	\$8.25	\$21.63	\$0.00	\$76.73

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, NEW) *	01/01/2021	\$42.96	\$8.25	\$22.75	\$0.00	\$73.96
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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

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - New**Effective Date -** 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.48	\$8.25	\$0.00	\$0.00	\$29.73
2	55	\$23.63	\$8.25	\$6.16	\$0.00	\$38.04
3	60	\$25.78	\$8.25	\$6.72	\$0.00	\$40.75
4	65	\$27.92	\$8.25	\$7.28	\$0.00	\$43.45
5	70	\$30.07	\$8.25	\$19.39	\$0.00	\$57.71
6	75	\$32.22	\$8.25	\$19.95	\$0.00	\$60.42
7	80	\$34.37	\$8.25	\$20.51	\$0.00	\$63.13
8	90	\$38.66	\$8.25	\$21.63	\$0.00	\$68.54

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT)	01/01/2021	\$41.02	\$8.25	\$22.75	\$0.00	\$72.02
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PAINTERS LOCAL 35 - ZONE 2

Classification

Effective Date

Base Wage

Health

Pension

Supplemental
Unemployment

Total Rate

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint**Effective Date -** 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.51	\$8.25	\$0.00	\$0.00	\$28.76
2	55	\$22.56	\$8.25	\$6.16	\$0.00	\$36.97
3	60	\$24.61	\$8.25	\$6.72	\$0.00	\$39.58
4	65	\$26.66	\$8.25	\$7.28	\$0.00	\$42.19
5	70	\$28.71	\$8.25	\$19.39	\$0.00	\$56.35
6	75	\$30.77	\$8.25	\$19.95	\$0.00	\$58.97
7	80	\$32.82	\$8.25	\$20.51	\$0.00	\$61.58
8	90	\$36.92	\$8.25	\$21.63	\$0.00	\$66.80

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, NEW) *

01/01/2021

\$41.56

\$8.25

\$22.75

\$0.00

\$72.56

* If 30% or more of surfaces to be painted are new construction,

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

Apprentice - PAINTER - Local 35 Zone 2 - BRUSH NEW**Effective Date -** 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.78	\$8.25	\$0.00	\$0.00	\$29.03
2	55	\$22.86	\$8.25	\$6.16	\$0.00	\$37.27
3	60	\$24.94	\$8.25	\$6.72	\$0.00	\$39.91
4	65	\$27.01	\$8.25	\$7.28	\$0.00	\$42.54
5	70	\$29.09	\$8.25	\$19.39	\$0.00	\$56.73
6	75	\$31.17	\$8.25	\$19.95	\$0.00	\$59.37
7	80	\$33.25	\$8.25	\$20.51	\$0.00	\$62.01
8	90	\$37.40	\$8.25	\$21.63	\$0.00	\$67.28

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, REPAINT)

01/01/2021

\$39.62

\$8.25

\$22.75

\$0.00

\$70.62

PAINTERS LOCAL 35 - ZONE 2

Apprentice - PAINTER Local 35 Zone 2 - BRUSH REPAINT

Effective Date - 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$19.81	\$8.25	\$0.00	\$0.00	\$28.06
2	55	\$21.79	\$8.25	\$6.16	\$0.00	\$36.20
3	60	\$23.77	\$8.25	\$6.72	\$0.00	\$38.74
4	65	\$25.75	\$8.25	\$7.28	\$0.00	\$41.28
5	70	\$27.73	\$8.25	\$19.39	\$0.00	\$55.37
6	75	\$29.72	\$8.25	\$19.95	\$0.00	\$57.92
7	80	\$31.70	\$8.25	\$20.51	\$0.00	\$60.46
8	90	\$35.66	\$8.25	\$21.63	\$0.00	\$65.54

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PANEL & PICKUP TRUCKS DRIVER	06/01/2021	\$35.78	\$12.91	\$14.82	\$0.00	\$63.51
TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	08/01/2021	\$35.78	\$13.41	\$14.82	\$0.00	\$64.01
	12/01/2021	\$35.78	\$13.41	\$16.01	\$0.00	\$65.20
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK)	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
PILE DRIVER LOCAL 56 (ZONE 1)						
For apprentice rates see "Apprentice- PILE DRIVER"						
PILE DRIVER	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
PILE DRIVER LOCAL 56 (ZONE 1)						

Apprentice - PILE DRIVER - Local 56 Zone 1

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.54	\$9.40	\$23.12	\$0.00	\$57.06
2	60	\$29.44	\$9.40	\$23.12	\$0.00	\$61.96
3	70	\$34.35	\$9.40	\$23.12	\$0.00	\$66.87
4	75	\$36.80	\$9.40	\$23.12	\$0.00	\$69.32
5	80	\$39.26	\$9.40	\$23.12	\$0.00	\$71.78
6	80	\$39.26	\$9.40	\$23.12	\$0.00	\$71.78
7	90	\$44.16	\$9.40	\$23.12	\$0.00	\$76.68
8	90	\$44.16	\$9.40	\$23.12	\$0.00	\$76.68

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 \$34.01/ 3&4 \$41.46/ 5&6 \$62.80/ 7&8 \$69.25

Apprentice to Journeyworker Ratio:1:5

PIPEFITTER & STEAMFITTER	03/01/2021	\$57.94	\$11.70	\$20.24	\$0.00	\$89.88
PIPEFITTERS LOCAL 537						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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Apprentice - PIPEFITTER - Local 537

Effective Date - 03/01/2021

Effective Date - 03/01/2021					Supplemental	
Step	percent	Apprentice Base Wage	Health	Pension	Unemployment	Total Rate
1	40	\$23.18	\$11.70	\$8.25	\$0.00	\$43.13
2	45	\$26.07	\$11.70	\$20.24	\$0.00	\$58.01
3	60	\$34.76	\$11.70	\$20.24	\$0.00	\$66.70
4	70	\$40.56	\$11.70	\$20.24	\$0.00	\$72.50
5	80	\$46.35	\$11.70	\$20.24	\$0.00	\$78.29

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	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
LABORERS - ZONE 2	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95

For apprentice rates see "Apprentice- LABORER"

PLUMBERS & GASFITTERS	03/01/2021	\$60.19	\$13.57	\$17.26	\$0.00	\$91.02
<i>PLUMBERS & GASFITTERS LOCAL 12</i>						

Apprentice - PLUMBER/GASFITTER - Local 12

Effective Date - 03/01/2021

Effective Date - 03/01/2021					Supplemental	
Step	percent	Apprentice Base Wage	Health	Pension	Unemployment	Total Rate
1	35	\$21.07	\$13.57	\$6.24	\$0.00	\$40.88
2	40	\$24.08	\$13.57	\$7.08	\$0.00	\$44.73
3	55	\$33.10	\$13.57	\$9.63	\$0.00	\$56.30
4	65	\$39.12	\$13.57	\$11.33	\$0.00	\$64.02
5	75	\$45.14	\$13.57	\$13.03	\$0.00	\$71.74

Notes:

** 1:2; 2:6; 3:10; 4:14; 5:19/Steps are 1 yr

Step4 with lic\$67.89, Step5 with lic\$75.59

Apprentice to Journeyworker Ratio:**

PNEUMATIC CONTROLS (TEMP.)	03/01/2021	\$57.94	\$11.70	\$20.24	\$0.00	\$89.88
PIPEFITTERS LOCAL 537						

For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"

PNEUMATIC DRILL/TOOL OPERATOR	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
LABORERS - ZONE 2	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER"						
POWDERMAN & BLASTER <i>LABORERS - ZONE 2</i>	06/01/2021	\$36.00	\$8.60	\$16.64	\$0.00	\$61.24
	12/01/2021	\$36.91	\$8.60	\$16.64	\$0.00	\$62.15
	06/01/2022	\$37.81	\$8.60	\$16.64	\$0.00	\$63.05
	12/01/2022	\$38.66	\$8.60	\$16.64	\$0.00	\$63.90
	06/01/2023	\$39.56	\$8.60	\$16.64	\$0.00	\$64.80
	12/01/2023	\$40.46	\$8.60	\$16.64	\$0.00	\$65.70
For apprentice rates see "Apprentice- LABORER"						
POWER SHOVEL/DERRICK/TRENCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.73	\$13.75	\$15.80	\$0.00	\$80.28
	12/01/2021	\$51.88	\$13.75	\$15.80	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (CONCRETE) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.73	\$13.75	\$15.80	\$0.00	\$80.28
	12/01/2021	\$51.88	\$13.75	\$15.80	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (DEWATERING, OTHER) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$33.40	\$13.75	\$15.80	\$0.00	\$62.95
	12/01/2021	\$34.19	\$13.75	\$15.80	\$0.00	\$63.74
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
READY-MIX CONCRETE DRIVER <i>TEAMSTERS 170 - J.G. MacLellan (Lowell)</i>	05/01/2021	\$25.50	\$10.01	\$6.35	\$0.00	\$41.86
	01/01/2022	\$25.50	\$10.37	\$6.35	\$0.00	\$42.22
	05/01/2022	\$25.85	\$10.37	\$6.35	\$0.00	\$42.57
	01/01/2023	\$25.85	\$10.77	\$6.35	\$0.00	\$42.97
RECLAIMERS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
	12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
RIDE-ON MOTORIZED BUGGY OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
ROLLER/SPREADER/MULCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
	12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
ROOFER (Inc.Roofing Waterproofing &Roofing Damproofg) <i>ROOFERS LOCAL 33</i>	02/01/2021	\$46.60	\$12.28	\$17.15	\$0.00	\$76.03
	08/01/2021	\$48.03	\$12.28	\$17.15	\$0.00	\$77.46
	02/01/2022	\$49.46	\$12.28	\$17.15	\$0.00	\$78.89

Classification

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

Apprentice - ROOFER - Local 33

Effective Date - 02/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.30	\$12.28	\$4.31	\$0.00	\$39.89
2	60	\$27.96	\$12.28	\$17.15	\$0.00	\$57.39
3	65	\$30.29	\$12.28	\$17.15	\$0.00	\$59.72
4	75	\$34.95	\$12.28	\$17.15	\$0.00	\$64.38
5	85	\$39.61	\$12.28	\$17.15	\$0.00	\$69.04

Effective Date - 08/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.02	\$12.28	\$4.31	\$0.00	\$40.61
2	60	\$28.82	\$12.28	\$17.15	\$0.00	\$58.25
3	65	\$31.22	\$12.28	\$17.15	\$0.00	\$60.65
4	75	\$36.02	\$12.28	\$17.15	\$0.00	\$65.45
5	85	\$40.83	\$12.28	\$17.15	\$0.00	\$70.26

Notes: ** 1:5, 2:6-10, the 1:10; Reroofing: 1:4, then 1:1
Step 1 is 2000 hrs.; Steps 2-5 are 1000 hrs.
(Hot Pitch Mechanics' receive \$1.00 hr. above ROOFER)

Apprentice to Journeyworker Ratio:**

ROOFER SLATE / TILE / PRECAST CONCRETE	02/01/2021	\$46.85	\$12.28	\$17.15	\$0.00	\$76.28
ROOFERS LOCAL 33	08/01/2021	\$48.28	\$12.28	\$17.15	\$0.00	\$77.71
	02/01/2022	\$49.71	\$12.28	\$17.15	\$0.00	\$79.14
For apprentice rates see "Apprentice- ROOFER"						
SHEETMETAL WORKER	02/01/2021	\$51.67	\$13.65	\$24.57	\$2.70	\$92.59
SHEETMETAL WORKERS LOCAL 17 - A	08/01/2021	\$53.42	\$13.65	\$24.57	\$2.75	\$94.39
	02/01/2022	\$55.17	\$13.65	\$24.57	\$2.80	\$96.19

Classification
Effective Date
Base Wage
Health
Pension
**Supplemental
Unemployment**
Total Rate
Apprentice - SHEET METAL WORKER - Local 17-A
Effective Date - 02/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$21.70	\$13.65	\$5.89	\$0.00	\$41.24
2	42	\$21.70	\$13.65	\$5.89	\$0.00	\$41.24
3	47	\$24.28	\$13.65	\$11.13	\$1.48	\$50.54
4	47	\$24.28	\$13.65	\$11.13	\$1.48	\$50.54
5	52	\$26.87	\$13.65	\$12.08	\$1.58	\$54.18
6	52	\$26.87	\$13.65	\$12.33	\$1.59	\$54.44
7	60	\$31.00	\$13.65	\$13.70	\$1.76	\$60.11
8	65	\$33.59	\$13.65	\$14.65	\$1.88	\$63.77
9	75	\$38.75	\$13.65	\$16.56	\$2.08	\$71.04
10	85	\$43.92	\$13.65	\$17.96	\$2.28	\$77.81

Effective Date - 08/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$22.44	\$13.65	\$5.89	\$0.00	\$41.98
2	42	\$22.44	\$13.65	\$5.89	\$0.00	\$41.98
3	47	\$25.11	\$13.65	\$11.13	\$1.48	\$51.37
4	47	\$25.11	\$13.65	\$11.13	\$1.48	\$51.37
5	52	\$27.78	\$13.65	\$12.08	\$1.58	\$55.09
6	52	\$27.78	\$13.65	\$12.33	\$1.59	\$55.35
7	60	\$32.05	\$13.65	\$13.70	\$1.76	\$61.16
8	65	\$34.72	\$13.65	\$14.65	\$1.88	\$64.90
9	75	\$40.07	\$13.65	\$16.56	\$2.08	\$72.36
10	85	\$45.41	\$13.65	\$17.96	\$2.28	\$79.30

Notes:

Steps are 6 mos.

Apprentice to Journeyworker Ratio:1:4

SPECIALIZED EARTH MOVING EQUIP < 35 TONS TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	06/01/2021	\$36.24	\$12.91	\$14.82	\$0.00	\$63.97
	08/01/2021	\$36.24	\$13.41	\$14.82	\$0.00	\$64.47
	12/01/2021	\$36.24	\$13.41	\$16.01	\$0.00	\$65.66
SPECIALIZED EARTH MOVING EQUIP > 35 TONS TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	06/01/2021	\$36.53	\$12.91	\$14.82	\$0.00	\$64.26
	08/01/2021	\$36.53	\$13.41	\$14.82	\$0.00	\$64.76
	12/01/2021	\$36.53	\$13.41	\$16.01	\$0.00	\$65.95
SPRINKLER FITTER SPRINKLER FITTERS LOCAL 550 - (Section A) Zone 1	03/01/2021	\$62.45	\$10.00	\$21.25	\$0.00	\$93.70

Apprentice - SPRINKLER FITTER - Local 550 (Section A) Zone 1**Effective Date -** 03/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$21.86	\$10.00	\$11.99	\$0.00	\$43.85
2	40	\$24.98	\$10.00	\$12.70	\$0.00	\$47.68
3	45	\$28.10	\$10.00	\$13.41	\$0.00	\$51.51
4	50	\$31.23	\$10.00	\$14.13	\$0.00	\$55.36
5	55	\$34.35	\$10.00	\$14.84	\$0.00	\$59.19
6	60	\$37.47	\$10.00	\$15.55	\$0.00	\$63.02
7	65	\$40.59	\$10.00	\$16.26	\$0.00	\$66.85
8	70	\$43.72	\$10.00	\$16.98	\$0.00	\$70.70
9	75	\$46.84	\$10.00	\$17.69	\$0.00	\$74.53
10	80	\$49.96	\$10.00	\$18.40	\$0.00	\$78.36

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***OPERATING ENGINEERS LOCAL 4*

06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN*OPERATING ENGINEERS LOCAL 4*

06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

TELECOMMUNICATION TECHNICIAN*ELECTRICIANS LOCAL 103*

03/01/2021	\$42.11	\$13.00	\$17.88	\$0.00	\$72.99
09/01/2021	\$43.77	\$13.00	\$18.00	\$0.00	\$74.77
03/01/2022	\$45.27	\$13.00	\$18.12	\$0.00	\$76.39
09/01/2022	\$46.99	\$13.00	\$18.24	\$0.00	\$78.23
03/01/2023	\$48.54	\$13.00	\$18.37	\$0.00	\$79.91

Apprentice - TELECOMMUNICATION TECHNICIAN - Local 103**Effective Date - 03/01/2021**

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$18.95	\$13.00	\$0.57	\$0.00	\$32.52
2	45	\$18.95	\$13.00	\$0.57	\$0.00	\$32.52
3	50	\$21.06	\$13.00	\$14.51	\$0.00	\$48.57
4	50	\$21.06	\$13.00	\$14.51	\$0.00	\$48.57
5	55	\$23.16	\$13.00	\$14.84	\$0.00	\$51.00
6	60	\$25.27	\$13.00	\$15.18	\$0.00	\$53.45
7	65	\$27.37	\$13.00	\$15.52	\$0.00	\$55.89
8	70	\$29.48	\$13.00	\$15.85	\$0.00	\$58.33
9	75	\$31.58	\$13.00	\$16.20	\$0.00	\$60.78
10	80	\$33.69	\$13.00	\$16.53	\$0.00	\$63.22

Effective Date - 09/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$19.70	\$13.00	\$0.59	\$0.00	\$33.29
2	45	\$19.70	\$13.00	\$0.59	\$0.00	\$33.29
3	50	\$21.89	\$13.00	\$14.57	\$0.00	\$49.46
4	50	\$21.89	\$13.00	\$14.57	\$0.00	\$49.46
5	55	\$24.07	\$13.00	\$14.91	\$0.00	\$51.98
6	60	\$26.26	\$13.00	\$15.26	\$0.00	\$54.52
7	65	\$28.45	\$13.00	\$15.59	\$0.00	\$57.04
8	70	\$30.64	\$13.00	\$15.94	\$0.00	\$59.58
9	75	\$32.83	\$13.00	\$16.28	\$0.00	\$62.11
10	80	\$35.02	\$13.00	\$16.63	\$0.00	\$64.65

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

TERRAZZO FINISHERS	02/01/2021	\$54.69	\$11.39	\$22.09	\$0.00	\$88.17
BRICKLAYERS LOCAL 3 - MARBLE & TILE	08/01/2021	\$56.09	\$11.39	\$22.25	\$0.00	\$89.73
	02/01/2022	\$56.68	\$11.39	\$22.25	\$0.00	\$90.32

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
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Apprentice - TERRAZZO FINISHER - Local 3 Marble & Tile

Effective Date - 02/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.35	\$11.39	\$22.09	\$0.00	\$60.83
2	60	\$32.81	\$11.39	\$22.09	\$0.00	\$66.29
3	70	\$38.28	\$11.39	\$22.09	\$0.00	\$71.76
4	80	\$43.75	\$11.39	\$22.09	\$0.00	\$77.23
5	90	\$49.22	\$11.39	\$22.09	\$0.00	\$82.70

Effective Date - 08/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.05	\$11.39	\$22.25	\$0.00	\$61.69
2	60	\$33.65	\$11.39	\$22.25	\$0.00	\$67.29
3	70	\$39.26	\$11.39	\$22.25	\$0.00	\$72.90
4	80	\$44.87	\$11.39	\$22.25	\$0.00	\$78.51
5	90	\$50.48	\$11.39	\$22.25	\$0.00	\$84.12

Notes:

Apprentice to Journeyworker Ratio:1:3

TEST BORING DRILLER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2021	\$42.07	\$8.60	\$17.72	\$0.00	\$68.39
	12/01/2021	\$43.08	\$8.60	\$17.72	\$0.00	\$69.40
For apprentice rates see "Apprentice- LABORER"						
TEST BORING DRILLER HELPER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2021	\$40.79	\$8.60	\$17.72	\$0.00	\$67.11
	12/01/2021	\$41.80	\$8.60	\$17.72	\$0.00	\$68.12
For apprentice rates see "Apprentice- LABORER"						
TEST BORING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2021	\$40.67	\$8.60	\$17.72	\$0.00	\$66.99
	12/01/2021	\$41.68	\$8.60	\$17.72	\$0.00	\$68.00
For apprentice rates see "Apprentice- LABORER"						
TRACTORS/PORTABLE STEAM GENERATORS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2021	\$50.19	\$13.75	\$15.80	\$0.00	\$79.74
	12/01/2021	\$51.33	\$13.75	\$15.80	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TRAILERS FOR EARTH MOVING EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2021	\$36.82	\$12.91	\$14.82	\$0.00	\$64.55
	08/01/2021	\$36.82	\$13.41	\$14.82	\$0.00	\$65.05
	12/01/2021	\$36.82	\$13.41	\$16.01	\$0.00	\$66.24
TUNNEL WORK - COMPRESSED AIR <i>LABORERS (COMPRESSED AIR)</i>	06/01/2021	\$52.90	\$8.60	\$18.17	\$0.00	\$79.67
	12/01/2021	\$53.91	\$8.60	\$18.17	\$0.00	\$80.68
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) <i>LABORERS (COMPRESSED AIR)</i>	06/01/2021	\$54.90	\$8.60	\$18.17	\$0.00	\$81.67
	12/01/2021	\$55.91	\$8.60	\$18.17	\$0.00	\$82.68
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR <i>LABORERS (FREE AIR TUNNEL)</i>	06/01/2021	\$44.97	\$8.60	\$18.17	\$0.00	\$71.74
	12/01/2021	\$45.98	\$8.60	\$18.17	\$0.00	\$72.75
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TUNNEL WORK - FREE AIR (HAZ. WASTE)	06/01/2021	\$46.97	\$8.60	\$18.17	\$0.00	\$73.74
LABORERS (FREE AIR TUNNEL)	12/01/2021	\$47.98	\$8.60	\$18.17	\$0.00	\$74.75
For apprentice rates see "Apprentice- LABORER"						
VAC-HAUL	06/01/2021	\$36.24	\$12.91	\$14.82	\$0.00	\$63.97
TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	08/01/2021	\$36.24	\$13.41	\$14.82	\$0.00	\$64.47
	12/01/2021	\$36.24	\$13.41	\$16.01	\$0.00	\$65.66
WAGON DRILL OPERATOR	06/01/2021	\$35.25	\$8.60	\$16.64	\$0.00	\$60.49
LABORERS - ZONE 2	12/01/2021	\$36.16	\$8.60	\$16.64	\$0.00	\$61.40
	06/01/2022	\$37.06	\$8.60	\$16.64	\$0.00	\$62.30
	12/01/2022	\$37.91	\$8.60	\$16.64	\$0.00	\$63.15
	06/01/2023	\$38.81	\$8.60	\$16.64	\$0.00	\$64.05
	12/01/2023	\$39.71	\$8.60	\$16.64	\$0.00	\$64.95
For apprentice rates see "Apprentice- LABORER"						
WASTE WATER PUMP OPERATOR	06/01/2021	\$50.73	\$13.75	\$15.80	\$0.00	\$80.28
OPERATING ENGINEERS LOCAL 4	12/01/2021	\$51.88	\$13.75	\$15.80	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
WATER METER INSTALLER	03/01/2021	\$60.19	\$13.57	\$17.26	\$0.00	\$91.02
PLUMBERS & GASFITTERS LOCAL 12						
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						
Outside Electrical - East						
CABLE TECHNICIAN (Power Zone)	08/30/2020	\$29.67	\$9.25	\$1.89	\$0.00	\$40.81
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						
For apprentice rates see "Apprentice- LINEMAN"						
CABLEMAN (Underground Ducts & Cables)	08/30/2020	\$42.03	\$9.25	\$10.27	\$0.00	\$61.55
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						
For apprentice rates see "Apprentice- LINEMAN"						
DRIVER / GROUNDMAN CDL	08/30/2020	\$34.62	\$9.25	\$10.07	\$0.00	\$53.94
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						
For apprentice rates see "Apprentice- LINEMAN"						
DRIVER / GROUNDMAN -Inexperienced (<2000 Hrs)	08/30/2020	\$27.20	\$9.25	\$1.82	\$0.00	\$38.27
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						
For apprentice rates see "Apprentice- LINEMAN"						
EQUIPMENT OPERATOR (Class A CDL)	08/30/2020	\$42.03	\$9.25	\$14.35	\$0.00	\$65.63
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						
For apprentice rates see "Apprentice- LINEMAN"						
EQUIPMENT OPERATOR (Class B CDL)	08/30/2020	\$37.09	\$9.25	\$10.87	\$0.00	\$57.21
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						
For apprentice rates see "Apprentice- LINEMAN"						
GROUNDMAN	08/30/2020	\$27.20	\$9.25	\$1.82	\$0.00	\$38.27
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						
For apprentice rates see "Apprentice- LINEMAN"						
GROUNDMAN -Inexperienced (<2000 Hrs.)	08/30/2020	\$22.25	\$9.25	\$1.82	\$0.00	\$33.32
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						
For apprentice rates see "Apprentice- LINEMAN"						
JOURNEYMAN LINEMAN	08/30/2020	\$49.45	\$9.25	\$17.48	\$0.00	\$76.18
OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104						

Apprentice - LINEMAN (Outside Electrical) - East Local 104

Effective Date - 08/30/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$29.67	\$9.25	\$3.39	\$0.00	\$42.31
2	65	\$32.14	\$9.25	\$3.46	\$0.00	\$44.85
3	70	\$34.62	\$9.25	\$3.54	\$0.00	\$47.41
4	75	\$37.09	\$9.25	\$5.11	\$0.00	\$51.45
5	80	\$39.56	\$9.25	\$5.19	\$0.00	\$54.00
6	85	\$42.03	\$9.25	\$5.26	\$0.00	\$56.54
7	90	\$44.51	\$9.25	\$7.34	\$0.00	\$61.10

Notes:

Apprentice to Journeyworker Ratio:1:2

TELEDATA CABLE SPLICER <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	02/04/2019	\$30.73	\$4.70	\$3.17	\$0.00	\$38.60
TELEDATA LINEMAN/EQUIPMENT OPERATOR <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	02/04/2019	\$28.93	\$4.70	\$3.14	\$0.00	\$36.77
TELEDATA WIREMAN/INSTALLER/TECHNICIAN <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	02/04/2019	\$28.93	\$4.70	\$3.14	\$0.00	\$36.77

Additional Apprentice Information:

Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the pre-determined hourly wage rate established by the Commissioner under the provisions of the M.G.L. c. 149, ss. 26-27D. Apprentice ratios are established by the Division of Apprenticeship Training pursuant to M.G.L. c. 23, ss. 11E-11L.

All apprentices must be registered with the Division of Apprenticeship Training in accordance with M.G.L. c. 23, ss. 11E-11L.

All steps are six months (1000 hours.)

Ratios are expressed in allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified.

- ** Multiple ratios are listed in the comment field.
- *** APP to JM; 1:1, 2:2, 2:3, 3:4, 4:4, 4:5, 4:6, 5:7, 6:7, 6:8, 6:9, 7:10, 8:10, 8:11, 8:12, 9:13, 10:13, 10:14, etc.
- **** APP to JM; 1:1, 1:2, 2:3, 2:4, 3:5, 4:6, 4:7, 5:8, 6:9, 6:10, 7:11, 8:12, 8:13, 9:14, 10:15, 10:16, etc.